Report on the 72nd Annual Meeting of the American Oil Chemists' Society

1981 in New Orleans

New Orleans continues to be a favorite city for AOCS as approximately 1,500 persons attended the society's 72nd annual meeting held May 17-21, 1981 in the Fairmont Hotel.

The attractions apparently were the technical program of more than 300 papers presented during 48 technical sessions and the city itself as more than 200 persons registered for the spouses' program. More than 200 technical program registrants were from outside the United States.

Technical session audiences were attentive and faithful, according to reports from some session chairmen. Flavor analysis sessions filled a relatively small meeting room to the point where attendees had to wait outside for a place to stand inside. More than 100 persons listened to a strong line-up of soap and detergent papers. Even on Thursday morning, the final half-day of the meeting, more than 100 persons attended the session on control of hexane losses. There were as many as eight concurrent technical sessions during the week.

Aside from past joint meetings with the International Society for Fat Research and with the American Association of Cereal Chemists, the New Orleans meeting was the largest national AOCS meeting ever held. There were more than 1,200 technical program registrants, more than 200 spouses' program registrants, and more than 130 exhibitor registrants.

For the first time in many decades, anticipatory abstracts were not published in *JAOCS* before the meeting. In response to many requests that such abstracts be published in the journal, AOCS officials agreed to resume publication of such abstracts each year. To maintain the continuity, the anticipatory abstracts for the New Orleans meeting are published in this issue of *JAOCS* (pages 569A-612A). Cancellations are not indicated.

The AOCS Governing Board approved a new staff member for AOCS, a director of methods development. A search committee has begun accepting applications from persons with technical expertise as well as strong oral and written communication skills. The new staff position is the first in AOCS specifically requiring advanced training in analytical chemistry including fats and oils and their derivatives.

One highlight of the meeting was the first presentation of a new AOCS award, the A. Richard Baldwin Distinguished Service Award. Dr. Baldwin, vice-president for research at Cargill Inc., was the initial recipient and, for once, was virtually at a loss for words. He quickly recovered, however, urging attendees to become more involved in the society's activities as a method to benefit society at large. Baldwin noted that he had joined AOCS in 1944. The knowledge and processing that provided fats and oils products to the public in 1944 would not suffice to meet demands in 1981, he said, adding that involvement in AOCS would help make it possible to provide foodstuffs to an even larger world population as the 21st century begins.

James E. Fitzmorris, Jr., former lieutenant governor of Louisiana, was keynote speaker for the opening plenary breakfast on Monday, May 18. Fitzmorris presented what might be termed an exhortation to strive for greatness in professional accomplishment, and more public interest and participation in politics.

For the past three years, Peter Bonnett has presented the $2,500 honorarium accompanying the Award in Lipid Chemistry in his capacity as division manager for Milton Roy's Applied Science Division Laboratory Group. Bonnett said, in reflecting on those presentations, that he has been impressed by the global scope of

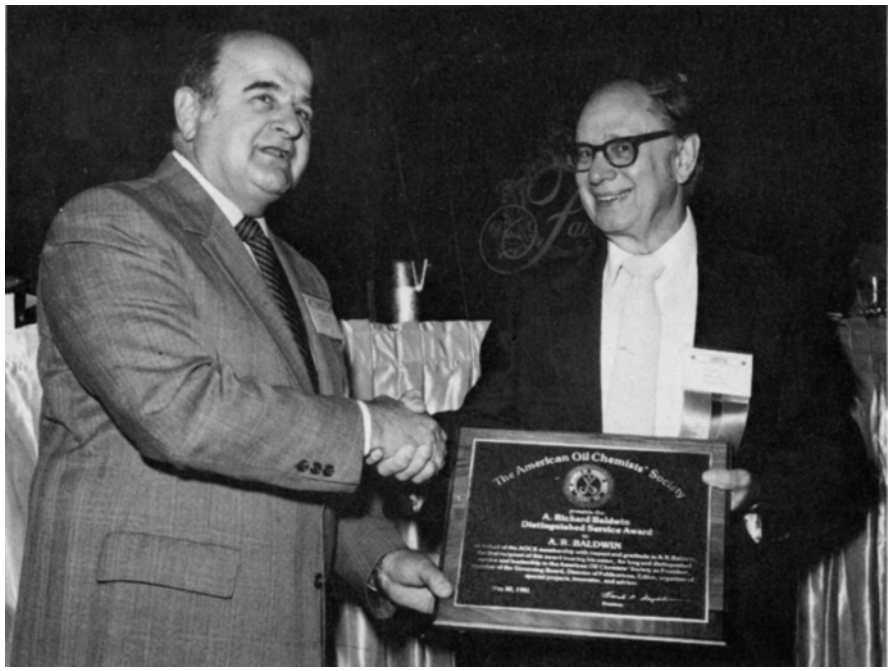
Peter Bonnett, *right*, represented the Applied Science Division of Milton Roy Laboratory Group in presenting the honorarium for the Award in Lipid Chemistry to Dr. Laurens van Deenen of the University of Utrecht.

those three award winners—Dr. Stephen S. Chang, originally from China and now head of the Food Science Department at Rutgers University, Dr. James F. Mead of the University of California in Los Angeles, and the 1981 recipient, Dr. Laurens van Deenen of the University of Utrecht in The Netherlands. A summary of Dr. van Deenen's acceptance address, "Phospholipid Dynamics in Membrane Structure," will be published later this year in *JAOCS*. In an entertaining presentation, Dr. van Deenen described his work on the distribution and translocation of phospholipids in biomembranes, and the potential importance of such studies.

In his introductory remarks, Dr. van Deenen recognized the many researchers who have worked with him through the years, sharing credit for the award with his colleagues. In thanking AOCS for the award, he commented that "lipid chemists all over the world benefit from the activities of the American Oil Chemists' Society."

For the second consecutive year, attendance at the main banquet, held Wednesday evening, was more than 1,000 persons. Local committee members and AOCS officials were surprised and pleased by that figure as well as the large attendance for the meeting in general.

The AOCS' 73rd annual meeting will be held May 2-6, 1982, at the Sheraton Centre in Toronto, Canada.



Dr. A.R. Baldwin, *right*, accepting the A. Richard Baldwin Distinguished Service Award, newly established to recognize "extended service to AOCS at positions of high responsibility." The award was presented by AOCS president Frank Naughton.

The Wednesday evening banquet was well attended.

The keynote address for the meeting was given by James E. Fitzmorris, Jr., executive assistant for economic development to the governor of Louisiana.

Service of the dessert for the Wednesday evening banquet was accompanied by a mock funeral.

Governing Board actions

AOCS to hire Director of Methods Development

The AOCS Governing Board has approved hiring of a "Director of Methods Development" for the AOCS staff. The new staff member will be the first person hired specifically for technical expertise in chemistry with emphasis on fats and oils.

Basically, the new staffer will be responsible for establishing programs to keep the AOCS *Book of Methods* current and to maintain communication with other groups interested in methods development.

AOCS will provide the initial funds necessary to establish the position, "pending development of a fund-raising campaign from industry for continued support," according to the motion approved by the Governing Board during one of its sessions at the AOCS 72nd Annual Meeting.

In other action, the Governing Board:

—Approved a motion to resume publishing anticipatory abstracts for national meetings and also to print abstracts for the New Orleans meeting.

—Approved scheduling of a short course on Nutritional Assessment of Dietary Fats to be held preceding the 1982 AOCS meeting in Toronto, Canada. The short course will be held in Guelph.

—Accepted a proposal by Armak Co. to administer a Ralph Potts Memorial Fellowship Fund. The fund will memorialize the late Ralph Potts, a long-time Armak employee and Honorary Member of the AOCS, who died this year. A panel from the Awards Administration Committee will work out details with Armak and a formal proposal concerning the new award is espected to come before the Governing Board during 1982.

—Heard a report to develop a new procedure to present the Bond Award. Committee Chairman William Doeden will conduct a mail poll of five choices among the AOCS committees involved in the award, and have a report on the responses for the 1982 Governing Board meetings. Proposals range from having authors formally submit their papers for consideration before each national meeting to discontinuing the award.

—Named A.R. Baldwin and Thomas Applewhite to head a committee to prepare a five-year plan for AOCS publications. A five-year plan concerning AOCS Headquarters activities has been prepared.

—Agreed to support a revision of V.C. Mehlenbacher's book on analysis of fats and oils with Marv Formo as editor; scheduled completion is June 1, 1983.

—Confirmed Arno Cahn as chairman for the Soap and Detergent Steering Committee for *JAOCS* and agreed the committee should organize as part of the National Program Planning Committee.

—Approved six persons as emeritus members of AOCS: R.L. Olson, Samuel E. Pack, Albert R. Tucker, Orlando Graziana, Johan Bjorksten and Francis C. Schmid. Emeritus members are exempt from dues; all six meet the qualification of being fully retired and having been AOCS members for a minimum of 30 years.

—Agreed that groups of individuals within AOCS supporting election of particular candidates must conduct such campaigns on their own without using any services from the AOCS headquarters.

One of the major topics for the Governing Board was increased meeting activity by the Society. In a series of separate actions, the board:

—Approved Montreux, Switzerland, as the site for a 1983 World Conference on Oleochemicals, tentatively scheduled for Sept. 18-23, 1983.

—Approved appointment of three chairman for a 1984 World Conference on Palm, Palm Kernel and Coconut, with Kurt Berger of the Palm Oil Research Institute of Malaysia (PORIM) as program chairman; David Tandy of EMI Corporation as program cochairman from the United States; and P.A.T. Swoboda, also of PORIM, as local arrangements chairman.

—Was told by 1984 General Chairmen Jess Covey and Tony Chen that Ed Lusas and Randall Wood will serve as technical program chairmen for the 1984 meeting.

—Voted to hold the 1985 AOCS Annual Meeting in Philadelphia.

—Was told that former AOCS Presidents Francis B. White, George Cavanagh and Ralph Holman have been appointed to a committee on the AOCS 75th Anniversary Celebration (Dallas in 1984) including instructions to make plans for a Past Presidents' reunion at that meeting. □

AOCS 73rd Annual Meeting

Call for papers

The technical program committee for the 73rd Annual Meeting of the American Oil Chemists' Society to be held May 2-6, 1982, in Toronto, is accepting abstracts for papers to be presented during that meeting. Persons wishing to present papers should submit three copies of a 100- to 300-word abstract with title, speaker and coauthors clearly indicated. Contributed papers are expected to be approximately 15 minutes, with five additional minutes for questions from the audience. Please indicate if you wish to make the presentation in a lecture-and-slide format or during a poster session. The technical program committee encourages presentation of poster session papers. Persons whose abstracts are accepted will be notified by the program committee. Mail abstracts to: Dr. James B.M. Rattray, 1982 AOCS Technical Program Chairman, Department of Chemistry, University of Guelph, Guelph, Ontario, N1G 2W1, Canada. Abstracts must reach Dr. Rattray by Nov. 15, 1981, to be considered.

DEADLINE: NOVEMBER 15, 1981.

Meeting notes

Breakfast sessions provided a forum for discussion among the technical session registrants.

Perhaps the youngest entrepreneur at the meeting was 11-year-old Mike St. Angelo whose dad, A.J. St. Angelo is on the staff at the Southern Regional Research Center. Mike was helping Dad in the registration area Sunday and Monday. Mike quickly noticed the soft drink bottle caps which, as part of a promotional campaign, could be redeemed for cash if a specific amount (25¢ or 50¢) was printed under the cap liner or if all the words in an advertising slogan could be collected. At last count, Mike had about $6 worth of bottle caps. He couldn't be at the meeting Tuesday, but told Dad to be sure to check the caps and particularly to find the word "real" which would complete a $1,000 parley. "Mike, I'm a Ph.D., I can't be back there looking for bottle caps," A.J. told his son. "I'll split it with you," Mike replied, obviously aware of what the bottom line is. "If I find it, I'll give you $250," Dad said. Pause. "Okay, I'll keep $250, you keep $250 and Mom and Terri can each have $250," Mike said. The needed "real" never turned up. (A.J. is somewhat of a fast talker himself—he had Mom and Terri also working in registration.) P.S. At the Wednesday evening banquet, Mike was the "corpse" for the mock jazz funeral.

• Banquet tables normally are numbered to (1) make sure everyone knows where they are supposed to sit and (2) provide some order to what could be a chaotic situation. A rather large sign-up for the New Orleans banquet meant, however, that extra tables had to be added. The hotel did this by reducing the size of the dance floor and adding more tables in the middle of the numbering sequence. The net result was that everything past about Table No. 60 did not resemble the original floor plan and consequently, many persons who thought they were at adjacent tables found themselves widely separated.

• Past President Norm Sonntag reports that at a social event for past presidents, Frank Naughton said that once he retired (nothing imminent is planned) he intends to become a castor oil consultant. "That'll keep you on the go," someone said, according to Norm.

• Soap and Detergent Association Vice-President Bob Singer told AOCS' soap and detergent advisory panel that several years ago a Lever Brothers executive casually mentioned to a group of SDA bigwigs that Lever planned to market a detergent called "Nothing." "Why?" asked an unsuspecting Procter & Gamble exec, whose Tide is the largest selling detergent. "Nothing cleans better than Tide," the Lever exec snapped.

• There was a reunion of sorts at the New Orleans meeting. Dr. Laurens van Deenen, recipient of the 1981 Award in Lipid Chemistry, and John Conkerton, official AOCS photographer for the New Orleans meeting (and husband of Edith Conkerton who headed the meeting registration team), were the participants. The last time their paths crossed was Sept. 13, 1944. That was when van Deenen was a 17-year-old high school student in the Dutch community of Maasterich and Conkerton was among the American soldiers who liberated the town from German troops that Wednesday. Naturally, neither recalls specifically seeing the other in 1944, but both enjoyed the coincidence that brought them together again in New Orleans.

• *JAOCS* is gaining international recognition. Ralph Holman, whose recent election to the National Academy of Science was announced during a technical session, was telling friends of a recent trip to England where he was to be met at the airport by someone he did not know. "They suggested that, as a recognition signal, they would be holding in plain view a recent cover of the *JAOCS*," Ralph said. "It worked."

Snow, Sweet top golfers

John Snow had the low gross (75) during the golf tournament held Monday, May 18, during the AOCS meeting and Louis Sweet had the low net (62). Actually, Sweet was one of three who tied for low net, but he won the trophy on the first playoff hole—with a bogey. Pat Martin had the longest drive (300 yards); Homer Gardner, golf tournament chairman, wound up closest to the hole at 6'4". Gross runners-up, in descending order, were Bill Walker, 82; Mike Boyer, 88; Jim Wheeler, 90; and Frank Passalaqua, 91; net runners-up were Bert Major, Dean Sandlin, both 62; Jim Reeves, 63; Walter Deutcher and Helmet Stupel, both 64. John Woerfel received the participation award.

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• Joe Pominski, Mike Ziegler and Henry Pearce may take over all AOCS membership campaigns. Nonmembers attending in New Orleans had green name badges and also had the opportunity, if they had paid a full week's nonmember registration fee, to join AOCS during the meeting without any additional cost. The three SRRC staffers undertook a campaign to sign up as many green badges as they could. Normally, AOCS adds 15 to 30 new members at a national meeting. This year the total of new members reached 113.

• During the plenary breakfast, General Chairman Robert Ory was introducing his hard-working committee (all volunteers) and asking them to stand up for a round of applause when he got to meeting finance chairman Reuben Feuge. Reuben didn't stand up as had other volunteers. "Oh no," said Ory, "He's not bonded." Reuben wasn't missing, it's just that he was busy balancing the books for a large on-site registration—more than 250.

Don Engler of the Fairmont Hotel staff congratulates Roslyn Kramer, winner of the "AOCS in New Orleans" quiz.

• Winner of the "AOCS In New Orleans" quiz conducted Sunday and Monday was Roslyn Kramer of the U.S. Army Natick R&D center in Natick, Massachusetts. She missed only one question, but did a Sherlock Holmes-style study of the exhibit hall to find precise answers to the questions, even calling the Southern Regional Research Center's library for help. Her reward: dinner and show for two in the Fairmont Hotel's Blue Room (courtesy of the hotel).

A Decade of Growth

The following is the text of 1980 AOCS President Frank C. Naughton's address to the business meeting of the 72nd Annual Meeting of the AOCS held May 18, 1981, in the Fairmont Hotel in New Orleans.

I'm very grateful to have had the honor of being your president for the past year. The American Oil Chemists' Society is recognized both nationally and internationally as the leading technical society for all professional people involved in the fields of fats, oils, lipids and associated technologies. Society members are derived from governmental laboratories, industrial organizations, research institutes, academia and other diverse work areas. When viewed from the president's position, it becomes rather amazing that a complex heterogeneous group of people representing research, management, sales, technical, manufacturing, engineering, educational and many other specific disciplines can blend into a homogeneous group and function in unison to supply the effort required for excellence and success.

During the past 10 years, this blend of Society members has shown a continuous growth pattern despite noticeable shifting patterns in which members change their job affiliations and do not remain members of the Society. Membership has grown to 3,893 in 1980 from 2,725 in 1971—an increase of 37%.

The Society has grown in national and international stature and increasingly is recognized as the authority in the areas of fat, oil and lipid knowledge. The technical presentations sponsored by the Society in annual meetings, short courses, local section meetings and world conferences, along with the technical publications, have attracted worldwide attention. Attendance of international people at our 1980 annual meeting with the International Society for Fat Research, as well as the short courses that preceded that meeting, attests to the recognition of the American Oil Chemists' Society as a leader in the worldwide dissemination of technical knowledge.

We have held four world conferences that have attracted more than 1,000 persons each. These were the 1976 conference on oilseed and vegetable oil processing and technology in Amsterdam, the 1977 conference on soaps and detergents, the 1978 conference on vegetable food proteins—again in Amsterdam, and the 1980 conference on soya processing and utilization in Acapulco. Four more conferences are being planned—a special conference on Dietary Fats and Health later this year in Chicago, a 1982 meeting in The Hague on edible oil processing, a 1983 meeting on oleochemicals, probably in Switzerland, and a 1984 conference on palm, palm kernel and coconut oils to be held in Malaysia.

We had more than 1,000 persons at our 1977 annual meeting in New York and have been above that level since then—1978 in St. Louis, 1979 in San Francisco and last year in New York for our joint meeting with the International Society for Fat Research.

To maintain its stature, the Society depends on the continuing efforts of its members, leaders and managers to organize and run these many programs and functions. Volunteer expertise is available in many diverse areas as members carry out the work of the technical committees to ultimately develop and to recommend new and revised official analytical methods. It has become increasingly difficult to obtain volunteer committee workers because of the increasing demands of their jobs. The Society recognizes those members who have given their time and talent unselfishly to their committee work and continue their dedicated efforts to make a better Society; however, the functions of many of these individuals are continually changing as they progress in their professional careers and they find it difficult to devote the time required to efficiently update the methodology.

The AOCS *Book of Methods* has served as the ultimate standard for analytical procedures required in the trading of fats and oils. This book has been maintained by the Uniform Methods Committee. Referee chemists and laboratories must use its methods to be certified by the Examination Board after satisfactory participation through the cooperative analytical program of the Smalley Committee of our Society. This critical function of the Society cannot be allowed to lag behind the new analytical and technological developments that are occurring at a rapid pace. To ensure the continuity of innovation and the future leadership of the Society in analytical methodology, a strong effort is being made to underwrite, organize and oversee the incorporation of new methodology in our book of methods. This is necessary for the Society and for the trade associations that are represented in our membership. The Governing Board and officers are considering an expanded AOCS Foundation to help guide technical committees and to coordinate the efforts of volunteers in evaluating new techniques and procedures so that faster methods and those with greater precision can find their way into the book.

Financially, we are caught in the grip of the spiraling inflation. Our Society has not been immune. We suffered a loss of net income from Society operations of approximately $12,000 in 1979. In spite of an unsteady economy and the ever-increasing costs, the Society made a very strong turnaround in 1980 and had a record operating surplus of over

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$200,000. While some of this was due to the first dues increase in more than 10 years, it is significant that the gain really came from many operations, including short courses, annual meetings and advertising.

The *Journal of the American Oil Chemists' Society* has shown significant growth during the past decade. In 1971 we had 5,577 paid subscribers, advertising revenues of $52,766, and published 888 pages of technical papers and 516 other pages. By mid-decade, we had 6,047 subscribers, advertising revenues of $73,786, and published approximately 540 pages of technical papers and 700 other pages. Last year, we had 6,612 subscribers, advertising revenues of $177,208, with 446 pages of technical papers and 938 other pages. Lipids circulation has grown from 1,809 in 1970 to 1,878 in 1975 to 2,083 in 1980. Total pages were 997 in 1971, 880 in 1975 and 1,094 during 1980.

The increased activity of our Society in meetings and publications has meant an improved financial position. In 1971, we had a net worth of $367,710, based on assets of $424,562 and liabilities of $56,852. By 1975, our assets had grown to $531,126 with liabilities of $48,207, for a net worth of $483,080. Last year our assets were $1,141,344, with liabilities of $49,169 for a net worth of $1,092,175. The value of our headquarters building in Champaign has been estimated at $250,000 in determining total assets.

From the 10-year financial history it can be concluded that our Society is in a healthy condition. Our current liabilities are well under control and our continued success in world conferences and diversification to international markets can be attributed to the past leadership and management of the Society.

Ten years ago, I was being indoctrinated into the running of an annual meeting by one of the American Oil Chemists' Society professionals, namely Henry Salomon, who was then chairman of the 1971 Atlantic City meeting. As cochairman of the meeting, I was introduced to a young man and his beautiful wife who were new to the Society and were also being indoctrinated into AOCS procedures. Ten years have rapidly passed by and his wife still remains beautiful, but I'm not too sure about the effect that 10 years as Executive Director of the Society has had on Jim Lyon. I do know that the accomplishments you have seen today are mainly attributable to his effective management of our Society. His concerted efforts have helped AOCS to meet the challenge of the 1970s and become financially and professionally sound.

I am pleased to have had the opportunity to work closely with Jim during the past year and to have been able to report to you the progress the Society has enjoyed during the past 10 years. I am more pleased that I have had the good fortune to work with the dedicated leaders and members who have given unselfishly of their time and talents. It is my most sincere wish that I will be able to continue to work with friends—the membership and the elected representatives of the Society—to meet the challenges of the 1980s and to return 10 years hence and observe much greater advancements and accomplishments for the American Oil Chemists' Society. □

AOCS President's Address

The following is the text of 1981 AOCS President Edward G. Perkins' address to the Inaugural Breakfast on Wednesday, May 20, 1981, during the 72nd Annual Meeting of the AOCS.

Frank Naughton has informed you of the "state of the society" from a membership and financial point of view. I want to discuss the mission of the Society and the scientific state of the Society. Our mission, our reason for being, is to educate and to provide members with up-to-date information and forums in which to exchange information. We do this by publishing two journals which cover all phases of our widely diversified field. Monographs and conference proceedings are another channel of information. The AOCS *Book of Methods* with its constant revisions and the Smalley program provide valuable services to members.

Various forums such as the national meetings, short courses and world conferences offer opportunities for exchange of information at the forefront of your discipline. The acceptance of these activities by both members and nonmembers indicates that we have, indeed, a healthy scientific base. The reputation of the Society through its members is increasing. You—the member—are the expert in your area. Thus, whenever a question in your discipline should arise, your name—the AOCS member—should be among the first to come to mind. The probability of this happening is enhanced by more member involvement in society activities. The Governing Board, officers and administrative committee need to know from you how to serve you better in these areas. We need your constructive criticism as well as complaints. Please communicate your ideas to the Governing Board, officers and chairmen of the proper committees. More membership involvement is needed at all levels of the Society work. We need more involvement, especially by our younger membership. In 1977, Dr. Applewhite said to this group—"to succeed is to serve." This statement is true in your life, and profession. Service to the Society will help you succeed both personally and professionally. We need your talents. The Society has approximately 77 administrative and technical committees (these committees have over 425 members). Such committees have a voracious appetite for ideas; new input is constantly needed. Many persons serve on several committees simultaneously. The results of committee work, such as new methods, are a renewable resource for the Society to help it carry out its mission. Membership on the committee dealing with your interests is stimulating, often serving as a source for information not yet available elsewhere. The interaction between persons serving in such capacities is fruitful and often leads to increased cooperation between individuals. It is the work of such committees and individuals that make the Society effective.

One last point I would like to make is to stress the need for increased cooperation among industry, academic institutions and governmental agencies. Within the Society, Frank Naughton, last year's president; Karl Zilch, next year's president; and myself represent cooperation between academia and industry. Frank and I work well together and I expect that Karl Zilch and I will learn a lot together. I have benefitted considerably from my colleagues in industry, and I hope that my industrial colleagues can also learn from the representatives of academia. Close cooperation is needed between these groups. There are many controversial issues ahead for the AOCS and its members. The relationship of fats to health is controversial and will be addressed in depth next December at an AOCS-sponsored conference composed of 55 speakers from academia, government and industry. Other issues such as pollution, energy use, and alternative methods of oil extraction and processing are before us. These must be addressed with integrity and in a professional manner, since these issues affect all of us.

Ever more complex federal regulatory requirements such as the Toxic Substances Control Act and other current and pending legislation require constant attention and continuing dialog among industry, academia and government. Our Society members should be actively involved in high-level discussions of these issues.

In these days of high inflation and decreased availability of funding for research and training, increased cooperation between industry and academia would appear to be desirable from both points of view. Our Society can help this to happen by providing more opportunities for information exchange.

I am committed to increasing the effectiveness of the AOCS through continuing education opportunities available at all levels. You are the officers and leaders of this Society for the future Join those who now serve and help the AOCS become a more effective leader and spokesman in the area of fats, oils and related disciplines. □

Frank Naughton, past president, *left*, congratulates incoming president Ed Perkins.

Awards

Bob Singer, *right*, represented the Soap and Detergent Association in presenting the SDA award to K.W. Dillan.

Peter Kalustian, *left*, accepting the AOCS Award of Merit from Tom Smouse, chairman of the Award of Merit Subcommittee.

SDA Award to Union-Carbide team

For the second consecutive year, the Soap and Detergent Association award for the best technical paper in the soap, detergent and cosmetic section of *JAOCS* has been awarded to a team of researchers from Union-Carbide's Technical Center in Tarrytown, New York.

The repeating winners are K.W. Dillan, who was present in New Orleans to receive the award, E.D. Goddard and D.A. McKenzie. The three wrote a paper entitled "Examination of the Parameters Governing Oily Soil Removal from Synthetic Substrates" that appeared in the July 1980 *JAOCS*. □

Keith, Fox repeat in Smalley, Doughtie competition

Horace Keith received the Smalley Award for the second consecutive year and Ronnie Fox received the Doughtie Award for the fourth consecutive year during the Inaugural Awards breakfast at the AOCS meeting in New Orleans.

Keith has won the Smalley Award in 1976, 1977, 1980 and 1981. The award is for the best analysis of combined nitrogen, oil and moisture in oilseed meal.

Fox has won the Doughtie Award seven times now, with victories in 1969, 1970, 1975, 1978, 1979, 1980 and 1981. The award is for best analysis of foreign matter, moisture, free fatty acids, oil, and ammonia in cottonseed.

The awards are part of the AOCS Smalley Check Sample series. Each year more than 7,000 samples of oilseed and fats and oils materials are distributed to subscribing chemists who analyze the samples using specified methods. Participants' results are then used to determine who has done the best. □

Award of Merit to Kalustian, Monick

The AOCS Award of Merit was presented in New Orleans to Peter Kalustian of Peter Kalustian Associates, and to the late John Monick, who spent his full career with Colgate-Palmolive.

Kalustian is a founding member of the AOCS Northeast Section and served as general chairman for the ISF-AOCS World Congress held last year in New York City. He has served on numerous national meeting committees. The New York meeting attracted 1,700 persons, one of the largest AOCS national meetings ever held.

Dr. Monick, who died earlier this year of cancer, had been an active member of AOCS soap and detergents activities as well as of the Northeast Section. His widow, Lydia, accepted the award.

The Award of Merit was established in 1967 to recognize achievements within AOCS and to stimulate those working in various AOCS activities. □

Recipients of the 1981 Honored Student Awards and E.G. Perkins, Chairman of the Honored Student Award Subcommittee. Back row: Jimbin Mai, Cornell University; E.G. Perkins; and Helen G. Brown, University of Arkansas. Front row: Beth Wilck, University of Guelph; Peter Child, University of Toronto; Flora Lau, Iowa State University; and Denise Schweizer, Ohio State University.

Smalley Check Sample Awards

OILSEED MEAL

Combined Moisture, Oil and Nitrogen

First Place: (Smalley Award)
Horace Keith, Anderson Clayton & Co., Lubbock, TX

Honorable Mention:
Melba Rogers, Plains Co-op Oil Mill, Lubbock, TX
Ronnie M. Fox, Fox Testing Labs., Lubbock, TX
J.E. Williams, Planters Manufacturing Co., Frankfort, IN
G.A. Seward, A.E. Staley Manufacturing Co., Frankfort, IN
D.C. Melear, Southwestern Laboratories, Fort Worth, TX

Moisture

First Place:
Melba Rogers, Plains Co-op Oil Mill, Lubbock, TX

Honorable Mention:
Horace Keith, Anderson Clayton & Co., Lubbock, TX
D.C. Melear, Southwestern Laboratories, Fort Worth, TX
Wayne McCluney, Traders Oil Mill Co., Fort Worth, TX
Ronnie M. Fox, Fox Testing Labs., Lubbock, TX
Paul Thionville, Thionville Laboratories Inc., New Orleans, LA
Lela I. Vines, Woodson-Tenent Labs., Gainesville, GA
Sandra Hunt, BioSearch Laboratories Inc., Arlington, TX

Oil

First Place:
Melba Rogers, Plains Co-op Oil Mill, Lubbock, TX

Honorable Mention:
Ronnie M. Fox, Fox Testing Labs., Lubbock, TX
Horace Keith, Anderson Clayton & Co., Lubbock, TX
Ed R. Hahn, Hahn Laboratories, Columbia, SC
G.A. Seward, A.E. Staley Manufacturing Co., Frankfort, IN
Roger C. Miller and Robert M. Gilpin, Geo. W. Gooch Laboratories Inc., North Little Rock, AR
Mike Valletta, SGS Control Services Inc., Carteret, NJ
Art Carnrick, A&L Plains Agricultural Labs. Inc., Lubbock, TX

Nitrogen

First Place:
Vince Sartell, Archer Daniels Midland Co., Lincoln, NE

Honorable Mention:
Luis Mestas, Kal Kan Foods Inc., Vernon, CA
J.E. Williams, Planters Manufacturing Co., Clarksdale, MS
J.E. Caran, Texas Testing Labs. Inc., San Antonio, TX
Thomas J. Moore and Guy E. Moore, Woodson-Tenent Labs., North Little Rock, AR
Donald C. Strathdee, Industrial Labs., Ft. Worth, TX
Horace Keith, Anderson Clayton & Co., Lubbock, TX
G.A. Seward, A.E. Staley Manufacturing Co., Frankfort, IN

Crude Fiber

First Place:
Paul Thionville, Thionville Laboratories Inc., New Orleans, LA

Honorable Mention:
John W. Thomas, SGS Control Services Inc., Kenner, LA
Mike Valletta, SGS Control Services Inc., Carteret, NJ
John Mann, Gold Kist Inc., Valdosta, GA
Luis Mestas, Kal Kan Foods Inc., Vernon, CA
James P. Minyard, Mississippi State University, Mississippi State, MS

COTTONSEED

Foreign Matter, Moisture, Free Fatty Acids, Oil and Ammonia

First Place: (Winner of R.T. Doughtie Jr. Award)
Ronnie M. Fox, Fox Testing Labs., Lubbock, TX

Honorable Mention:
Thomas J. Moore and Guy E. Moore, Woodson-Tenent Labs., North Little Rock, AR
Ed R. Hahn, Hahn Laboratories, Columbia, SC

SOYBEANS

Combined Moisture, Oil and Ammonia

First Place:
Thomas J. Moore and Guy E. Moore, Woodson-Tenent Labs., North Little Rock, AR

Honorable Mention:
John Ledin and Ardin Backous, Woodson-Tenent Labs., Des Moines, IA
W.M. Allen, A.E. Staley Manufacturing Co., Fostoria, OH
Robert Hein, Dawson Mills, Dawson, MN
Carl Moss, A.E. Staley Manufacturing Co., Champaign, IL

PEANUTS

Moisture, Free Fatty Acids, Oil and Ammonia

First Place:
Leon S. Hunter, Pope Testing Labs., Dallas, TX

Honorable Mention:
Charles R. Jenkins, Deep South Laboratory, Montgomery, AL

SAFFLOWER AND RAPESEED

Moisture, Oil and Nitrogen

First Place:
John W. Thomas, SGS Control Services, Kenner, LA

Honorable Mention:
James A. Laubscher, Morning Star Labs., Los Angeles, CA
E.J. Jacobson, Pacific Vegetable Oil Corp., Richmond, CA

SUNFLOWER SEED

Foreign Matter, Moisture and Oil

First Place:
John W. Thomas, SGS Control Services, Kenner, LA

Honorable Mention:
Mike Valletta, SGS Control Services Inc., Carteret, NJ
Melba Rogers, Plains Co-op Oil Mill Inc., Lubbock, TX

COTTONSEED OIL

Free Fatty Acids, Refining Loss and Refined Color

First Place:
B.O. Pattison, Pattison's Labs., Harlingen, TX

Honorable Mention:
Ronnie M. Fox, Fox Testing Labs., Lubbock, TX
Ed R. Hahn, Hahn Laboratories, Columbia, SC
John W. Thomas, SGS Control Services, Kenner, LA
Leon S. Hunter, Pope Testing Labs., Dallas, TX

Continued on page 562A.

Continued from page 560A.

SOYBEAN OIL

Free Fatty Acids, Neutral Oil and Bleached Color

First Place:
A.E. Engelbrecht, Hunt-Wesson Foods Inc., Memphis, TN

Honorable Mention:
Jim Hardy, Lever Brothers Co., East Los Angeles, CA
John Ledin and Ardin Backous, Woodson-Tenent Labs., Des Moines, IA
Robert Hein, Dawson Mills, Dawson, MN
Don Parton, Humko Products, Champaign, IL
L.D. McClung, CPC International, San Francisco, CA

VEGETABLE OIL FOR COLOR ONLY

First Place:
W.J. Johnson, Southern Cotton Oil Co., Memphis, TN

Honorable Mention:
Emma Clarice O'Dell, Anderson Clayton & Co., Abilene, TX
Melba Rogers, Plains Co-op Oil Mill, Lubbock, TX
A.E. Engelbrecht, Hunt-Wesson Foods Inc., Memphis, TN
Betty Miller, Curtis & Tompkins Ltd., San Francisco, CA

NIOP FATS AND OILS

Specific Gravity, Free Fatty Acids, Iodine Value, Saponification Value and Lovibond Color

First Place:
Paul Thionville, Thionville Laboratories Inc., New Orleans, LA

Honorable Mention:
Mike Valletta, SGS Control Services Inc., Carteret, NJ
Albert Reynaud and Ramesh Patel, Chas. V. Bacon Inc., Marrero, LA

TALLOW AND GREASE

Titer, Free Fatty Acids, Moisture, Unsaponifiable Matter and Insoluble Impurities

First Place:
H. Hirayama, Nippon Yuryo Kentei Kyokai, Yokohama, Japan

Honorable Mention:
Minoru Saito, Japan Food Research Labs., Tokyo, Japan
Nippon Yuryo Kentei Kyokai, Kobe, Japan
Mike Valletta, SGS Control Services Inc., Carteret, NJ
T.M. Narayanan Nair, Chas. V. Bacon Labs., Jersey City, NJ
Ed R. Hahn, Hahn Laboratories, Columbia, SC

EDIBLE FATS

Free Fatty Acids, Free Glycerin, Alphamonoglycerides, Wiley Melting Point, Capillary Melting Point, Congeal Point, Lovibond Red Color, Peroxide Value, and Iodine Value

First Place:
George Payne, Kraft Inc., Industrial Foods, Memphis, TN

Honorable Mention:
Herbert L. Haynie, Bunge Edible Oil Corp., Fort Worth, TX
Oils Group, Chemical Lab., Canada Packers Ltd., St. Boniface, MB, Canada
Jack Mellema, Kraft Inc., Glenview, IL
Don Parton, Humko Products, Champaign, IL
R.C. Walker, Anderson-Clayton Foods, Richardson, TX

DRYING OILS

Acid Value, Iodine Value, Color and Specific Gravity

First Place:
Richard Foss, Spencer Kellogg Div. Textron, Inc., Buffalo, NY

Honorable Mention: (Tie)
T.M. Narayanan Nair, Chas. V. Bacon Labs., Jersey City, NJ
Robert E. Pierce, Honeymead Products Co., Minneapolis, MN

GAS CHROMATOGRAPHY

Preparation of Methyl Esters on Fats and Oils and GC Determination of Fatty Acids

First Place:
Chung I. Kim, CPC International, Bayonne, NJ

Honorable Mention:
Jeanne D. Joseph & Gloria Seaborn, Nat. Marine Fisheries Service, Charleston, SC
Dr. Ragnar Ohlson, AB Karlshamns Oljefabriker, Karlshamn, Sweden
Richard M. Bugh, Capital City Products Co., Columbus, OH
F. Oey Teng Moh, Unimills, B.V., Awijndrecht, Holland
Jim Dyck, C.S.P. Foods, Ltd., Nipawin, SK, Canada

CELLULOSE YIELD

Moisture and Cellulose

First Place:
Ronnie M. Fox, Fox Testing Labs., Lubbock, TX

Honorable Mention:
Leon S. Hunter, Pope Testing Labs., Dallas, TX

MILK AFLATOXINS

First Place:
Dr. J. Pauw, Kaascontrolestation, The Netherlands

Honorable Mention:
John Wieters, Morris Testing Labs., Macon, GA

PEANUT AFLATOXINS

First Place:
Jim Henderson, Procter & Gamble Co., Cincinnati, OH

Honorable Mention:
E. Tarter, Health & Welfare Canada, Scarborough, ON., Canada
R.A. Moffitt, Carnation Research Laboratory, Van Nuys, CA
A.V. Jain, University of Georgia, Athens, GA
D.M. Ffinch, Quantum Pty. Ltd., East Brisbane, Australia
Pert Laboratories Inc., Edenton, NC

COTTONSEED AFLATOXINS

First Place:
Gerald D. Lee, Anderson Clayton & Co., Phoenix, AZ

Honorable Mention:
Thomas E. Russell, University of Arizona, Phoenix, AZ
Andy Gibson, National Pet Food Corp., Phoenix, AZ

CORN AFLATOXINS

First Place:
A.V. Jain, University of Georgia, Athens, GA

Honorable Mention:
John D. McKinney, Ranchers Cotton Oil Co., Fresno, CA

Continued on page 568A.

Technical Sessions

USDA researcher reports on new extraction method

Technical presentations during the New Orleans meeting covered virtually every segment of the fats and oils, lipids, and oilseed protein spectrum, with attendance sometimes overflowing the meeting space.

Soybean oil extraction with supercritical fluids was a topic for J.P. Friedrich of the USDA's Northern Regional Research Center in Peoria, Illinois. There has been previous work on such extraction methods, Friedrich noted, with the most prominent current commercial application being its use in producing decaffeinated coffee products.

The NRRC work has involved use of carbon dioxide and has produced what Friedrich described as "a virtually degummed crude soy oil." Flavor scores were almost identical for those of hexane-extracted oil, Friedrich said, without the expense of degumming. Capital for high-pressure equipment costs would be considerable, but Friedrich said these pressures are not unusual for other chemical processes. At the NRRC, extraction was done at 5,000 psi at 50 C. The benefits are a crude oil that does not need degumming and an extraction solvent, carbon dioxide, that may be more readily available and less costly than hexane. Work to evaluate meal quality was recently begun, Friedrich said.

In another paper on use on supercritical CO_2, Alegria B. Caragay of Critical Fluids Systems Inc., a subsidiary of Arthur D. Little Co., reported on research there on using CO_2 in purification and fractionation of fats and oils.

Work at Critical Fluid Systems also has led to a process to remove oil from potato chips and other snack foods without affecting the flavor or texture, according to Caragay. Patents are being sought by the firm. Work is under way on applications in fermentation chemicals, essential oils, pharmaceuticals, environmental control systems and fuel processing systems.

In the field of essential fatty acids, Dr. Ralph Holman of The Hormel Institute presented a preview of work he will review in more detail during the Conference on Dietary Fats and Health this December in Chicago. Holman had one case history indicating that linolenic may be among the essential fatty acids. A child who had lost most of the small intestine because of an accident exhibited EFA deficiency symptoms while on intravenous feeding with a safflower-oil-based solution. After a change to a soy-oil-based solution, the symptoms disappeared, Holman reported. Other cases indicate EFA deficiency may be a result of metabolic disorder as well as of dietary origin, Holman said.

In separate papers on cottonseed protein, Dr. E.W. Lusas of Texas A&M University reported on processing and use of glandless cottonseed protein whereas Alice N. Milner of Texas Woman's University reported on nutritional studies of cottonseed protein. Lusas reported that meat substitutes and tofu-like protein concentrates have been developed. Milner said use of glandless cottonseed protein in diets has shown no significant differences in growth, weight maintenance or other factors compared to other dietary protein sources.

"Ohio Curd" was the topic for Ohio State University's Andrew C. Peng, who described the coagulation of soybean and cheese whey protein mixture with glucono-delta-lactone (GDL) in an interesting talk. The gel that results held its texture and flavor for a year in ordinary refrigeration—"I tasted it in my mouth—I didn't swallow it, but I tasted it," Dr. Peng reported. Ohio Curd's amino acid content and protein content with its stability make it a potential source of inexpensive protein, Dr. Peng said.

Abstracts for these and other papers submitted for the meeting follow. The chart on page 612A indicates which papers were presented during each session.

Continued from page 562A.

W.E. Hobbs, General Mills Inc., Minneapolis, MN
Jennifer Kinkead and Kathleen Lacey, Chemonics Industries, Phoenix, AZ

FISH MEAL

Protein, Fat, Moisture, Ash and Pepsin Digestibility

First Place:
Paul Thionville, Thionville Laboratories Inc., New Orleans, LA

Honorable Mention:
Albert Reynaud and Ramesh Patel, Chas. V. Bacon Inc., Marrero, LA
Lela I. Vines, Woodson-Tenent Labs., Gainesville, GA
John Ledin and Ardin Backous, Woodson-Tenent Labs., Des Moines, IA

FISH OIL

Free Fatty Acids, Moisture and Iodine Value

First Place:
Paul Thionville, Thionville Laboratories Inc., New Orleans, LA

Honorable Mention:
T.M. Narayanan Nair, Chas. V. Bacon Inc., Jersey City, NJ

FISH SOLUBLES

Protein, Fat, Moisture, Ash, pH and Ammonia Nitrogen

First Place:
Albert Reynaud and Ramesh Patel, Chas. V. Bacon Inc., Merrero, LA

Honorable Mention:
Paul Thionville, Thionville Laboratories Inc., New Orleans, LA

Abstracts

Unless indicated by *, first name given is speaker.

1

THE MAJOR LIPID FRACTIONS OF BRYOPHYLLUM PINNATUM (LIM). Gregory E. Anekwe, The Department of Biochemistry, College of Medicine, University of Lagos, Nigeria.

Bryophyllum pinnatum (Lim) of the order saxifragales and class Angiospermae, is a very common plant in many parts of Africa. Its stem cuttings are generally credited with having potential medicinal properties, including effectiveness in the treatment of abscesses, severing of the umbilical cord, induction of labor and treatment of ovarian cysts. These apparent medicinal effects which it exerts appear to suggest a significant role for lipids and lipid derivatives most especially, steroids and prostaglandins. Thus, we decided to investigate the lipid composition of the plant. The data suggested that the major neutral lipids were phosphatidylglycerol, (44%), phosphatidylethandamine (11%) and an unknown fraction (24%). A lipid with the chromatographic properties of a sulfolipid was also identified. An analysis of the fatty acid composition of the phosphoglycerides and the triacylglycerol of the stem cuttings by gas liquid chromatography suggested that octadecanoic and hexadecanoic acids were the predominant fatty acids in all the glyceride fractions. A significant quantity of eicosanoic acid was also found. Odd-numbered and branched chain fatty acids were predominant in the triacyglycerol fraction. The nonsaponifiable fraction (NSF) was obtained by the saponification of the total neutral lipids with 5% methanolic KOH and subsequent extraction of the NSF with petroleum ether. The NSF thus obtained was separated into its components by alumina chromatography. Specific thin layer chromatographic techniques were used to characterize these components. The data showed that the NSF of *B. pinnatum* (Lim) consisted of hydrocarbons (33%) sterols (18%) and coenzyme Q (49%). The relatively large quantities of phosphatidylglycerol, octa- and hexa-decanoic acids and coenzyme Q found in this plant may suggest a special role for them in *B. pinnatum* (Lim).

2

PHYTOPLANKTON LIPIDS. Neil S. Shifrin, Teknekron Research, Inc., 1483 Chain Bridge Road, McLean VA 22101.

Research was conducted to investigate the physiological capability of microalgae for producing oils, via photosynthesis, at a rate which could result in commercial applications. The range of total lipid fractions in 30 freshwater and marine species was measured as a function of several environmental growing conditions. Green algae lipid fractions averaged 17.1 ± 4.4% (± 1 S.D., 17 species) of total dry weight in log phase and typically ranged from 35 to 50% after 4 to 9 days of nitrogen starvation. One species, *Monallantus salina*, produced a 72% lipid fraction after 9 days of nitrogen starvation. Nutrient additions to a nitrogen starved culture of *Oocystis polymorpha* showed that the excess cellular lipids do not rapidly disappear during recovery from the stress condition. Diatoms averaged lipid fractions of 24.5 ± 4.7% (11 species) in log-phase and responsed less consistently to nitrogen starvation. In the diatom, *Cyclotella cryptica*, silicate starvation resulted in a doubling of the lipid mass per cell within a 6 to 12 hr period. Increasing temperature up to 36 produced increasing lipid fractions in *Oocystis polymorpha* but not in *Cyclotella cryptica*. Measurements over a light:dark period of 12:12 followed by 24 hrs of continuous light showed that lipid fractions in *Oocystis polymorpha* were temporally constant. However, diel variations in the lipid mass per cell were noted and these corresponded to cell size variations during the division cycle. Intraspecific differences in lipids were also measured. In the most notable case, a nitrogen starved, copper tolerant clone of *Chlorella vulgaris* had nearly twice the lipid fraction compared to an intolerant clone of the same species. In terms of possible commercial applications, the laboratory studies indicated that a lipid fraction range of 25 to 50% of dry weight might feasibly be maintained in phytoplankton cultures without imposing extreme conditions. This range of lipid fractions, combined with literature values of 15 gm m^{-2} d^{-1} for feasible outdoor culture biomass yields, would result in a potential oil production rate of 80 to 160 bbl ha^{-1} yr^{-1}. Based on the largest literature value for the total annual cost of producing a phytoplankton product ($44,000 ha^{-1} yr^{-1}) it was estimated that phytoplankton oil could be produced at $1.75 to $3.50 per kg (50 and 25% lipid fraction, respectively). An analysis of using sewage as a substrate showed that by taking a credit for treating the sewage, oil from phytoplankton could be produced in the range of $19 to $38 per bbl ($0.12 to $0.24 per kg).

3

EFFECT OF SURFACTANTS ON YIELDS OF FUNGAL CARBOHYDRASES. Frederick W. Parrish, USDA, SEA-AR, SRRC, P.O. Box 19687, 1100 Robert E. Lee Blvd., New Orleans, LA 70179.

Fungal carbohydrases are of importance for a number of food and nonfood uses. The use of β-galactosidase to hydrolyse lactose in milk to enable lactose-intolerant individuals to consume milk and milk products without gastric distress symptoms is currently of great interest. Hydrolysis of lactose with β-galactosidase provides a mixture of glucose and galactose which possesses greater sweetness than lactose and potential for application in baking and confectionery products. The cellulase enzyme complex is of potential utility in two areas. They are the hydrolysis of agricultural residues to glucose which can be fermented to ethanol or other chemical feedstocks, and the treatment of animal feed for increased nutritional availability. An important factor in the economics of these applications is the cost of the enzyme so a method of increasing enzyme yields in a fermentation can be of great value. When nonionic surfactants are added to culture media, stimulation and extracellular enzyme production may occur. This effect has been demonstrated with various surfactants for β-galactosidase and cellulase production.

4

OXIDATIVE DEGRADATION OF PHEROMONES IN LABORATORY AND FIELD EXPERIMENTS. I. Weatherston, P.W. Carlson, M.A. Golub,* S.A. Phelan, and J.M. Lee. Albany International Controlled Release Division, 110 A Street, Needham Heights, MA 02194.

In recent years the use of behavior-modifying chemicals to monitor and control insect pest populations has increased substantially. A large number of these pheromones, notably lepidoptera sex attractants, are long chain alcohols, esters or aldehydes possessing one or more double bonds and thus are closely related chemically to fats and oils. Recently, Albany International Controlled Release Division undertook field testing of a pheromone formulation which contained long chain aldehydes. With a formulation expected to last 21 days, no biological activity was observed after 4 days even though physical examination of the fibers showed that they still contained a large amount of material. Subsequent field experiments designed to evaluate the longevity of the formulation revealed that even though the fibers contained almost a full charge of liquid, more than 80% of the aldehyde had disappeared by the 4th day, thus verifying the biological results. At the same time infrared analysis of the contents of these fibers revealed a shift in the carbonyl frequency from 1730 cm^{-1}, characteristic of aldehydes, to 1715 cm^{-1}, characteristic of carboxylic acids. A series of laboratory and field experiments were then undertaken to find a way to prevent this conversion and thereby increase the longevity of aldehydic pheromone formulations in the field. These experiments included investigation into the effects of the addition of antioxidants to the pheromone, ultraviolet stabilizers to both the pheromone and the fibers, and alterations in the composition of the fiber itself before a satisfactory solution was eventually found. More recent field trials have indicated biological activity for the proposed 21 days and beyond in some cases.

5

IMMUNOCHEMICAL ANALYSIS OF COTTONSEED HULLS AND KERNELS FOR ANTIGENS FOUND IN COTTON DUST, BRACT, OR MICROBIAL ENDOTOXINS. Antonio A. Sekul and Robert L. Ory, USDA, SEA, SRRC, 1100 Robert E. Lee Blvd., P.O. Box 19687, New Orleans, LA 70179.

Cotton dust and cotton bract were extracted with water and the extracts were injected into rabbits to induce formation of antibodies. Antigens extracted from cotton dust and bract were identical by immunochemical tests and reacted with the injected rabbit antisera, but not with serum from normal (noninjected) rabbits. Cotton dust/bract antisera also reacted with aqueous extracts of cotton stem, leaf, burr and gin trash from cotton textile mills, but did not react with antigens extracted from cottonseed hulls or seed (kernel) proteins, nor with endotoxins of microorganisms that might be found on baled cotton or cottonseed. This suggests that the immunologically active antigen of cotton dust/bract is found primarily in textile mill dust and not in cotton oil mill dust.

6

ARE TERPENOID SUBSTRATES BOUND TO P-450 HEMEPROTEINS VIA SULFHYDRYL GROUPS? Ralph I. Murray, John A. Bumpus, and K.M. Dus, Dept. of Biochemistry, St. Louis Univ. School of Medicine, 1402 S. Grand Blvd., St. Louis, MO 63104.

For enzymes with bulky hydrophobic substrates that have very few functional group "handles," significant problems arise in understanding how these substrates can be properly positioned and oriented in the active site. Monoxygenases responsible for biotransformation of a broad spectrum of lipophilic compounds fall into this category. Their substrate and oxygen binding components

are the highly specialized P-450 hemeproteins. We are interested in the metabolism of terpenoids, particularly in the biosynthesis of steroid hormones, where each P-450 mediated reaction proceeds with a high degree of regiospecificity and stereoselectivity. The camphor hydroxylase of *P. putida* utilizes a cytochrome P-450 designated as $P\text{-}450_{CAM}$. Due to its stability, its structural similarity to other P-450s and its availability in a homogenous state, $P\text{-}450_{CAM}$ provides a useful model system for the study of P-450 hemeproteins in general, and for steroid metabolizing P-450s in particular. Several sulfhydryl groups play a crucial role in the structure and function of $P\text{-}450_{CAM}$. One of these, we have suggested, may be involved in the formation of the enzyme substrate complex through a transient covalent coupling with the camphor carbonyl group as a thiohemiketal bond. Isobornyl bromoacetate (IBA), a structural analogue of camphor, was designed to covalently label the active site with high specificity. Addition of IBA to $P\text{-}450_{CAM}$ (1:1) resulted in an immediate type I spectral shift, almost identical to that produced with camphor. Substantial labeling of one cysteine was indicated by amino acid analysis; acid hydrolysis converts the derivatized cysteine to carboxymethylcysteine, a form readily quantitated. Competition of substrate and label, and the close correlation of their spectral responses, support our concept that a cysteine sulfhydryl in the active site of $P\text{-}450_{CAM}$ accounts for proper binding and orientation of its substrate. Extension to the side chain cleavage of cholesterol and subsequent P-450 mediated hydroxylations in the synthesis of steroid hormones, using similar substrate derived affinity labels, indicated that this may be a general feature of the specific binding of substrate to P-450 (NIH grant GM 21726).

7

CHEMICAL SENSES AND FOOD FLAVOR. James C. Boudreau, Sensory Science Center, 6420 Lamar Fleming, Houston, TX 77025.

When food is consumed, a vast number of chemosensory systems in the oral and nasal cavities are activated, resulting in the complex sensations known as flavor. The flavor complex can be broken down into a variety of sensations of both oral and nasal origin. More than a dozen oral sensations may be identified. Many nasal sensations may be identified, but many of these are common to different foods; thus standard flavor profiles may be made and different foods compared. These sensations are a result of the activation of different neural systems. The basic neural subdivisions consist of oral taste bud systems, oral trigeminal free nerve ending systems, nasal olfactory systems and nasal trigeminal systems. The oral and nasal trigeminal trigeminal systems probably play a greater role in food flavor than commonly realized. These oral and nasal systems perform an exact chemical analysis of the food. The compounds that activate the oral systems are mainly primary nutrients present in fairly large quantities in foods, and include amino acids and peptides, nucleotides, sugars, inorganic ions, phenolic compounds, lactones and S, N, and O heterocycles. Nasally active food compounds are typically found in small quantities and indirectly represent the major food nutrients from which they are formed. Few volatile compounds do not elicit nasal sensations, but certain classes of compounds are most important in natural food odors.

8

ROLE OF LIPIDS IN MEAT FLAVOR. M.E. Bailey, University of Missouri, Columbia, J.C. Ching, Mary Kay Cosmetics, H.B. Hedrick, University of Missouri, M.C. Legendre, USDA, and H.P. Dupuy, V-Labs.

Lipids act not only as precursors for many volatiles associated with desirable and undesirable meat flavor, but also as solvents for lipid-soluble flavor molecules as well. The characteristic flavor of beef, pork and lamb and much of the undesirable flavor associated with meat is due to lipid or its degradation products. Meat lipids are degraded hydrolytically and oxidatively during processing, cooking and storage, and these changes often result in undesirable flavor. Other lipid constituents responsible for undesirable flavor include those associated with animal feeding, animal species and animal sex. Volatile compounds associated with undesirable meat flavor include low molecular weight aldehydes, hydrocarbons and furans. Undesirable lipid flavors result from feeding certain forage crops to sheep and cattle, and "mutton flavor" is apparently caused by intermediate branched chain fatty acids that may result from grass feeding. The most important lipid resulting in undesirable flavor due to animal sex is 5α-androst-16-ene-3-one, although other C_{19}-16-ene steroids are probably involved.

9

THE FLAVOR OF GRASS-FINISHED BEEF. Sharon L. Melton, University of Tennessee, Food Tech and Science, P.O. Box 1071, Knoxville, TN 37901.

Controversy exists concerning the question of whether cattle finished on grass alone have less desirable flavor than cattle finished on grain. Reports from the University of Tennessee (U.T.) and elsewhere have shown definitely that steers finished on predominantly fescue pastures have less desirable flavor than steers finished on a grain ration of similar energy level. Grass-finished beef has been characterized as having a higher intensity of milky flavor and a less intense beef fat flavor than grain-finished beef. The less desirable flavor of grass-finished beef may be due to changes in the fatty acid composition of beef caused by the grass ration, and also may be due to less glucose present in the grass-finished than in the grain-finished beef. Unreported research at U.T. involved a study in which the beef flavor was investigated as a function of time. Steers were finished on corn from 0 to 140 days, where at 0 days all steers had received only fescue pasture. Subjective evaluation of beef flavor by quantitative descriptive analysis showed that the difference between grass- and grain-finished beef was complex and involved other flavor descriptions such as fishy, liver and sour. Sour flavor-by-mouth and titratable acidity of ground beef from corn-finished cattle decreased with time, yet there were no significant differences in lactic acid content. At least part of the flavor differences between grass- and grain-finished beef is caused by lactones formed during cooking of the meat.

10

THE EFFECT OF FEED, PREPARATION, AND PROCESSING ON FISH AND SEAFOOD FLAVOR. George J. Flick, Jr., Food Science and Technology Department, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, Michael Legendre, Allen J. St. Angelo and Robert L. Ory, Southern Regional Research Center, U.S. Department of Agriculture, P.O. Box 19687, New Orleans, LA 70179.

Feed can affect fish flavor directly or indirectly by encouraging the growth of odor-emitting algae. Flavor volatiles in crab meat vary, depending on the type of thermal processing used to facilitate processing and on changes during storage that occur primarily in low-molecular-weight compounds. Dimethyl sulfide is responsible for the flavor of clams and oysters. During storage, molluscs will increase in carbonyl, hydrogen sulfide and thiol concentrations. Carbonyl content will increase with refrigerated storage until approximately 3 weeks, then it will decrease. Red and white fish filet muscles will produce different volatile profiles during frozen storage. The largest variation will occur in the lower molecular weight compounds. During refrigerated storage of fish, higher rather than lower molecular weight carbonyls are produced. The lower molecular weight metabolites will continue to increase during storage while the larger compounds reach an apparent maximum. Undesirable odors (aldehydes, alcohols and hydrocarbons) in cooked sardines develop from the lipid fraction in the meat. A variety of sulphur compounds and aldehydes are present in fresh fish. After 2–3 weeks of refrigerated storage, some of these compounds decrease and are replaced by ketones. Apparently, both intrinsic and extrinsic decomposition is responsible for fish flavor and odor. Bacteria inoculated in sterile fish muscle produce a variety of sulfide compounds, mercaptans, alcohols, ketones and substituted pyrazine derivatives. Processing involving physical disintegration of fish, such as mincing, predisposes rancidity. Selected types of undesirable taints can be minimized by smoking or canning. Cooked fish usually stores better than fresh during frozen storage.

11

METHODOLOGY FOR HEADSPACE GC PROFILING OF BREAKFAST CEREALS FOR CORRELATION WITH OLFACTORY EVALUATION. E.L. Anderson, T.E. Geselle, M.P. Bussey, J.G. Michael and J.F. Yamashita, Research Department, Kellogg Company, 235 Porter Street, Battle Creek, MI 49016.

A quantitative, objective methodology relying upon headspace analysis with capillary column GC has been developed and applied as an aid in determining the degree of oxidative rancidity development in cereal products. Organic volatiles were purged with He at 80 ml/min for 5 min from 10 g cereal thermostated at 50 C ± 0.1 and trapped onto a Tenax trap held at room temperature. The Tenax trap was subsequently thermally desorbed (10 min @ 1 ml/min) in the injector port (250 C) of a GC onto the LN_2-cooled initial portion of a glass capillary column (50 m x 0.25 mm, OV-101[2]). Analysis was achieved by removing the LN_2 coolant and by temperature programming the GC oven from 35 to 180 C at 4 C/min. Reproducibility of the GC method was studied and key factors relating to the precision of the analysis were identified. Of the 140 separated peaks of headspace samples of cereal, the coefficients of variation (CV) of the peaks areas were as follows:

Range of C.V.	*Peaks in Range (%)*
$CV \leq 0.1$	14.4
$0.1 < CV \leq 0.3$	61.0
$0.3 < CV \leq 0.5$	15.3
$CV > 0.5$	9.3

Compounds that correlated best with odor panel scores were in the range of CV ≤ 0.1, the highest reproducibility class. Compounds with the best reproducibility had correspondingly good peak shape and were present in amounts significantly above the detection limits. External standardization and standard addition methods were evaluated for quantitation of hexanal in cereal product headspace. Standard addition required 2 days of equilibration between compound addition and headspace analysis of the sample, but it allowed the GC area count to be related to the ppm concentration of the compound in the sample. The external standard method provided a rapid check on sensitivity of the GC instrumentation.

12

FOAM STABILITY IN AQUEOUS SURFACTANT/OIL SYSTEMS. III. THE ROLE OF THE SURFACTANT DISTRIBUTION COEFFICIENT ON FOAM STABILITY. J.A. Wingrave, Conoco Inc.

Because foam stability results from surfactant absorption in the air/water foam bubble interface, an important property for foam stabilization is the relative solubility of the surfactant molecules in the oil and water phases. The surfactant distribution coefficient measures this solubility behavior and is defined as the ratio of surfactant concentration in the oil-to-water phases. In this paper, the distribution coefficients for various high-performance foam surfactant systems were measured as a function of variables such as: mono- (soft) and poly- (hard) valent ion concentration oil (soil) type and surfactant type and concentration. These results are checked and evaluated using current foam stability theories and experimental techniques.

13

HLB AND HYDROPHOBE BRANCHING. Alain Graciaa, Universite de Pau et des Pays de l'Adour, Pau, France, and Y. Barakat, M. El-Emary, L. Fortney, R. Schechter, S. Yiv and W. Wade, The University of Texas, Austin, TX.

Increased hydrophobe branching is used to increase water solubility of surfactants, which is usually considered synonymous with increasing surfactant HLB. When HLB is viewed in the context of a partitioning between oil and water, it is seen that branching favors partitioning into the oil phase, thus lowering surfactant HLB. An alternate to HLB is proposed that defines a surfactant's properties based on the optimal alkane for the oil phase and includes considerations of surfactant phase behavior.

14

FADING RATE OF DYE IN MICELLES OF AMPHOTERIC SURFACTANTS. Hisao Hidaka, Yoshinori Takahashi and Hayashi Kubota, Meisei University, 337, Hodokubo, Hino-shi, Tokyo 191 Japan, and Shuji Yoshizawa, Science University of Tokyo.

It is worthwhile to study catalysis in micellar systems as a model of chemical energy transformation from solar energy. Alkaline fading rate of the basic dye solubilized (crystal violet, CV) in an amphoteric surfactant, N-(2-hydroxyethyl)-N-(2-hydroxydodecyl)-β-alanine (HAA) micellar systems was measured by spectroscopic analysis. The surfactant can exist in three ionic forms depending upon pH value of the solution (cationic, zwitterionic or anionic form). The rate (the pseudo first order) decreased in the anionic form of HAA (0.3 times slower for the zwitter ionic form) and conversely increased in the cationic form of HAA (2.1 times faster). The fading rate was faster as electrolyte (NaCl or NaBr) was added, due to the change of micellar structure. The rate using an acidic dye (bromophenol blue, BPB) was also examined. The reaction mechanism was governed by the solubilized state in micelles and surface ionic charges on micelles.

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PLUMING OF NONIONIC SURFACTANTS DURING THE SPRAY-DRYING PREPARATION OF POWDERED DETERGENTS: CAUSES, EFFECTS, AND POTENTIAL SOLUTIONS OF THIS PROBLEM. D.L. Wharry, A.B. Carel and E.L. Sones, Conoco Inc., Research & Development, 140 R&D West, Ponca City, OK 74601.

During the preparation of powdered detergents via spray drying, a plume is often observed exiting the spray tower. This problem increases noticeably during the preparation of nonionic-based powders. The plume consists mainly of organic components in the form of an aerosol. Currently, several methods are available to reduce this plume to meet EPA regulations; e.g., reduced production rates and the use of cyclone separators and demisters. These methods treat pluming as an inherent problem. An investigation of the sources of the plume should lead to ways of eliminating or minimizing the problem so that post-treatment is not necessary. Previously, the plume was thought to be caused by oxidative degradation of the nonionic surfactant. However, recent results indicate that the primary source of organic components in the air stream from a spray drying process is volatilization of the light ends. The subjects of this paper are: a comparison of the current methods for evaluating pluming tendencies, and an explanation of these pluming tendencies of nonionic surfactants based on relative amounts and volatility of light ends. Recent advances in ethoxylation technology have led to a linear primary alcohol ethoxylate with dramatically improved pluming tendencies, caused by a 40–60% reduction in light ends.

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SURFACE ACTIVE AGENTS IN THE GLASS INDUSTRY: OPTIMIZATION OF AN INDUSTRIAL CHEMICAL CLEANING PROCESS OF GLASS LENSES. Uri Zoller, Haifa University-Oranim, Israel.

Countless processes have been advocated for cleaning glass, and it appears that many treat the subject more as an art than a science. The chemical cleaning of glass is an extremely complicated problem because its exposure to the chemical attack of either water, acid, alkali salt solutions or even gases in the atmosphere may result in corrosion. The glass may either react with the corrosive materials to form new compounds on the surface or be preferentially dissolved, leaving a leached surface layer. In reality, corrosion generally occurs as a result of a simultaneous combination of these events. This is particularly true in industrial chemical cleaning processes of glass lenses. Although both the physico-chemical parameters and the conditions of the technological cleaning process in industry vary considerably (and constantly), the absolute cleanliness (and spotlessness!) of the glass surface of the lenses is the primary condition for further processing and/or fitness to the ultimate use. The problem one confronts in applying a surface active agent-based cleansing formula under such circumstances is threefold: (1) application of the available knowhow (mainly accumulated under controlled laboratory conditions) under actual in vivo field conditions; (2) optimization of the industrial chemical process within the framework of these constraints; and (3) assessment of the final results (i.e., the degree of cleanliness of the lenses' surface after any change of the system parameters in terms that will comply with the required standards). This paper will present data of a selected industrial case study in which application, optimization and assessment of the chemical cleaning process of glass lenses involving various formulations has been carried out. The results will be discussed and some conclusions will be drawn with regard to the "real world" of such processes.

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WORLDWIDE PERSPECTIVES ON PROCESSING OF SOYBEAN OIL. T.L. Mounts, K. Warner and G.R. List, Northern Regional Research Center, 1815 North University, Peoria, IL 61604.

Latest available statistics indicate that soybean oil production is at more than 13 million metric tons. Although more than 90% of soybean production is in the United States, Brazil, Argentina and China, processing of soybean oil for edible purposes is practiced on a worldwide basis. In many countries soybean oil is used as a liquid (or in liquid form), and the particulars of this usage form the basis of processing problems. Sensory techniques developed at the Northern Research Center utilizing a trained analytical panel were applied to evaluation of processed soybean oils acquired from many countries. In most instances, results of sensory tests and chemical analyses of the oils indicated they were of poor quality when compared with U.S.-processed soybean oil. Limitations on processed oil quality have been related to use of black iron deodorizers, inadequate conditions of vacuum or temperature of deodorization, and failure to use or improper use of citric acid.

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THE UTILIZATION OF SUPERCRITICAL FLUIDS IN THE PURIFICATION AND FRACTIONATION OF FATS AND OILS. Alegria B. Caragay and Val Krukonis, 15 Acorn Park, Cambridge, MA 02140.

At pressure and temperature conditions above the critical point, dense gases such as carbon dioxide exist as supercritical fluids that have been found to exhibit unique solvent properties for a large number of organic substances. These supercritical fluids have been used to develop novel extraction processes for the food industry using a clean, inexpensive, nonflammable, nontoxic solvent. Fatty acids have been found to have a higher solubility in supercritical carbon dioxide than triglycerides. Moreover, the triglycerides were also found to exhibit different solubility patterns. The solubility levels can be influenced dramatically by modest pressure changes. Thus, supercritical fluid extraction was adapted to purify "spent" cooking oil and to fractionate selected fats and oils. The results of these studies will be discussed to illustrate potential process applications of this emerging technology.

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NEW PALM OIL SOLVENT FRACTIONATION PROCESS. A.

Athanasiadis, DeSmet, Helme,* Barbara P. Klein and Bernard LeSieur*, LeSieur.

A new palm oil solvent fractionation process will be described. This process is especially versatile, and makes it possible to obtain three or four fractions according to the economic situation of the market. Two of the fractions are particularly interesting: one is a "superfluid" similar to peanut oil (cloud point about -2 C); and one is a hard fraction (POP) that could interest industries using cocoa butter. This process is patented in particular in the U.S.A. The technologies used are all allowed in the U.S.A. as well as in Europe.

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THE UNIQUE FEATURES OF THE DE SMET DEODORIZERS. C. Louis Kingsbaker and Guy L. Posschelle, 2625 Cumberland Parkway, Suite 200, Atlanta, GA 30339.

The design of the De Smet deodorizer is uniquely different than those normally used in the United States. This paper will describe the advantages of the peripheral compartmented SCD and MTD units for large capacities, as well as the horizontal design for special service. The process and energy advantages will be emphasized.

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NEW PROCESS IN WINTERIZING, DEGUMMING-BLEACHING AND DEACIDIFICATION-DEODORIZATION OF EDIBLE OILS. H.L.S. Staff, H.L.S. Ltd., POB 193, Petah Tikva, Israel.

Theoretical consideration of winterizing, concerning specially sunflowerseed and cottonseed oils. Current practices of winterizing, cooling-crystallization, filtration. Separation with detergents and winterizing in miscella. New types of filters for winterizing. Preliminary conditions for deacidification-deodorization: dry or wet degumming-bleaching, the importance of removing of phosphatides, new methods for degumming-bleaching. Deacidification-deodorization, continuous or semicontinuous. Description of types. Yields and consumptions. Use of this method and its limits. Oil quality and stability. Ecological problems. New operating results and technical data from factories.

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PRACTICAL ASPECTS OF CONTINUOUS REFINING LOSSES, THEIR ORIGINS AND SUGGESTED CORRECTIONS. Angel Abrego López, Apartado Postal #139 "C", Morelia Michoacán México.

There are at least seven different partial losses that added together give the total refining loss. Some of them can be corrected at the mill, others can be corrected by changes in operating conditions in the refinery, and still others by proper maintenance and operator care. Mill corrections can bring an economical gain to the mill, because of better premiums or lower penalties. The corrections or adjustments in operating conditions in the refinery can be adjusted by weighing the crude refined oils after a change in conditions, allowing time for the intended change to take place. This operation is time consuming, but the inconvenience can be overcome by measuring the changes in refining loss more quickly. Proper maintenance and operator care can be responsible for losses greater than normally expected.

23

VARIATION OF THE IODINE VALUE AND LINOLENIC ACID CONTENT OF CANOLA RAPESEED GROWN IN WESTERN CANADA. James K. Daun, Canadian Grain Commission, Grain Research Laboratory, Room 1404, 303 Main Street, Winnipeg, Manitoba, R3C 3G9 Canada.

Development of low-erucic-acid rapeseed varieties in the early 1970s, and further development of canola seed (low-erucic-acid, low-glucosinolate Brassica seeds) in the mid 1970s resulted in an increase in the iodine value of rapeseed from about 100 to 118 Wijs units. This increase in unsaturation was predominately due to an increase in the linolenic acid content of the oil from 8% to as high as 14%. In general, the iodine values and linolenic acid contents of samples of farm-grown rapeseed were found to be significantly greater in more northern and western regions of the Canadian Prairies. This increase is probably caused by a combination of environmental and varietal effects. Since a significant proportion of the canola/rapeseed grown in some areas of Canada was found to have an iodine value greater than 125 Wijs units, it may be necessary to revise some national and international standards.

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SULFUR CONTENT OF CANOLA OIL. James K. Daun, Canadian Grain Commission, Grain Research Laboratory, Room 1404, 303 Main Street, Winnipeg, Manitoba, R3C 3G9 Canada.

The sulfur contents of 100 samples of crude canola oils collected from western Canadian canola crushing plants were determined using the Raney nickel procedure. Values for the sulfur ranged from 3 to 41 ppm. Samples of pressed oil generally contained less sulfur than did samples of solvent-extracted oil. The levels of sulfur in the canola oil were not much less than levels found in rapeseed oil, indicating that lowering the level of glucosinolates in the seed did not result in a lower level of sulfur in the oil. Significant differences were found in the average sulfur levels among crushing plants, indicating that process variables play an important role in the level of sulfur in the oil. Laboratory hydrogenation studies of refined canola oils with different levels of sulfur indicated that less than 3 ppm sulfur was allowable in canola oil to give a nearly equivalent hydrogenation ratio to soybean oil.

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REFINABILITY OF NEW-RAPESEED OILS. Maurice Naudet, Elie Sambuc and Guy Devinat, Laboratoire National des Matières Grasses, Université d'Aix-Marseille, Place V. Hugo-F 13331 Marseille Cedex 3.

Multiregressions—mainly multilinear ones—elaborated by statistical calculations between first flavor scores and characteristics of deodorized oils* and characteristics of crude oils facilitate the prediction of, on one hand, the quality (flavor score of the freshly deodorized oil) and the stability (flavor score after standardized storage) of the deodorized oils from a limited number of analytical values; and on the other hand, the values of these last analytical values from analytical value of the crude oil, when submitted to a standardized rafination procedure. *Secondly between selected characteristics of deodorized oils.

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VARIABILITY IN OIL CONTENTS, POLYUNSATURATED FATTY ACIDS, AND VITAMIN E ISOMERS AMONG CORN INBREDS. E.J. Weber, E.A. Yen, L. Galliher and D.E. Alexander, USDA-SEA-NCR, S320 Turner Hall, University of Illinois, Urbana, IL 61801.

For 18 corn inbreds, the oil contents, as determined by nuclear magnetic resonance spectroscopy, ranged from 1.7 to 18.4%. The values for linoleic acid varied from 38.0 to 73.6% of the total fatty acids when the fatty acid methyl esters were analyzed by gas chromatography. The tocopherol isomers were separated and quantitated by two procedures: (a) thin layer chromatography followed by a modified Emmerie-Engel colorimetric determination, and (b) high-performance liquid chromatography on a silica absorption column with ultraviolet absorbance detection. γ-Tocopherol has traditionally been considered to be the predominant vitamin E isomer in corn oil, but among 18 inbreds examined in this study, four had higher levels of α-tocopherol than γ-tocopherol. Correlations among oil contents, polyunsaturated fatty acid levels, and the various vitamin E isomers and the possible effects of these interactions on the stability of corn oil to autoxidation will be discussed.

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CHEMICAL, NUTRITIONAL AND TOXICOLOGICAL EVALUATION OF UNCONVENTIONAL OILS—MESTA SEED OIL. C. Rukmini and Malini Vijayaraghavan, National Institute of Nutrition, Hyderabad-500007, A.P., India.

Widespread shortages of traditional edible oils have focussed attention on minor oil seeds or unconventional oil seeds that can be exploited for human consumption. A comprehensive and systematic investigation of such oils has been undertaken involving chemical analysis, nutritional evaluation and toxicological safety by the multigeneration breeding studies in rats according to FDA protocol. Three minor oils were selected for the study: Mesta oil (*Hibiscus sabdariffa*), Cleome Viscosa oil (Capparidaccae), and Mango kernel oil. The results for mesta oil are reported in this paper. *Hibiscus sabdariffa* is grown as a fiber crop and the annual production of the seed oil as a by-product is estimated at 13,000 tons. Chemical analysis indicated the presence of three abnormal fatty acids in small quantities (5.5%): sterculic acid, malvalic acid, and 12,13-epoxy oleic acid. Nutritional evaluation, made by feeding the oil at 10% levels (in a 20% protein diets) to weanling albino rats for 22 weeks showed inferior growth performance when compared with a control group fed diets with 10% levels of ground nut oil. Toxicological evaluation over three generations showed inferior reproductive performance and altered lipid metabolism in the livers of the group fed mesta oil compared to controls. However, no teratogenic effects or abnormalities were present in any organs over three generations that were examined histopathologically. These studies indicated that it is undesirable to use mesta oil as a sole dietary fat. Further studies are needed to see whether deodorization and hydrogenation would improve the quality of this oil.

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RUBBER SEED OIL: THE UNTAPPED POTENTIAL SOURCE IN KARNATAKA (INDIA). V. Jayappa, P.K. Shanbhag, K.B. Patil and Shrinivas Amminalli, Karnataka Soaps & Detergents Ltd., P.B. No. 5531, Rajajinagar, Bangalore, 560 055, Karnataka State, South India.

Rubber seeds constitute 25–30% good fatty oil, which is used as a major raw material for the manufacture of soaps. Karnataka, with about 6,000 ha of rubber plantations having about 13 lakhs of trees, is so far untapped for its seeds. It is expected to yield around 500 tons of seeds during this year and about 1,000 tons by 1984–85. Seeds collected from various rubber plantation divisions during a previous season were extracted for oil and the oils were analyzed for their fatty acid composition by Perkin Elmer gas liquid chromatography on a silar 5 cp column containing 6% Gas Chrom Q of 100 to 120 mesh, and using a flame ionisation detector attached with minigrator and recorder. Linoleic acid was the chief constituent (37.55–41.57%), oleic (21.41–27.51%), linolenic (14.95–20.10%), palmitic (9.4–11.36%) and stearic (5.75–9.26%) acids were the other major constituents. Small amounts of caprylic and myristic acids were also detected. One sample was unusual in containing two odd chain fatty acids, nonanoic (0.31%) and hendecanoic acids (0.29%). We also report for the first time the presence of small amounts (trace to 0.59%) of decenoic (10:1) and tetradecenoic (14:1) acids in rubber seed oils.

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CHROMATOGRAPHIC BEHAVIOR OF A HOMOLOGOUS SERIES OF OCTADECYNOATES AND THE CORRESPONDING GEOMETRICAL AND POSITIONAL OCTADECENOATE ISOMERS. Moghis U. Ahmad, Theresa Lee and Randall Wood, Department of Biochemistry and Biophysics, Texas A & M University, College Station, TX 77843.

A homologous series of octadecynoates ($\Delta 2$ to $\Delta 14$) have been synthesized by a number of organic reactions. The octadecynoates were partially hydrogenated to produce selectively the corresponding *cis* and *trans* octadecenate isomers. These >98% pure geometrical and positional C-18 isomers were examined by argentation thin layer chromatography (TLC) and capillary gas liquid chromatography (GLC) using polar and nonpolar liquid phases. The position of the triple bond, the position of the double bond and the configuration of the double bond alter the TLC and GLC behavior of some isomers to the extent that they do not appear to belong to the same series. Generally, as the position of unsaturation moves toward the extremes of either end of the hydrocarbon chain, the chromatographic behavior becomes more abnormal. This abnormal behavior of some isomers creates some special problems in isolation, purification and identification of these compounds in biological samples. This work was supported by a grant (No. 5901-0410-8-0017) from the Competitive Grants Office of the U.S. Department of Agriculture and by Public Health Service Research Grant No. CA 20136 from the National Cancer Institute.

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DOUBLE BOND ANALYSES OF DIENOIC FATTY ACIDS IN MIXTURES: COMPARISON OF STRATEGIES FOR SOLUTION OF LINEAR SIMULTANEOUS EQUATIONS. A.C. Beckwith, R.O. Butterfield and H.J. Dutton, Northern Regional Research Center, 1815 North University Street, Peoria, IL 61604.

A method has been described for analysis of mixtures of dienoic fatty acids, which occur in biological materials and in hydrogenated edible fat products. The method involved ozonization, reduction of alcohol fragments by sodium borohydride, gas chromatographic analysis for alcohol, alcohol-ester and internal dialcohols, and computer solution of a matrix of linear simultaneous equations. A new method is proposed for setting up the linear equations in the form of a single triangular matrix. The analysis, which is programmed through a computer, tests the matrix for linearly independent equations, automatically selects those data (meeting simple test conditions that are to be used), and determines the relative amounts of diene isomers that are permitted. The advantages and disadvantages between the new strategy and the old are compared, using the same analytical data.

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OPTIMIZATION OF PARAMETERS FOR THE ANALYSIS OF TRIGLYCERIDES BY REVERSE PHASE HPLC USING A UV DETECTOR AT 210 NM. J.A. Singleton and H.E. Pattee, USDA, SEA, AR, P.O. Box 5906–NCSU, Raleigh, NC 27650.

Factors affecting the qualitative analysis of triglycerides from natural oils on reverse phase HPLC columns were investigated. Triglycerides from a saturated oil were separated by differences in chain length, whereas the triglycerides from an unsaturated oil were separated into groups based on the degree of unsaturation. Selection of solvent pairs used as the mobile phase as well as percent composition of the mobile phase within the compatibility limits of the system will be discussed in terms of the temperature and solute solvent interactions that affected resolution and detectability. Physicochemical factors underlying the forces of attraction between solute molecules, mobile phase composition and the hydrocarbonaceous ligand will also be discussed.

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ANALYSIS OF LIPID CLASSES AND LIPOFUSCIN SUBSTANCES BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY. F.C. Phillips and O.S. Privett, The Hormel Institute, University of Minnesota, 801 16th Avenue N.E., Austin, MN 55912.

The fractionation and analysis of the lipid classes and fluorescent substances of animal tissues by high performance liquid chromatography (HPLC) using a combination of fluorescence and flame ionization detectors is described. The lipid classes and fluorescent substances are extracted from rat kidney and liver tissue by a new method that involves preextraction of nonlipid and aqueous soluble fluorescent substances with hot dilute (0.05N) acetic acid. The lipid classes and organic soluble fluorescent substances are extracted from the residual tissue in three extractions: the first with chloroform/methanol, 1:1, v/v; the second with chloroform/methanol, 1:2, v/v; and the third with methanol. The fractionation of these compounds by HPLC is carried out with a column 0.2 x 45 cm, which is packed with a special adsorbent prepared by reacting silicic acid with ammonium hydroxide. The eluent is passed through a fluorescence detector that provides a profile of the fluorescent compounds, and then through a flame ionization detector for analysis of the lipid classes. The method is demonstrated on rat blood serum, and liver and kidney tissue.

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HIGH PERFORMANCE LIQUID CHROMATOGRAPHY OF CHOLESTEROL OXIDES. Alan J. Sheppard and Chih-shang J. Shen, Division of Nutrition, FDA (HFF-268), 200 C Street, S.W., Washington, DC 20204.

High performance liquid chromatographic (HPLC) techniques have been investigated for their suitability in the analysis of cholesterol oxides, which have been reported to possess varying degrees of biological activity. The adsorption μPorsil column, and partition reverse-phase μBondapak C_{18} and CN columns were used under various isocratic and gradient solvent conditions. The column effluent was monitored with a spectroflow monitor at either 212 nm or 230 nm and with a refractometer in series. A number of the HPLC systems evaluated were useful for qualitative identification and quantitative determination of various cholesterol oxides. The optimum operational parameters (i.e., type of mobile phase, flow rate and column pressure) for these systems are reported and discussed. The minimum detectable quantity and linear dynamic range were also determined for each compound separated.

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EXTRACTION OF ASCORBYL PALMITATE FROM WHEAT FLOUR AND ANALYSIS BY HIGH-PRESSURE LIQUID CHROMATOGRAPHY. Sharon L. Melton, Judy Harrison and Donna Churchville, University of Tennessee Food Tech. and Sci., P.O. Box 1071, Knoxville, TN 37901.

L-ascorbic acid-6-palmitate, AP, at 0.5, 1.0, 1.5 and 2.0% was mixed homogenously with wheat flour, and the lipids (including AP) were extracted from the flour by a chloroform-methanol procedure. Based on weight of lipid extracted, AP recoveries of 112, 96, 102 and 84% were found for flour samples containing 0.5, 1.0, 1.5 and 2.0% AP, respectively. AP was separated from polar and nonpolar flour lipids by a Partisil 10 HPLC column (Whatman PXS-1045), 4.6 x 250 mm, using a solvent system of 65:25:2 v/v/v $CHCl_3$:CH_3OH:H_2O at a flow rate of one ml/min. AP was detected at 254 nm. Under these conditions for HPLC, triglycerides, monoglycerides, lecithin, cephalin and other flour lipids had retention times of 2.50 to 2.75 min, and AP had a retention time of 4.75 min. A standard curve of absorbance at 254 nm versus AP from 1.0 to 10 μg was linear. HPLC analysis of AP in the lipid extracts of flour showed that only 20–50% of AP added to flour was recovered. At the time of HPLC analysis, the extracts had been stored 6–8 weeks at -18 C under nitrogen. Special care must be taken to prevent oxidation of AP during extraction from food products. Results will be reported for HPLC analysis of AP in spiked flour samples, which have had BHA or BHT or both added during the lipid extraction procedure to prevent oxidation of AP.

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CHEMICAL AND BIOLOGICAL STUDIES OF PHYTATE-MINERAL INTERACTIONS. K.T. Smith* and John T. Rotruck*, The

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Phytate, which is native to oilseed proteins, has been implicated as an inhibitor of mineral absorption in animals. Our work has employed both chemical and biological techniques to investigate the suggested interaction of phytate with minerals. Thus far, we have rigorously defined the solution structure of phytate and investigated the complexation and precipitation reactions of phytate with calcium and zinc. This work indicates considerable potential for phytate to complex minerals; however, it does not allow predictions of in vivo interactions. Our in vivo work has shown that levels of sodium phytate (up to 2% of the diet) have no effect on parameters of zinc status in rats. Furthermore, our work indicates that variables encountered in soybean protein processing can significantly affect zinc bioavailability. In addition, our results suggest that the methodology used to analyze the data can affect zinc bioavailability calculations. Altogether, these data suggest that factors in addition to phytate are involved in the reduced zinc bioavailability observed from certain oilseed protein preparations. In fact, zinc bioavailability is not significantly reduced in some soybean preparations. Other work indicates that iron bioavailability is not affected by either endogenous or exogenous phytate.

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BIOAVAILABILITY OF CERTAIN MINERALS IN PHYTATE-CONTAINING FOODS. G.S. Ranhotra and J.A. Gelroth, Nutrition Research, American Institute of Baking, 1213 Bakers Way, Manhattan, KS 66502, and G.L. Winterringer, Kansas State University.

The bioavailability of certain nutritionally significant minerals such as Zn, Fe, Mg and Ca is reported to be adversely affected by phytates (PH) and fiber in foods. Cereal grains and leguminous seeds are the major source of phytates in our diet. Processing of food (e.g., milling, sprouting, cooking, baking) normally reduces the PH levels. Most likely, this improves the availability of minerals in processed food. For example, Zn availability improved in soy-fortified breads, where PH hydrolysis during baking is substantial, but not in soy-fortified cookies, where PH hydrolysis is minimal. Unlike Zn, the effect of PH on other minerals is less definitive. Morris et al. reported no difference in Fe availability in human subjects fed dephytinized and nondephytinized wheat bran muffins. Some preliminary data suggest that Mg in soy-fortified breads (PH-hydrolyzed) may be quite available. The effect of PH on Ca availability remains quite controversial. These and other relevant studies on the role of PH in mineral nutriture will be discussed.

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STUDIES ON PHYTATE/ZINC MOLAR RATIO AND BIOAVAILABILITY OF DIETARY ZINC. Eugene R. Morris and Rex Ellis, U.S. Department of Agriculture, SEA, Beltsville Human Nutrition Research Center, Vitamin and Mineral Nutrition Laboratory, Beltsville, MD 20705.

Whole grains and legumes are important dietary sources of zinc for both humans and animals. These foods, however, contain phytate, which in high concentrations inhibits the bioutilization of zinc. The studies to be discussed were undertaken to quantitatively define the ratio of phytate to zinc in the diet, which will cause a change in biological response parameters that is indicative of reduced bioavailability of zinc. The growth rate of young rats decreased if the molar ratio of phytate/zinc was greater than about 12:15 if Naphytate was added in a semipurified diet with $ZnSO_4$ as the zinc source. When low-phytate wheat bran, prepared by either an enzymatic or extraction procedure, with a phytate to zinc molar ratio of 4 or 8 was the dietary zinc source, the growth rate of rats did not decrease. When either soybean or wheat bran, phytate/zinc molar ratios of about 30 and 45, respectively, was the dietary zinc source, growth and bone zinc accumulations by young rats were poor, but improved significantly when the diet was supplemented with $ZnSO_4$ to reduce the overall ratio to about 15. In a study with adult men, the mean zinc balance was 2.7 mg/day when the diet included 36 g of whole wheat bran, and the molar ratio phytate/zinc of about 10 overall, compared to 2.0 mg/day when an equivalent amount of dephytinized bran was consumed. Analysis of hospital diets including soy protein meat substitute menus indicated that a molar ratio of 10 or greater in a single meal is an infrequent occurrence. The nutritional implication of these studies is that the phytate in the diets consumed by most of the U.S. population is probably not a deterrent to utilization of dietary zinc.

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THE UTILIZATION OF PHYTATE PHOSPHORUS BY POULTRY. Talmadge S. Nelson, Linda K. Kirby and Gordon C. Ballam, Department of Animal Sciences, University of Arkansas, Fayetteville, AK 72701.

Plant seeds are the primary source of ingredients used in animal feeds. The major form of phosphorus in seeds and seed byproducts occurs as salts of phytic acid and accounts for 50–90% of the total present. The amount of phosphorus animals can utilize from seeds and their byproducts is of economic importance to the feed industry. The annual consumption of phytate phosphorus by poultry and swine is about 200,000 tons annually which, based on inorganic phosphorus, has a value of approximately $200,000,000. Poultry rations will usually contain .3–.4% total phosphorus from feed ingredients derived from seeds. This is sufficient phosphorus to approach or meet the requirements of poultry if all of it was available. However, in the absence of phytase, poultry utilize almost none of the phosphorus in phytate. Alkaline phosphatases are ineffective in hydrolyzing phytate to release phosphorus in balanced poultry rations because of the adverse effects of calcium. Phytase, either of microbial origin or active within an ingredient, must be present in the diet for poultry to hydrolyze significant amounts of phytate. An active phytase in wheat is sometimes effective in hydrolyzing phytate although the amount hydrolyzed is variable. A fungal phytase is effective in hydrolyzing natural phytate in feed ingredients. Chicks can utilize the hydrolyzed phosphorus as efficiently as inorganic phosphate.

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FATE OF PHYTATE IN BREADMAKING USING WHOLE WHEAT FLOUR. U. Tangkongchitr, P.A. Sieb* and R.C. Hoseney, Kansas State University, Department of Grain Science and Industry, Shellenberger Hall, Manhattan, KS 66506.

An analytical scheme was devised to measure phytate phosphorus, inorganic phosphorus, and phosphorus not precipitated by ferric ion in flour, dough and bread. The scheme was used to follow the loss of phytate during breadmaking. In whole wheat puploaves, the cumulative loss of phytate phosphorus after fermentation, proofing, and baking was $\sim$16%, 19%, and 22%, respectively. The loss of phytate phosphorus was almost totally accounted for by an increase in inorganic phosphorus. Since 1953 it has been known that wheat phytase has a pH optimum of 5.1. As expected, the most rapid loss of phytate phosphorus in fermenting dough occurred when the pH of the dough was adjusted in the mixer from 6 to 5. Between pH 6 and 5, the loss of phytate in fermenting dough was shown to be controlled by both the solubility of phytate and the activity of phytase. Below pH 5 the activity of phytase alone is the limiting factor. In a model aqueous system using the concentrations of phytate and metals that occur in dough, 37% of phytate was soluble at pH 6, whereas 84% was soluble at pH 5. Phytate phosphorus in seven commercial whole grain breads ranged from 218 to 808 mg/lb loaf "as is," whereas that in white bread ranged from 83 to 173 mg/lb.

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CONTRIBUTIONS OF WALTER A. PONS, JR., TO DEVELOPMENT OF METHODOLOGY FOR MYCOTOXINS. L.S. Lee and L.A. Goldblatt, USDA, SEA, SRRC, 1100 Robert E. Lee Blvd., P.O. Box 19687, New Orleans, LA 70179.

Walter Pons began work on mycotoxins in 1963, well prepared by 20 years experience in the Analytical Section of the SURDD, USDA. His first paper on aflatoxin methodology, presented at a meeting of the AOCS in 1964, was rated as one of the three best. In this paper he introduced acetone as the extraction solvent for aflatoxins, moved away from the lengthy, exhaustive soxhlet extraction to the far more rapid equilibrium shaker extraction, and introduced lead acetate to precipitate major interfering impurities. Early on, he saw the need for the calibration of reference aflatoxin standards and for their availability. He prepared and supplied more than 3,000 aflatoxin standards used worldwide as a public service of USDA before such standards were available commercially. Pons pioneered in every aspect of developing analytical methodology for aflatoxins. He was instrumental in: developing objective densitometric methods for determining aflatoxins in diverse commodities, including milk, eggs, and mixed feeds; in multimycotoxin methodology; in application of minicolumns for the rapid estimation of aflatoxins in various agricultural commodities; and most recently in application of HPLC to the precise objective determination of aflatoxins. Many of Walter's contributions resulted from the generous gift of his time. He organized symposia, presented seminars, participated in workshops and responded freely and enthusiastically to numerous requests from analysts for assistance.

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MINICOLUMN CHROMATOGRAPHY: THE STATE OF THE ART. Charles E. Holaday, National Peanut Research Laboratory, P.O. Box 637, Dawson, GA 31742.

The thin layer chromatographic procedures developed for detect-

*Presenting author

ing and quantitating the aflatoxins during the early 1960s were not adaptable to a rapid screening method. Because it was needed, Holaday proposed a rapid screening method for aflatoxin in peanuts based on a minicolumn chromatography technique. The minicolums are made from glass tubing 4–6 mm id, and are filled with one or more adsorbents, including silica gel, Florisil, and alumina. These adsorbents are used either individually or in combination with each other depending upon the application. Since Holaday's original proposal, several improvements in the method have been made and the application has been expanded to include aflatoxin screening procedures for other commodities and for screening a number of these commodities for other mycotoxins.

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A RAPID METHOD FOR DETERMINATION OF AFLATOXINS IN COTTONSEED AND MEAL. John D. McKinney, Ranchers Cotton Oil, P.O. Box 2596, Fresno, CA 93745.

An analytical method using Waters Associates SEP-PAK or equivalent silica gel cartridges has demonstrated a versatile, rapid technique for cleanup and isolation of the aflatoxins from extracts of cottonseed and cottonseed meal for determination by TLC, HPLC, or rapid millicolumn. The procedure involves blender extraction of a 25-g, finely ground sample of cottonseed meats or meal with acetonitrile-water (84 + 16) azeotrope. An aliquot of filtered extract is evaporated to dryness on a steam bath and the dry extract is dissolved in toluene-acetonitrile (95 + 5). The extract solution is then pumped through a silica gel cartridge by means of a Luer tip syringe and the cartridge washed with methylene chloride + ethyl ether (20 + 80). If the final extract is to be quantitized by TLC or HPLC, a small cleanup column of acid-washed alumina deactivated by 4% water is mated to the SEP-PAK and the combined columns are eluted with methylene chloride-acetone (80 + 20). For rapid millicolumn use, the SEP-PAK is alternately mated with a Velasco millicolumn and methylene chloride + acetone (80 + 20) extraction and developing solvent are pumped through the combined columns. The millicolumn is then observed under a long wave ultraviolet light for an aflatoxins band at the top of the florisil layer.

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CONFIRMATION OF AFLATOXINS AT THE FIELD LEVEL. James Velasco, Bldg 006, BARC West, Beltsville, MD 20705.

A simple and inexpensive procedure is described that confirms the presence of aflatoxins in minicolums used to screen agriculture products at the field level. Sample extract solutions found to give positive fluorescence to the florisil layer in minicolumns are further concentrated for thin layer development. The concentrated sample solution is spotted on a commercial strip of alumina precoated with silica gel and developed in 7 ml of solvent for 10 min. If the sample solution yields fluorescent spots at the same R_f as aflatoxin standards and if they are of higher fluorescent intensity, a chemical confirmation is made. One drop of trifluoroacetic acid is superimposed on the fluorescent spots and redeveloped for 5 to 10 min, then compared with similarly treated B1 or G1 standard aflatoxin spots.

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A SUBSTITUTE FOR BENZENE IN AFLATOXIN STANDARD SOLUTIONS. James Velasco, Bldg 006, BARC West, Beltsville, MD 20705.

The Aflatoxin Subcommittee of AOCS was requested to investigate possible substitutes for benzene in the preparation of aflatoxin standards. The request was made because of the safety and economic problems associated with chemicals labeled as cancer-causing by OSHA. Two solvents that are currently being evaluated to replace benzene are heptane and toluene.

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ENZYME-LINKED IMMUNOSORBENT ASSAY FOR T-2 TOXIN. J.J. Pestka, S.S. Lee, H.P. Lau and F.S. Chu*, Food Research Institute, 1925 Willow Dr., University of Wisconsin, Madison, WI 53706.

An enzyme-linked immunosorbent assay (ELISA) was developed for the rapid quantitation of T-2 toxin, a trichothecene mycotoxin produced by members of the genus *Fusarium*. T-2 toxin was first converted to the T-2 hemisuccinate (T-2HS) and then conjugated to either bovine serum albumin (BSA) or horseradish peroxidase in the presence of water-soluble carbodiimide. T-2 antisera was elicited from albino white rabbits after immunization with T-2HS-BSA and then air-dried onto polystyrene microtissue culture plates pretreated with BSA and glutaraldehyde. The plates were washed, preincubated with 1% BSA-phosphate buffered saline, and then washed again. The ELISA was conducted in the microplate by simultaneously incubating standards of T-2 toxin and T-2HS peroxidase conjugate. Displacement curves were prepared after determining total bound enzyme with the substrate hydrogen peroxide and the chromogen 2,2'-azino-di-3-ethyl-benzthiazoline-6-sulfonate. The ELISA took about 2 hr to complete and allowed detection of T-2 toxin at levels as low as 10 pg per assay.

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REVERSED-PHASE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC SEPARATION OF XANTHOMEGNIN, VIOMELLEIN, AND RUBROSULPHIN. J.H. Wall and E.B. Lillehoj, USDA, SEA, Southern Regional Research Center, PO Box 19687, New Orleans, LA 70179.

Penicillium viridicatum and a number of other fungal species produce a group of structurally related secondary metabolites that have been implicated in animal and human mycotoxicoses. The predominant substances in the toxin complex include Xanthomegnin, viomellein and rubrosulphin. Broad assessment of the quantitative presence of the substances in agriculture commodities has been limited by the paucity of definitive separation techniques. To enhance the efficacy of separation-detection systems, a number of high-performance liquid chromatographic methods were developed and tested. A reversed-phase procedure was identified as an extremely efficient separation technique. The method involved the modification of a C_{18} column in situ with sulfuric acid and sodium lauryl sulfate (SLS). Fungal extracts in acetonitrile were introduced into the system and eluted with water/acetonitrile/H_2SO_4/SLS (rr:45:02:01, v/v/wt/wt). Utilization of a radial compression module reduced the separation time to 16 min. In addition to the enhanced resolution provided by the reversed-phase column, the major metabolites were not chemically modified during the process. Consideration of the solvents used and the mobility of test compounds suggests that a partition mechanism is involved in effecting the separations.

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CONFIRMATION OF IDENTITY OF AFLATOXINS. Stanley Nesheim and William C. Brumley, Food and Drug Administration, 200 "C" Street SW, Washington, DC 20204.

Aflatoxins are detected and determined by analytical procedures based on physical and chemical properties, e.g., UV absorbance, fluorescence, solubility, and chromatographic retention times during thin layer or liquid chromatography. For acceptance of analytical results based on these properties, especially for regulatory purposes, proof of identity of the compound being measured is absolutely essential. Numerous tests have been devised for confirmation of identity. Included are tests based upon toxicological effects observed in the duckling, zebrafish, chick embryo, *Bacillus megaterium* and many other species; chemical tests based upon formation of derivatives such as the acetates and water adducts; and tests based upon color changes of TLC spots after contact with spray reagents, e.g., sulfuric acid. All the foregoing have inherent uncertainties in interpretation of identity. On the other hand, mass spectrometry is one of the most specific methods of identification available; however, it has been difficult to apply at the low concentrations at which aflatoxins are routinely detected. In this paper the confirmation techniques for aflatoxins are placed in historical perspective and are reviewed and evaluated. A recently developed procedure for the application of negative-ionization mass spectrometry for the confirmation of identity of aflatoxins in foods or feeds at concentrations as low as 2 ng/g is described. This procedure consists of isolation of the aflatoxin by AOAC methods, purification by preparatory two-dimensional TLC, in situ elution of the aflatoxin TLC spot, and analysis of the sample by negative-ion-chemical-ionization mass spectrometry using a direct insertion probe.

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PONS COLUMN ADAPTED FOR USE IN SOLVENT-SAVING MODIFICATION OF THE CB PROCEDURE FOR AFLATOXIN. L.S. Lee and E.L. Catalano, USDA, SEA, SRRC, 1100 Robert E. Lee Blvd., P.O. Box 19687, New Orleans, LA 70179.

Increased costs dictate the search for analytical methods that are conservative in solvent usage. One such method has been developed that reduced by 80% the solvents required in the CB procedure. This is the official AOAC-AOCS procedure for quantitating aflatoxins in corn, peanuts, soy, crops and pistachio nuts. The small chromatographic tube (Bio-Rad Laboratories glass Econo-Column, 1.0 cm id x 30 cm long) used for packing the cleanup column used in the HPLC aflatoxin procedure for cottonseed was adapted for use in the proposed modification of the CB procedure. The sample aliquot is reduced by one-fifth and the amount of each developing solvent is similarly reduced. Thirty mL of each of the three column washes is used instead of the 150 mL dictated by the official CB procedure. Sample size and extracting solvents are unchanged so there is no loss in sensitivity. The conservative modification has been applied suc-

cessfully to corn, peanuts and soy. Densitometrically detected levels of aflatoxin range from 3 to over 1000 ng of aflatoxin/g sample with excellent agreement between results by the official CB procedure and those obtained by the new conservative modification.

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THE EFFECTS OF DIFFERENT ANTIOXIDANTS ON THE FLAVOR QUALITY OF SOYBEAN OIL DURING STORAGE. J. Wen and David B. Min*, Dept. of Food Science and Nutrition, The Ohio State University, 2121 Fyffe Road, Columbus, OH 43210.

The antioxidant effects of 5 levels of BHA, PG, and TBHQ on soybean oil during storage have been studied by measuring peroxide value, the depletion of dissolved oxygen in oil, and the off-flavor compounds formed. The antioxidant activities in soybean oil were BHA, PG and TBHQ, in that order. TBHQ was at least 2 times more active than BHA in antioxidant activity in soybean oil. The antioxidant effectiveness increased as the concentration increased up to 150 ppm, then the effectiveness leveled off or decreased as the concentration increased to above 150 ppm. The combined measurements of dissolved oxygen content depletion and volatile flavor compounds formed in oil could be good methods to evaluate different antioxidant activities in different food systems, when selecting the right antioxidant system.

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THE KINETIC STUDIES OF OXYGEN DEPLETION AND VOLATILE FLAVOR COMPOUND FORMATION IN POTATO CHIPS AND OILS. D.Q. Schweizer, J. Wen and David B. Min, Department of Food Science and Nutrition, The Ohio State University, 2121 Fyffe Road, Columbus, OH 43210

Potato chips and edible oils containing four levels of ferric ions and four levels of citric acid were stored at 55 C. The flavor quality was evaluated for peroxide value, oxygen absorption and volatile off-flavor compound concentration, using a gas chromatographic method. The results indicate that the higher the ferric ion in the potato chips or oil, the greater the rates of oxygen depletion and the formation of volatile off-flavor compounds. The greater the concentration of citric acid, the lower the rates of oxygen depletion and the formation of volatile off-flavor compounds. By simultaneously decreasing the ferric ion and increasing the citric acid content in oil, the flavor quality of oil can be improved significantly during storage. However, when ferric ion content was greater than 15 ppm, the effects of citric acid were almost minimal. Similarly, four levels of TBHQ were added to potato chips and were found to increase flavor quality during storage. The detailed kinetic studies of oxygen reaction with oil and potato chips to form volatile flavor compounds in the presence of citric acid, ferric ion, TBHQ and combinations of citric acid and ferric ion will be reported.

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IMPROVED METHOD FOR THE FLAVOR EVALUATION OF FATS AND OILS. Rebecca Stone and Earl G. Hammond, Dept. of Food Technology, Iowa State University, Ames, IA 50011.

The flavor of fats and oils are scored traditionally by tasting the oil directly and rating the flavor intensity on a 10-point scale. Disadvantages of this approach are the strong carryover of flavor between samples and rapid taster fatigue. The method is improved by tasting oils as 1.5% emulsions in water with 0.5% gum acacia as an emulsifying agent. The bland end of the scale is fixed by a solution containing only gum acacia. A solution containing .4 mg/mL diacetyl is used as a fixed reference point that is near midscale for most judges. Soybean oil oxidized under a variety of conditions was used to evaluate the method and compare it with the traditional sensory method. Flavor deterioration in the emulsion was not a problem if the samples were scored within 1 hr. Ratio scaling proved less satisfactory than the 10-point scale. The flavor scores were correlated with the total volatiles measured by gas chromatography according to Jackson and Giacherio. The flavor stability of a soybean oil containing 4.4% linolenic acid obtained by plant breeding was compared with normal soybean oil using the improved method.

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STUDIES ON POTATO CHIP FLAVOR STABILITY. Jiu nn-yann Tang, Michael Ma, Jeanne Street, Lynn Warren, Otto E. Schroeder and Alan Wohlman, Res. & Development, Frito-Lay, Inc., 900 N. Loop 12, Irving, TX 75061.

A simple and versatile gas chromatographic (GC) method has been developed and applied to potato chip stability studies. This method was used not only for rapid differentiation between products resulting from photo- and thermal-induced lipid oxidations of potato chips, but also for testing the effects of various storage factors on stability of potato chip products or edible oils upon storage. The participation of "singlet oxygen" in photooxidation of potato chips was established by using various well-known quenchers. The major rancid and light-struck aromas were identified by GC/MS techniques. Autoxidation of the oil (rancidity) was found to be more detrimental to the flavor stability of potato chips packaged in light-protected film than was photooxidation. This was demonstrated by the strong correlation between hexanal development (autoxidation product) and hedonic scores of the chips as a function of time. Furthermore, an attempt has been made to develop a unique objective chemical method to estimate shelf-life based on the initial peroxide value and defined storage conditions.

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SENSORY ANALYSIS OF FOOD PRODUCTS CONTAINING WHITE SKINNED PEANUT FLOURS. Carolyn H. Vinnett, Robert L. Ory and Allen J. St. Angelo, USDA, SEA, SRRC, 1100 Robert E. Lee Blvd., P.O. Box 19687, New Orleans, LA 70179.

White skin peanut flour was added to milk and milk beverages to serve as a nutritional supplement and was added to soups as a thickener and nutritional supplement. The milks, milk beverages and chicken- and beef-flavored soups containing the peanut protein were evaluated by trained sensory panels. Taste panels rated the overall quality, characterized the attributes, and quantified the properties of the peanut protein-supplemented food products. The sensory profiles of a 2% dispersion of this flour did not agree with sensory profiles observed for those milks formulated with 10% of the peanut flour. The initially poor overall quality of commercially prepared plain milks formulated with 10% peanut flour was improved by the addition of flavoring. The plain milk sensory properties were characterized by the panel as slightly bland and chalky. Beef- and chicken-flavored soup mixes functionally supplemented with 5% peanut flour had an overall quality rating either equal to or better than the commercial soup reference standards. Sensory profiles were established by panels for both experimental soups. Off-tastes or tastes commonly associated with peanut flours were not detected in either of the soups and there was no evidence of adverse effects on the texture of either soup.

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RELATIONSHIPS OF FLAVOR AND GAS CHROMATOGRAPHIC VOLATILE ANALYSIS OF SOYBEAN OIL AND PROTEIN PRODUCTS. K. Warner, Northern Regional Research Center, 1815 North University Street, Peoria, IL 61604.

Correlation of sensory attributes and gas chromatographic (GC) volatile profiles of food products produces valuable information on product quality, storage stability and prediction of oxidative stability. Although sensory analysis can stand alone as an evaluation method, instrumental and chemical tests for quality cannot. These objective tests must be calibrated against results from properly designed odor and flavor tests conducted by trained and experienced panels. The ultimate test for the reliability and validity of a GC procedure should be based on statistically significant correlations with sensory attributes of the food. This paper reviews studies correlating sensory evaluations with GC volatile profiles of vegetable oils, fat-containing foods and soy flours, concentrates, and isolates. Direct GC sampling procedures and headspace analyses have been utilized. The GC data are expressed as total volatiles or groups of related peaks or as individual peaks. The peak used for correlation is chosen as a marker to indicate quality or storage stability. Future research in correlation of volatiles and sensory data will be directed toward identifying cause-effect relationships.

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QUALITY OF LIPIDS IN DEEP-FAT-FRIED PRODUCTS. S.N. Sultana and D.P. Sen*, Discipline of Lipid Technology, Central Food Technological Research Institute, Mysore-570 013, India.

Deep-fat-fried products are widely used in India as snack and breakfast food items. These items form an important source of fat in Indian diets. Because oil gets damaged during the process of heating, it was considered important to assess the quality of lipids of a few Indian deep-fat-fried products such as "Chakkali," "Kodubale," potato chips, "Masala vade," "puree," "Khara Bundi" and "Bajji." Major ingredients of the products are powdered rice and Bengal gram flour (Chakkali), powdered rice and roasted Bengal gram (Kodubale), Bengal gram flour and mixed vegetables (Masala Vade), wheat flour (Puree), Bengal gram flour and potato pieces (Bajji), and Bengal gram flour (Khara Bundi). Results indicated lesser amounts of oxidized components in the lipids extracted from the products compared to those present in the frying medium. A series of analyses of lipids extracted from deep-fat-fried products has shown they have higher iodine values, lower refractive indexes, oxidized fatty acids, non-urea-adduct-forming fatty acids and oxirane oxygen contents, compared to frying oil. To elucidate these findings, model experi-

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ments with major components of the products were conducted; these confirmed the observations above.

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NEW DEVELOPMENTS IN DETERGENCY THEORY. Anthony M. Schwartz, 2260 Glenmore Terr., Rockville, MD 20850.

Practical detergency is the result of several different soil-substrate separation processes and soil-bath association processes, all of which are at least partially reversible. Detergency theory therefore involves not a simple unified approach, but rather an analysis in basic physicochemical terms of each of these processes, together with their mutual interactions and interdependencies. Textile detergency encompasses the separation of solid particulates, liquids and hydrophilic macromolecular soils from a relatively small number of fibrous substrates. These soils must then be dispersed and emulsified or solubilized in micelles or mesophases. Recent significant advances in the theory of these processes are reviewed, and their relative importance in typical textile detergency systems is assessed.

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EVALUATION OF DETERGENCY. Erik Kissa, E.I. Du Pont de Nemours & Co., Chemicals and Pigments Dept., Jackson Laboratory, Wilmington, DE 19898.

Detergency evaluation depends on a representative selection of soil and a reproducible and realistic application of soil to the test fabrics. Mechanical work performed during soiling affects detergency and is an important variable in detergency testing. Soiling of textiles in use involves direct application of soil, or transfer from another surface. Laboratory methods for direct or transfer soiling will be reviewed and the selection of model soils will be discussed. A novel soiling method will be described that uses polyurethane foam cubes to transfer soil onto test fabrics rotated in an Accelerotor. The soiling level can be varied from barely visible to heavy soiling on nonrepellent or repellent fabrics. Soiling is uniform, rapid (completed in a few minutes) and believed to simulate soiling of textiles in contact with skin. Estimation of residual soil on washed fabrics by visual and instrumental methods will be discussed.

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KINETICS OF DETERGENCY. I. Weil and E. Vikara, Lever Brothers Company, Research Center, 45 River Road, Edgewater, NJ 07020.

Detergency is generally determined by the amount of soil removed from a substrate in an arbitrarily set time period—a type of measurement that is not sufficient for an understanding of the mechanisms involved. To clarify some of the soil removal mechanisms, a kinetic study was undertaken. Since rate data has its greatest impact on mechanistic interpretation if the parameters affecting the system can be independently studied, experimental systems and soil cloths were designed to give specific information on the effect of both calcium ion interactions and pH. In this study, the behavior of anionic surfactants, such as linear alkylbenzene sulfonates, alkylethoxysulfates and soaps, in the presence and absence of the commonly used chelating and precipitant builders, were investigated.

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EFFECTS OF ADSORPTION ON DETERGENCY PHENOMENA—PART I. M.J. Schwuger, Henkel KGaA, Postbox 1100, D-4000 Düsseldorf 1, West Germany.

Washing of textiles is a complex process in which soil is removed mainly by physical separation processes without changes of matter. Besides depending on the primary step of soil removal, the overall performance also depends on the effective stabilization of soil in the detergent solution, i.e., the prevention of redeposition of already removed soil. The various physical-chemical mechanisms of separation and stabilization of soil can be attributed to the adsorption at different interfaces. In this connection, the most important detergent ingredients complement each other as they act according to different principles. Surfactants are adsorbed unspecifically at all interfaces via hydrophobic interactions. Parallels between the adsorption and the wash effect are depicted, based on model investigations. Particularly, the connections between constitution and properties of individual surfactants are described in detail.

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EFFECTS OF ADSORPTION ON DETERGENCY PHENOMENA—PART II. M.J. Schwuger, Henkel KGaA, Postbox 1100, D-4000, Düsseldorf, West Germany.

In the second part, the importance of specific interactions for the washing process as well as the results of investigations in multicomponent systems is reported. Water-soluble complexing agents are chemisorbed only specifically on particles and textile fibers with distinct charge centers and substrata having bivalent ions at the interface. Zeolites have a dual task with respect to the adsorption. As adsorbents, they specifically bind bivalent ions in their cavities via electrostatic bonding forces, whereas soil particles can be adsorbed on the external surface. In multicomponent systems, unspecific interactions may be enhanced. Only the mutual complement of specific and unspecific adsorption effects enables the attainment of the positive overall washing effect of a detergent.

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ADSORPTION STUDY OF NONIONIC SURFACTANTS ON POLYESTER FIBER. M.L. Gum and E.D. Goddard, Union Carbide Corporation, Tarrytown Technical Center, Tarrytown, NY 10591.

An adsorption study of a series of nonionic surfactants on polyester fiber was performed to determine the relative importance of substrate affinity in the detergency process. The fiber used in this study was a multifilament polyester yarn. Owing to the relatively low surface area/g of the yarn, analytical methods for detecting the depletion of surfactant due to adsorption have to be extremely sensitive. One qualitative technique used was streaming potential measurements. The electrokinetic effect, which the streaming potential measures, depends on the nature of the electrical double layer at the fiber/solution interface. The modification of the streaming potential indicates that the extent of surfactant adsorption onto the fiber surface is very similar for the nonionic surfactants studied. A very sensitive, quantitative analytical technique, which can only be used for surfactants with an appropriate chromophore, is UV spectroscopy. The UV study showed that the adsorption of the nonylphenol ethoxylate onto the polyester is Langmuirian with the adsorption plateau occurring at the critical micelle concentration. For alcohol ethoxylates without a UV chromophore, convenient quantification at the ppm level represents a difficult analytical problem. In this paper, total carbon analysis was developed as a sensitive analytical tool for surfactant determination. Agreement between the UV and total carbon data for the nonylphenol ethoxylate was quite good. The total carbon method also gave good results for other alcohol ethoxylates. The relevance of the data to the detergency process will be discussed.

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FOOD AND ENERGY. Larry R. Kelso, Agriculture and Food Processes Branch, Department of Energy, Conservation and Renewable Energy, Industrial Programs, CS-121.5, Forrestal Building, Washington, DC 20585.

The Office of Industrial Programs is responsible for research, development and demonstration of technologies which will improve the efficiency of the processes used in a broad spectrum of industries. The Agriculture and Food Processes Branch plans and implements the program to develop and demonstrate new and innovative food production and processing system technologies, which improve the utilization of energy resources throughout the entire food chain as they relate to the required mechanical systems that deliver the completed products to the market. The food industry sector's energy consumption is large, also. It is estimated to consume 16.5% of the nation's total energy demand. The sector's energy intensity (i.e., the relative size of energy use as a factor of production) is high, but varies among industries within the section. The primary stages of production—farming, fishing and forestry—are less energy-intensive, only accounting for one-fifth of energy demand. Moreover, in the 1970-78 period, farm energy consumption was virtually flat. From the beginning of this century until the early years of the 1970s, the food industry sector expanded its energy use, as relative energy prices experienced a long-run secular decline. In response to those price signals, food producers and processors carried out a wholesale substitution of energy for labor. This broad changeover to mechanical and chemical forms of energy expanded the sector's productivity. Energy intensification has not been an unmixed blessing, however, in wake of the 1973 OPEC embargo, soaring energy prices and tightening supplies have generated considerable consternation within the food industry sector and elsewhere. Government efforts to aid the food industry sector were originally limited to "crisis management" activities—getting emergency supplies of fuel to food producers. However, with the general realization that our energy crisis requires a more systematic response, the Department of Energy established the Agriculture and Food Processes Branch with the responsibility for research development and demonstration of new energy technologies related to the following areas: integrated farm systems, irrigation technology improvements, crop drying methodologies, alternative farm power systems, fertilizer formulation and usage, milk processing and handling, agriculture systems modeling, food processing efficiency improvement, sterilization, food packaging systems, sugar processing, citrus processing and meat processing systems.

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SOLAR THERMAL SYSTEMS IN INDUSTRY. D.J. Allen and A.C.

Gangadharan, Foster Wheeler Solar Development Corp., Livingston, NJ 07039.

A significant portion of the demand for industrial process heat can be met with solar energy. Whether this energy source is widely used will depend not only upon its economic attractiveness, but also upon the ease with which solar thermal systems interface with the remainder of the industrial plant. Foster Wheeler has recently designed solar thermal systems to supply hot water and process steam to industry and has nearly completed the construction of one such system. Drawing on this experience, we will discuss the solar technologies that can best satisfy the user's energy requirements, the minimization of interfacing problems, and the potential operating and maintenance requirements of solar thermal systems.

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THE PRACTICAL ECONOMICS OF SOLID FUEL FIRED PROCESS STEAM GENERATION. Michael R. Walker, P.O. Box 609, Hixson, TN 37343.

This paper discusses the practical application of coal/wood waste-fired boiler systems for steam generation with particular reference to efficiencies, cost savings and application theory. Case studies are presented that deal with companies who are major oil processors that have taken, or are taking, the major step towards energy economy and independence by installing new coal/wood/waste boilers, or retrofitting existing boilers to burn solid fuel and process waste. Slides will be used to illustrate the paper, showing these and other typical installations on a case study basis. Environmental regulations will also be discussed, along with the impact of these regulations on the economics involved.

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UPDATE ON OPERATIONS OF TWO STAGE COAL GASIFIER AT THE UNIVERSITY OF MINNESOTA IN DULUTH. D.F. Bress and R.J. Broeker, Foster Wheeler Energy Corp., Livingston, NJ 07039.

The proposed paper would be an update on operations at the FW-Stoic two-stage coal gasifier heating plant at the Duluth campus of the University of Minnesota. This gasifier furnishes a low-BTU gas fuel for firing in the university's boilers. Previous papers have described the project and reported on initial operations. This paper will review recent operations, provide operating data, and report on the performance of coals, including lignite, that have been gasified but not previously reported on.

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CURRENT ENERGY CONSIDERATIONS FOR HYDROGEN GENERATION BY THE ELECTROLYTIC PROCESS. C.C.M. Baker, The Electrolyser Corporation, Ltd., 122 The West Mall, Etobicoke, Toronto, Canada M9C 1B9.

In selecting on-site hydrogen generation equipment for the hydrogenation of edible oils, current high energy prices have become a significant factor in any cost analysis. This paper deals with current and projected costs and availability of electricity and natural gas in North America and compares utility requirements for producing hydrogen through electrolysis or steam reforming. Recent advanced electrolyser design has substantially improved the energy efficiency of electrolytic hydrogen generators. A detailed review of these improvements and subsequent reduction in both operating and capital costs will be presented. Second generation designs incorporate modifications that allow operation at higher current densities, which are more than twice the current density in conventional electrolysers. Overall cell voltage is reduced through the reduction of electrode overvoltages—the major contributors to electrical inefficiency. Further efficiency-related considerations such as on-site co-generation of steam and electricity will be investigated.

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ENERGY CONSERVATION IN FATTY ACID CHEMICALS. Roger Daniels, Union Camp Corporation/Chemical Division, P.O. Box 2668, Savannah, GA 31402.

Some examples of the ways in which energy conservation measures can be taken in an older organic chemicals plant are examined. Many of the features that can be built into a new continuous refinery are not applicable to a multiproduct, largely batch process factory; however, there are many ways to save energy as the incentive provided by rising fuel prices becomes more pressing. These energy-saving features can also lead to improved yield and throughput and to reduced emission losses.

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THE EFFECT OF SOLVENT EXTRACTION VARIABLES ON ENERGY USAGE. George E. Anderson, 1229 Tyler St. N.E., P.O. Box 1364, Minneapolis, MN 55440.

The intent of this presentation is to clarify the significance, in terms of energy consumption, of seemingly minor changes in process variables. The initial part of the presentation will note the relative significance of various energy uses and proceed to develop a simplified calculation of total steam usage in a solvent extraction system. A basic, modern 1500 ton/day soybean processing plant is the basis for the calculation. Once this calculation is established, the theoretical effects of process variables will be examined. The major variables presented will include flake moisture, meal moisture, solvent ratio, and solvent carryover to the desolventizer. Brief mention will be made, if time allows, of the relative efficiency of drying the material at various stages in the process or by alternative means.

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SOME THOUGHTS ON SOYBEAN PROCESSING. Norm H. Witte, Central Soya Company, Inc., 1300 Fort Wayne Bank, Fort Wayne, IN 46082.

Not available at press time.

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ENERGY CONSERVATION IN EDIBLE OIL PROCESSING. David C. Tandy and Larry W. Gavin, EMI Corporation, 3166 Des Plaines Avenue, Des Plaines, IL 60018.

The two main energy consumers in a typical edible oil processing facility (i.e., deodorizer and physical steam refiner) are the steam jet ejectors to achieve the high vacuum required in the process and the external heat source (i.e., Dowtherm vaporizer and thermal oil heater) necessary for raising the oil to a suitable processing temperature. This paper will discuss two control configurations in which closed loop control is added to various points of a multistage vacuum system to minimize steam usage. Also presented are two methods by which maximum utilization of process heat can be obtained. Edible oil deodorizing requires heating the oil to a temperature of 475–525 F and subsequently cooling the oil before storage. Substantial energy which in the past has been rejected to a cooling tower may be recovered in the preheating of incoming feedstock or in raising the temperature of make-up boiler feedwater going to the steam plant.

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ENERGY CONSERVATION FOR AN OILSEEDS COMPLEX. Kenneth W. Becker, Davy McKee Corporation, 10 South Riverside Plaza, Chicago, IL 60606.

For more than a decade, major oilseed processors have continued the practice of grouping the systems for receiving and storage, preparation and extraction, vegetable oil refining, and protein processes within a single oilseed complex. Energy considerations have been one of the major factors in the consolidation of these various manufacturing facilities at a single site. For example, such practice not only permits better and more efficient uses of steam but also allows substantial savings in transportation costs. Today, most large oilseed processors are installing new vegetable refineries on the same site as their crushing plants. Some of the advantages to be gained by the consolidation of these various facilities at a single site are discussed in this paper.

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TOTAL ENZYMATIC SYNTHESIS OF CHOLESTEROL FROM LANOSTEROL: A PROGRESS REPORT. James L. Gaylor, Assoc. Director Life Sciences Research, CR & DD, E.I. duPont de Nemours & Co., Wilmington, DE 19898; Gary J. Fisher, Washington University, St. Louis; Wayne D. Bowen, National Institute of Mental Health; Greg Grinstead, Young-Ki Paik and James M. Trzaskos, University of Missouri.

We wish to resolve and reconstitute the microsomol enzymes of cholesterol biosynthesis. Elucidation of the enzymology has been achieved primarily through dissection of the membrane-bound, 19-step process. The first segment resolved was the 10-step oxidative demethylation of the 4-gem dimethyl group. The 4-demethylation was resolved into three component reactions catalyzed by: 4-methyl sterol oxidase (NAD(P)H- and O_2-dependent); 4α-carboxylic acid decarboxylase (NAD-dependent); and 3-ketosteroid reductase (NADPH-dependent). The 3-ketosteroid reductase has been solubilized with Lubrol WX and the decarboxylase has been solubilized with deoxycholate. The 4-methyl sterol oxidase has been solubilized with Renex 690 and purification is underway. Shortly we should achieve reconstitution of the enzymes of this central half of the 19-step process. The C-32 oxidative reaction of 14α-methyl group elimination is catalyzed by a form of cytochrome P-450 that is induced by isosafrole. The induced cytochrome P-450 has been solubilized with Emulgen 913 and purified to homogeneity (17 nmol/mg protein). The 24,25-dihydrolanosterol is oxidized by combination of cytochrome P-450 reductase, hematin, NADPH, glutathione, and the cytochrome in an artificial liposome. Oxidation product identification is underway. The $\Delta^8 \rightarrow \Delta^7$-isomerase has been solubilized with octylglucoside plus taurodeoxycholate. Δ^{24}-Sterol reductase is also released by octylglucoside. Because Δ^7-sterol-5-desaturase and 4-methyl sterol oxidase

require cytochrome b_5, an affinity column of the latter has been used for resolutions of small amounts of proteins in the presence of detergent. Only three enzymes remain to be solubilized: 2 reductases, $\Delta^{14(15)}$- and Δ^7-reductase, and the decarbonylase of C-32 elimination. Cholesterol synthesis could not have appeared biologically until membranes contained both the cytochrome P-450 and b_5-electron transport enzymes. Chemically, all enzymic attacks appear to be initiated on the α-face of the steroids. Considerable genetic pressure ultimately must have been needed for the stereospecific clearing of the steroidal α-face to form cholesterol.

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BIOSYNTHESIS OF 1-OCTANOL FROM OCTANE. STEREOCHEMISTRY OF THE ENZYMIC OXYGENATION. Eliahu Caspi, James U. Piper and Stuart Shapiro, The Worcester Foundation for Experimental Biology, 222 Maple Avenue, Shrewsbury, MA 01545.

The (1R)- and (1S) [1-^{3}H,^{2}H,^{1}H] [1-^{14}C]-octanes, required for the investigations of the stereochemistry of hydroxylation of primary carbon atoms, were synthesized via (1S)- and (1R) [1-^{3}H,^{1}H] [1-^{14}C]-octanols. This study was predicated on the operation of a normal kinetic isotope effect $k_H > k_D > k_T$. The bulk of the products formed were expected to be alcohols derived from the oxygenation of the achiral termini of ^{12}C- and ^{14}C-octanes. In addition, oxygenation of the chiral methyls was expected to yield mixtures of octanols R-C-^{3}H,^{2}H(OH) > R-C-^{3}H,^{1}H(OH) > R-C-^{2}H,^{1}H(OH). Irrespective of whether the hydroxylation of the chiral methyls will proceed with retention or inversion of configuration, the produced alcohols will be mixtures of (1R)- and (1S)-octanols in different proportions. It was demonstrated that the hydroxylation of octane by enzymes of *P. oleovorans* proceeds with a normal kinetic hydrogen isotope effect to give mixtures of chiral 1-octanols. A method for analyzing the composition of the mixtures of alcohols derived from oxygenation of (1R)- and (1S)-octanes was developed. Using these procedures, it was proven that hydroxylation proceeds with retention of configuration. Work supported by grants NSF (PCM 7800582) and NIH (AM 12156).

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MARINE SHORT SIDE CHAIN STEROLS: FACTS AND HYPOTHESES CONCERNING THE MECHANISM OF CARBON ATOMS ELIMINATION AND ALSO THEIR POSSIBLE ORIGINS. J.L. Boutry, I.U.T. La Rochelle, France, and M. Barbier, Institut de Chimie des Substances Naturelles, 91190 Gif sur Yvette, France.

The particular situation encountered with short, or hypermethylated, side chain sterols of the marine environment, and their possible role and origins, will be briefly reviewed before the presentation of results. In a series of model experiments using C_{27}, C_{28} and C_{29} sterols and a pool of marine bacteria, shorter side chain sterols have been isolated; these are now under investigation. Such experiments are connected with the need for a model that produced C_{26} sterols, which would permit the identification of the precursors and microorganisms responsible for such degradations. The results obtained so far will be discussed and the general situation of marine sterols will be considered.

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THE PARTICIPATION OF STEROL CARRIER PROTEIN$_2$ (SCP_2) IN CHOLESTEROL BIOSYNTHESIS, UTILIZATION AND INTRACELLULAR TRANSFER. Terence J. Scallen, Billie J. Noland and Kathleen L. Gavey, Dept. Biochemistry SOM, University of New Mexico, Albuquerque, NM 87131.

We have recently described the purification to homogeneity of sterol carrier protein$_2$ (SCP_2) from rat liver 303,000 x g soluble supernatant. SCP_2 activates the microsomal conversion of 4,4-dimethyl-Δ^8-cholestenol to C_{27} sterol and the microsomal conversion of 7-dehydrocholesterol to cholesterol. The purification factors achieved (1400- to 1500-fold) were essentially the same for both substrates. In contrast to SCP_1, SCP_2 did not activate the microsomal conversion of squalene to lanosterol. SCP_2 is a basic protein (pI ≅ 8.6) with a molecular weight of 13,500, as measured by SDS gel electrophoresis. The most abundant amino acid is lysine (14.0 mole %). In addition, SCP_2 has no arginine or tyrosine. SCP_2 also activates the microsomal conversion of cholesterol to cholesteryl ester. In addition, SCP_2 is required for the transfer of cholesterol from adrenal lipid droplets to adrenal mitochondria, where it is then utilized for steroid hormone biosynthesis. SCP_2 thus plays a key role in the biosynthesis, utilization and intracellular transfer of cholesterol. (Supported by NIH Grants AM-10,628 and HL-16,796.)

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THE REGULATION OF TETRAHYMANOL BIOSYNTHESIS IN *Tetrahymena pyriformis*. Colin F. Warburg and David C. Wilton,*

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The eukaryotic protozoan *Tetrahymena pyriformis* biosynthesizes a unique pentacyclic triterpenoid alcohol tetrahymanol, which is used as a structural component of the membrane of this organism. When a number of sterols such as cholesterol and ergosterol are added to the growth medium, these sterols are taken up and utilized by the organism, whereas there is a complete inhibition of tetrahymanol biosynthesis. The primary site of this inhibition by cholesterol is located after mevalonic acid in the pathway and results will be presented to implicate the enzyme squalene synthetase as the step that is being regulated. Some properties of the enzyme from this organism will be presented, as will the possible role of this enzyme in the regulation of tetrahymanol biosynthesis during the normal growth of *T. pyriformis* in culture.

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THE USE OF SPECIFICALLY DESIGNED INHIBITORS TO STUDY THE REGULATION OF HIGHER PLANT STEROL BIOSYNTHESIS. A. Rahier and P. Schmitt, Institut de Botanique, Laboratoire de Biochimie Végétale 28, rue Goethe, 67083—Strasbourg Cédex, France; A.S. Narula, Research School of Chemistry, Canberra, A.C.T. 2600, Australia; and P. Benveniste,* Institut de Botanique, Strasbourg Cédex, France.

AY 9944 [I, *trans*-1,4-bis(2-chlorobenzylaminomethyl) cyclohexane]; fenarimol [II, α-(2-chlorophenyl)-α-(4-chlorophenyl)-5-pyrimidine methanol]; 15-aza-24-methylene-D-homocholesta-8,14-dien-3β-ol (III); 24-methyl,25-aza-cycloartanol (IV); 7-oxo-4α,14α-dimethyl-9; and 19-cyclo-ergostane-3β-ol (V) were given to suspension cultures of bramble cells (*Rubus fruticosus*). Results obtained showed that the normally occurring sterols disappeared almost completely and were replaced by new sterols, many of them being found for the first time in a living organism. The major targets of the drugs were the following enzymes: $\Delta^8 \rightarrow \Delta^7$ isomerase for I; 14α-methyl hydroxylase for II; Δ^{14} reductase for III; S-adenosyl methionine-cycloartenol-C-24 methyltransferase for IV; and cycloeucalenol-obtusifoliol isomerase for V. The inhibitory properties of IV and V have been tested both in vivo and in vitro. The two approaches yielded consistent results. Results obtained with IV are discussed in the light of the current theories concerning the "transition state analogs" and are shown to have important implications both in the search of new inhibitors and in the understanding of the molecular mechanisms involved in sterol biosynthesis.

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CHEMICAL IONIZATION-MASS SPECTROMETRY OF FATTY ACIDS: THE EFFECT OF FUNCTIONAL GROUPS ON THE CI SPECTRA. Ronald D. Plattner, Northern Regional Research Center, 1815 N. University Street, Peoria, IL 61604.

Although instruments with capabilities for chemical ionization-mass spectrometry (CI-MS) have been widely available for a number of years, the literature is surprisingly sparse in systematic studies of CI spectral patterns for different types of fatty acids and their derivatives. CI spectra show much less fragmentation than normal electron impact (EI) spectra. The amount of fragmentation varies from essentially only quasimolecular ion (M+1) production in isobutane CI spectra of saturated long-chain methyl esters (such as methyl palmitate and methyl stearate) to considerable fragmentation in the CI spectra of polyhydroxy fatty acids. When isobutane is the reagent gas, adding double bonds to the fatty ester increases fragmentation slightly, but the intense quasimolecular ion $(M+1)^+$ is still the base peak in all cases. The addition of oxygenated groups into the fatty ester can change the nature of the quasi-molecular ion. For example, in isobutane CI spectra of hydroxy esters, the $(M-1)^+$ ion, not the $(M+1)^+$ ion, is observed. The loss of neutral molecules such as H_2O and CH_3OH also becomes an important process as additional functional groups are added to the molecule. When ammonia is the reagent gas, saturated long-chain fatty esters have little fragmentation, yielding only an abundant ion at $(M+NH_4)^+$ instead of $(M+1)^+$. A small ion at $(M)^+$ is also observed. The presence of oxygenated functional groups in the molecule causes the $(M+NH_4)^+$ ion to become less prominent (or even absent), and M^+ or $(M+1)^+$ and ions arising from the loss of neutral molecules are increased. CI spectra of oxygenated fatty acids sometimes show fragments that are diagnostic to locate the functional group. In general, because diagnostic ions are not intense, CI spectra do not serve as well as EI spectra to locate functional groups. However, unlike EI spectra, CI spectra of polyfunctional fatty acid derivatives do show ions that are indicative of molecular weight, making CI a valuable additional tool for the study of these molecules.

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SEPARATION OF PAIRS OF C-24 EPIMERIC STEROLS BY GLASS CAPILLARY GAS CHROMATOGRAPHY. Raymond H. Thompson, Jr., Nutrient Composition Laboratory, USDA, Building 264, BARC-East, Beltsville, MD 20705, Glenn Patterson, Dept. of Botany, University of Maryland, Malcolm J. Thompson, Insect Physiology Lab, USDA, and Hal T. Slover, Nutrient Composition Lab, USDA.

This is the first report of the chromatographic separation of pairs of C-24 epimeric sterols. The trimethylsilyl ethers of nine pairs of C-24 epimeric sterols; brassicasterol and 24-epibrassicasterol; 22,23-dihydrobrassicasterol and campesterol; ergostanol and campestanol; Δ^7-ergostenol and Δ^7-campestenol; poriferasterol and stigmasterol; 22,23-dihydroporiferasterol and sitosterol; chondrillasterol and spinasterol; Δ^7-poriferastenol and Δ^7-stigmastenol; 25-dehydrochondrillasterol and 25-dehydrospinasterol; were partially or completely separated by gas chromatography on a glass capillary column coated with SP-2340. The epimeric pairs of sterols with saturated side chains and the one pair with two double bonds in the side chain were completely separated from each other, whereas the epimeric pairs with a double bond at C-22 showed only partial separation. The 24β-epimers with saturated side chains eluted before the corresponding 24α-epimers. This order was reversed for epimeric pairs containing double bonds in the side chain at C-22. Gas chromatograms showing the degree of separation of the nine pairs of C-24 epimeric sterol trimethylsilyl ethers and data of relative retention times are presented.

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A MICRO-QUANTITATIVE PROCEDURE FOR THE ESTIMATION OF FREE FATTY ACIDS AND THE LIPASE ACTIVITY IN CEREAL GRAIN. M.R. Sahasrabudhe, Food Research Institute, Agriculture Canada, Central Experimental Farm, Ottawa, Ontario K1A 0C6, Canada.

A sensitive colorimetric procedure based on the formation of copper soaps was developed for the determination of free fatty acids (FFA) and was applied to the determination of lipase activity in cereal grains and oilseeds. The test can be applied to single grains, since only a small sample (5 mg) is needed. FFA was extracted with chloroform-heptane-methanol. Diethyldithiocarbamate was chosen for the development of color. Lipase activity in grains was assessed by relative increases in the FFA content of flour when incubated under controlled moisture, pH and time. Lipase activity of fat-free or low-fat fractions was assayed with olive oil as substrate.

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COMPARISON OF THREE METHODS OF DETERMINING OIL CONTENT OF SUNFLOWER SEED. James A. Robertson, USDA, SEA, R.B. Russell Agricultural Research Center, P.O. Box 5677, Athens, GA 30613.

A solvent extraction method (AOCS Tentative Method Ai 3-75) was compared with two instrumental techniques, near infrared reflectance (NIR) and wide-line nuclear magnetic resonance (NMR), for the determination of total oil in oilseed-type sunflower seed. Preliminary experiments showed that sunflower seed for NMR analyses could be dried a minimum of 20 min at 130 C in a forced draft oven or about 6 min at 1.5 KW power in a microwave oven. Eight sunflower seed samples of varying oil contents, replicated five times, were analyzed by the three procedures. The overall average oil contents and standard deviations for the eight samples were: AOCS extraction method, 44.46% $\pm$ 0.33%; NMR, 44.82% $\pm$ 0.27%; and NIR, 44.19% $\pm$ 0.81%. The NIR analysis had the highest standard deviation but was still at an acceptable level. Statistical evaluation of the data will be presented and the advantages and disadvantages of the three methods will be discussed.

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SPECTROPHOTOMETRIC ASSAYS OF PALM OIL QUALITY. P.A.T. Swoboda, Palm Oil Research Institute of Malaysia, 18th Floor, Angkasa Raya Building, Jalan Ampang, Kuala Lumpur 04-06, Malaysia.

Ultraviolet and visible spectrophotometric assays are used to measure color and primary and secondary oxidation products. Both accepted and new analytical procedures will be considered and their role in characterizing the quality of Malaysian palm oil products will be described. Developments in technique and instrumentation will be discussed. AOCS and other national and international official analytical methods will be criticized and recommendations will be made for their improvement.

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DETERMINATION OF TRACE METALS IN ORGANICS BY AUTOMATED FURNACE ATOMIC ABSORPTION SPECTROSCOPY. Herbert Kahn, John Sotera and Timothy Corum, Instrumentation Laboratory, Inc., Jonspin Road, Wilmington, MA 01887.

There is a continuing need to determine the concentrations of metallic elements, either toxic or nutritive, in edible oils and fats. For low concentrations, an atomic absorption (AA) spectrophotometer equipped with a furnace atomizer is frequently used. Conventional AA systems face problems because they do not handle organic solvents or materials very well, and therefore require considerable chemical preparation. A more recent device, the FASTAC sampler, sprays the sample into the furnace in the form of an aerosol that dries immediately on contact. The problems with organic solvents are thereby overcome. Details regarding the determination of arsenic, copper, nickel, iron, and other elements are presented. The results of a study on analytical interferences are also given.

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WET DIGESTION VERSUS SIMPLER METHODS FOR DETERMINATION OF HEAVY METALS IN FISH OILS. R.G. Ackman, Technical University of Nova Scotia, Fisheries Research and Technology Laboratory, P.O. Box 1000, Halifax, N.S. B3J 2X4, and C.M. Elson, St. Mary's University, Halifax.

Wet digestion of fish oil with nitric acid in sealed Teflon containers was found to be a practical, if time-consuming, method for solubilizing heavy metals for determination by atomic absorption spectroscopy. The processes of degumming, alkali refining and bleaching reduced the Cd, Pb, Cu, As and Zn of menhaden oil to less than 0.1 ppm. Each stage of refining will be discussed with its effect on the probable type of metal compound originally present. Additional information for Pb, Cu and Zn was provided by an exploration of extraction of a methyl isobutyl ketone solution of the oil with nitric acid, but this method and direct injection of MIBK-oil solution into the furnace were not satisfactory. Hydrogenation had little effect on the final content of Pb and Cu.

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RACEMIZATION OF AMINO ACIDS IN PROTEINS AND PROTEIN FOODS. J.W. Finley and D.E. Schwass, USDA-SEA-AR-WRRC, and W.G. Horn, University of California, Berkeley, CA.

Food proteins occasionally are exposed to alkali during isolation or processing. Along with the benefits of increased solubility and modified functional characteristics, detrimental changes may also occur. Alkaline treatment of proteins can result in crosslink formation (e.g., lysinoalanine) and racemization of amino acid residues in the protein. This paper discusses the effects of varying pH, time temperature and water activity on the tendency of proteins to racemize and to form lysinoalanine. Amino acid residues within a protein varied considerably in their tendency to racemize. Under severe alkaline conditions (stronger than normally used in food processing), aspartic acid and serine were shown to be 50% racemized, which could be of toxicological concern because D-serine can be nephrotoxic. Commercially processed foods that received mild alkaline treatment as a consequence of processing showed only slight increases in racemization. A few special products such as coffee whiteners, liquid protein diet foods and tortillas showed slightly higher levels of racemization.

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EFFECT OF ULTRASONIC COMMINUTION ON LIQUID CLASSIFICATION OF COTTONSEED PROTEIN AND GOSSYPOL PIGMENT GLANDS. R.J. Hron, Sr., and A.V. Graci, Southern Regional Research Center, SEA, USDA, P.O. Box 19687, New Orleans, LA 70179.

Slurries of pin-milled full-fat and flaked, hexane-extracted cottonseed (in hexane) were ultrasonically comminuted and liquid classified using laboratory differential settling techniques. Sonication of the full-fat cottonseed slurries increased the liquid classified protein fraction recovery from 25.8% (unsonicated control) to over 60%, while the protein content remained basically constant at 67% and free gossypol increased slightly from 0.023% to 0.032%. Sonication of flaked, solvent-extracted (fat-free) slurried cottonseed yielded a 28% classified fraction containing 72% protein and 0.032% free gossypol. Although demonstrated on a laboratory scale, ultrasonic comminution has the potential to make the production of edible cottonseed protein concentrates from glanded seed (via a process such as the Liquid Cyclone Process) competitive with other protein products.

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EFFECTS OF RESIDUAL LINTERS ON COTTONSEED OIL AND MEAL YIELDS. L.A. Johnson, S.P. Clark and E.W. Lusas, Food Protein Research & Development Center, F.M. 183, Texas A & M University, College Station, TX 77843.

The cottonseed oil milling industry may be forced to reduce or eliminate delintering operations in order to meet dust levels standards established for work areas by OSHA and EPA. Effects of residual linters on oil and protein yields in cottonseed oil milling of seed with 2, 4, 6, 8 and 11% residual linters to produce meal at 42 and 55%

protein were determined. Loss of oil and protein is greater in hulling-separation of high-linter seed than in solvent extraction. Second-stage hulling may be required at 8% linter levels and higher. Increased linters on hulls, when extracting 41% protein meal, improved solvent percolation in both shallow and deep-bed extraction, but did not affect residual oil in resulting meal. Removing linters to make high-protein meal caused reductions in percolation rate and increased residual oil content of meals processed in a deep-bed extractor, but not in shallow-bed extraction.

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PRODUCTION OF EDIBLE COTTONSEED FLOUR BY AIR CLASSIFICATION OF GLANDED COTTONSEED: COST ANALYSIS. K.M. Decossas, J.J. Spadaro, R.S. Kadan and G.M. Ziegler, Jr., Southern Regional Research Center, SEA, USDA, P.O. Box 19687, New Orleans, LA 70179.

An edible, 65% protein cottonseed flour prepared by air classification of milled flour from solvent-extracted glanded cottonseed has physical characteristics that make it attractive for use in food formulations. The product, which meets the free gossypol standards of both the Food and Drug Administration and the Protein Advisory Group of the United Nations System, can be produced from primary cottonseed kernels for as little as 11.2–15.7¢/lb. A flowsheet and material balance for the process are given, and hypothetical satellite plants are described for continuous production of 25 and 50 tons of flour daily. Capital investment costs, manufacturing costs, general expenses, and profitability are reported for the hypothetical plants for production of up to 35 million lb annually. The cost analysis substantiates the fact that the future for this process and its product is promising. The process is inexpensive and there are ready markets for the product.

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REVIEW OF GLANDLESS COTTONSEED PROCESSING AND UTILIZATION. E.W. Lusas, J.T. Lawhon, K.C. Rhee and R.G. Simmons, Food Protein Research and Development Center, Texas A & M University, FM Box 183, College Station, TX 77843.

Cottonseed is the world's second largest pool of high-quality plant protein. Enough protein is produced to meet dietary needs of approximately 300 million people, based on 65 gm/day intake. However, current commercial varieties of cottonseed contain gossypol, a green compound that is toxic to nonruminant animals and man. Commercial processes to detoxify gossypol by heat treatment result in appreciable reductions in protein quality. Only limited amounts of resulting meals are useable in swine, calf and poultry feeds. Heat-treated cottonseed flours have been withdrawn from the U.S. food ingredient market. Attempts to physically separate glands containing gossypol from flours by mechanical processes, or to extract gossypol by selective solvents, have had limited success; earlier commercial processes have been short-lived. An alternative to removal of gossypol from cottonseed of standard varieties is development of varieties that are genetically free of gossypol. The discovery of glandless cottonseed was announced in 1959, and research into its uses as human food has been conducted over 20 years. This paper will summarize the current status of glandless cottonseed development as a crop, including progress in solving earlier problems of fiber yield and quality. Research on glandless cottonseed and processing and utilization as human food as nut substitutes, flour, and protein concentrates and isolates will be reviewed. Previously unpublished processing research data will be presented. Experience of other countries in glandless cottonseed development will also be described.

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PREPARATION AND COMPOSITION OF A DRY MILLED FLOUR FROM COWPEAS. R.D. Phillips, Department of Food Science, University of Georgia Agricultural Experiment Station, Experiment, GA 30212.

Cowpeas having a smooth, brown, loosely adhering seedcoat (Mississippi Silver Hull Crowder) were milled to a flour by coarsely cracking the dry (12% H_2O) peas on a Morehouse Mill, aspirating the seedcoats on a peanut sheller, and reducing the cotyledon fraction to a flour by several passes through the Morehouse Mill. The flour was produced in 88% yield from the starting peas. The amino acid profile of the pea flour resembled that of soybeans and other legumes, being high in lysine and relatively low in cystine plus methionine.

Proximate Analysis

	Whole peas	Cotyledon fraction flour	Seed coat fraction
Water	12.9	13.1	12.7
Oil*	1.4	1.6	ND+
Crude Protein (NX6.25)*	24.9	25.8	10.9
Ash*	3.3	3.3	2.3
Acid Detergent Fiber*	9.8	4.2	50.7
Carbohydrate, by difference*	47.7	52.0	22

*Moisture free basis +Not determined

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INVESTIGATING SOLVENT RESIDUALS IN SOYBEAN MEAL AND SOLVENT CONTENT OF VENTED STREAMS. R.L. Chessin, Research Triangle Institute, P.O. Box 12194, Research Triangle Park, NC 27709.

The Research Triangle Institute investigated the potential technologies for controlling solvent emissions from the vegetable oil industry. Soybean mills exclusively were studied. Meal samples were collected at ten U.S. soybean plants. In addition, solvent recovery, dryer and cooler vents were sampled for solvent concentration at three of these plants. Plant parameters such as temperature and pressure were monitored prior to and during sampling. There appeared to be a weak association between overall solvent loss and solvent content in the meal. Monitoring plant parameters highlighted differences between plants, though showed little correlation with solvent losses. These test results contributed to the development of a model of solvent losses for the soybean industry.

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THE ART OF OILSEED MEAL SCREENING AND GRINDING. George R. Thomas, Prater Industries, Inc., 1515 S. 55th Court, Cicero, IL 60650.

The grinding and screening of oilseed meal and hulls may be considered an art rather than a pure science, due to the need to properly blend all of the parameters involved to produce the desired finished product. The grinding of oil seed meal as a protein supplement is best achieved by using a side-feed mill, with plenty of air thruput and a large screen area. However, for the fine grinding of soymeal or isolate products (50 mesh or finer), an impact turbo mill with closely controlled clearances is generally used. Oilseed hull grinding requires a mill with a high hammer tip speed, wear-resistant grinding elements, good air flow, and again, a large screen area. The size and speed (RPM) of each mill in the system, and the type of system selected to deliver the desired finished product. Since we know that approximately 30% of meal from the extraction plant is minus 10 mesh already, it is desirous to screen the meal ahead of grinding to remove these fine particles. Good screening practices before and after grinding, covering such items as bed depth, slope, amplitude and sizing, must be considered for good screening efficiencies.

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OUR EXPERIENCE IN PROCESSING MATERIALS WITH HIGH PERCENTAGES OF DUST SUCH AS CORN (MAIZE), RICE BRAN, SUNFLOWER CAKE. H.L.S. Staff, H.L.S. Ltd., POB 193, Petah Tikva, Israel.

Theoretical considerations concerning extraction. Types of extractors, importance of immersing and percolation. Factors that influence the extraction process, such as extraction time, moisture, drainage and temperature. Practical process consideration depending on the preparation of raw material, especially raw materials with dust. Description of the new TOM (turning over of the material) extractor where the material is inverted midway and dropped below. This inversion mixes the material and destroys the impermeable layer of the fines in the upper part of the material bed. Methods to reduce the solvent content in meal, for raw materials with high retention times, as corn germ and sunflowers. Possibility to use flash desolventizing separately or together with desolventizer-toaster. Actual operating results from factories.

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AFLATOXIN BIOSYNTHESIS: HOW IS IT REGULATED? J.W. Bennett, Department of Biology, Tulane University, New Orleans, LA 70118.

Aflatoxin B_1 is a C-17 compound derived through a polyketide pathway in which the general steps are acetate → anthraquinones → xanthones → aflatoxin B_1. ^{14}C-radiotracer studies have identified six compounds as aflatoxin precursors. These intermediates are norsolorinic acid, averantin, averufin, versiconal hemiacetal acetate, versicolorin A, and sterigmatocystin. All of these intermediates are substituted C-20 polyhydroxy-anthraquinones, with the exception of sterigmatocystin, which is a C-18 xanthone. Versicolorin A, sterigmatocystin, and aflatoxin B_1 all contain the biologically active difuran moiety. The genetic regulation of aflatoxins and other secondary metabolites is poorly understood. In this laboratory, control of aflatoxin biosynthesis has been studied using two classes of blocked mutants. One type of ultraviolet light-induced mutant accumulates detectable aflatoxin intermediates such as averantin and versicolorin A. The other class is produced by serial transfer of my-

celial macerates and produces no detectable polyketides. Resting cell cultures of both classes will convert sterigmatocystin to aflatoxin B_1. This indicates that the enzymes for the later steps of the aflatoxin pathway are regulated in a distinct way from the early enzymes.

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AFLATOXIN BIOSYNTHETIC PATHWAY: PREPARATION OF [^{14}C]-LABELED AFLATOXIN B_1, B_2, G_1, AND G_2. John C Floyd and J.W. Bennett, Tulane University, and L.S. Lee, USDA, SEA, SRRC, 1100 Robert E. Lee Blvd., P.O. Box 19687, New Orleans, LA 70179.

We compared two methods for preparing radiolabeled aflatoxins from [^{14}C]-acetate for use in biosynthetic studies at the end of the aflatoxin pathway; the Sahlab-Edwards (SE) method which uses a 3-day-old mycelium and a defined medium containing $MnCl_2$ with incubation at 27 C; and the Lee-Bennett (LB) method, which uses a 2-day-old mycelium and a defined medium containing low levels of Mn with incubation at 30 C. In general, the LB method produced lower quantities of aflatoxin but the product had higher specific activity. The SE method produced 0.157 μmol of aflatoxin B_1 and 0.28 μmol of G_1; the LB method produced 0.058 μmol of aflatoxin B_1 and 0.001 μmol of G_1. The specific activities (in Ci/mol) for aflatoxins produced by the LB method were B_1 = 2,241, B_2 = 0.156, G_1 = 5.00 and G_2 = 0.0625 by the LB method, and were B_1 = 0.256, B_2 = 0.100, G_1 = 2.545 and G_2 = 2.035 by the SE method. Preliminary evidence indicates that aflatoxin B_1 is not a precursor of the other major aflatoxins, B_2, G_1, and G_2. No incorporation of unlabeled aflatoxin B_1 into the other aflatoxins was observed in 24-, 48-, or 72-hr resting cell cultures. Feeding experiments utilizing unlabeled aflatoxin B_2 and G_1 produced aflatoxin B_1 and G_2.

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EFFECT OF β-IONONE ON *ASPERGILLUS PARASITICUS* GROWTH, SPORULATION, MORPHOLOGY AND AFLATOXIN PRODUCTION. D.M. Wilson, University of Georgia, Tifton, R.C. Gueldner, USDA-SEA-AR-SGIRL, Tifton, GA, and J.K. McKinney, R.H. Lievsay, B.D. Evans and R.A. Hill, University of Georgia, Tifton, GA 31793.

The ketone, β-ionone, is reported to be one of the naturally occurring volatile metabolites of developing corn ears. In testing the effects of volatile compounds on several *Aspergillus flavus* and *A. parasiticus* isolates, we found that β-ionone applied to the surface of PDA plates had a striking inhibition of growth and sporulation of these fungi. The colonies were restricted, remained buff colored and had little or no sporulation. There were major effects on the morphology of the asexual reproductive structures. The conidiophore development was arrested and normal sporulation did not occur. Mycelial transfers from these atypical cultures grown 3 days on PDA had normal conidia. Incorporation of β-ionone, at levels of 10-1000 μl/l, in liquid media seeded with spore suspensions of *A. parasiticus* (NRRL 2999), severely depressed aflatoxin accumulation after a 10-12 day growth period in shake culture.

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REDUCING AFLATOXIN CONTAMINATION IN PEANUT GENOTYPES BY SELECTION AND BREEDING. A.C. Mixon, P.O. Box 748, Coastal Plain Station, Tifton, GA 31793.

A laboratory screening procedure was developed for evaluating peanuts (*Arachis hypogaea* L.) for resistance to aflatoxin-producing strains of *Aspergillus* species. Results of screening within more than 3500 peanut accessions, lines and cultivars revealed the potential for breeding to reduce aflatoxin contamination in peanut cultivars. Resistant genotypes were identified. Studies revealed that factors associated with resistance to fungal colonization were contained in the seed testa; these included compactness and arrangement of the cell structure, lack of permeability to liquids, uniformity and completeness of waxy surface, the amount of tannins and total amino acid. Cross breeding was undertaken between resistant genotypes and higher yielding cultivars and/or breeding lines for selecting within successive generations. Breeding procedures produced several promising lines. In the 1979 laboratory tests, 41 of 155 of the advanced lines had less percentage seed colonization by aflatoxin-producing strains of *Aspergillus* species than the most resistant genotype, P.I. 337409, and one-fourth to one-half the percentage seed colonization expressed by commercial cultivars used as checks. Research for the past 4 years has shown that yield, market value and seed quality determinations for some lines bred for resistance are agronomically equal to that of commercial cultivars.

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EFFECT OF DROUGHT ON OCCURRENCE OF *ASPERGILLUS FLAVUS* IN MATURING PEANUTS. T.H. Sanders, R.A. Hill, R.J. Cole and P.D. Blankenship, National Peanut Research Laboratory, P.O. Box 637, Dawson, GA 31742.

Peanuts grown in experimental plots, with soil moisture controlled to give adequate moisture and drought-stress, were sampled biweekly from 100 days after planting until harvest at 144 days after planting. Maturity of individual pods was determined without destroying pod integrity and the nature and quantity of the microflora were subsequently assessed. Drought-stressed peanuts matured more slowly than those grown with adequate soil moisture. On peanuts with no visible damage to the pod or kernel, colonization by *Aspergillus flavus* was more frequent in immature than mature kernels. Drought-stress increased the incidence of *A. flavus* whereas irrigation decreased it, except when soil temperatures were modified. *A. Flavus* infestation was greatly increased at all maturity levels by pod damage.

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VARIABILITY IN CORN HYBRID RESISTANCE TO PREHARVEST AFLATOXIN CONTAMINATION. E.B. Lillehoj, USDA, SRRC, SEA, AR, 1100 Robert E. Lee Blvd., P.O. Box 19687, New Orleans, LA 70179, and M.S. Zuber, Dept. of Agronomy, University of Missouri.

A major constraint in evaluating corn hybrids for resistance to preharvest contamination of kernels by aflatoxin has been the unusual heterogeneity associated with the toxin distribution. A few kernels containing high levels of toxin are routinely responsible for contamination of large sample lots. Extraordinary heterogeneity is also observed in toxin occurrence between fields within a region and between large geographic areas. Edaphic and climatic differences have been linked to the initiation of plant stress during crop development; this process appears to render immature kernels susceptible to aflatoxin accumulation in a discontinuous manner. To reduce intrinsic variability and acquire definitive information on hybrid differences in susceptibility to contamination, several techniques have been developed including: (a) extension of the number of regional test sites, (b) expansion of the sample sizes, (c) increase of replication numbers, and (d) elevation of toxin levels in kernels by introduction of appropriate experimental treatments. Reduction of test variability has allowed for delineation of hybrid differences in aflatoxin resistance. A diallel set of genotypes has identified specific corn inbreds with heritable qualities of reduced aflatoxin levels in developing kernels. The results provide a basis for further characterization of genetic factors for resistance to the toxin-producing fungi.

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RELATIONSHIP BETWEEN BRIGHT GREENISH-YELLOW FLUORESCENCE AND AFLATOXIN CONTAMINATION IN YELLOW CORN MARKETED IN NORTH CAROLINA. J.W. Dickens and T.B. Whitaker, P.O. Box 5906, Raleigh, NC 27650.

During 1977 and 1978, a sample was collected from each of a total of 2,387 lots of corn that had recently been harvested from North Carolina farms. The average weight of the samples was approximately 4.5 kg. The percentage by weight of bright greenish-yellow fluorescent (BGY) kernels in each sample was determined by hand sorting the kernels under longwave ultraviolet light. After determination of the percent BGY kernels the entire sample was ground and analyzed for aflatoxin. The average aflatoxin concentration in the samples was 84 ppb. Aflatoxin was not detected in 42% of the samples. Regression analyses was performed on the data from the 1,373 samples in which aflatoxin was detected. The linear regression equation is: PPB AFLATOXIN = 199.5 (% BGY). The correlation coefficient is 0.90. Analysis of the data from the 2,387 lots indicate that % BGY can be an effective criteria for preliminary screening of lots of corn during marketing if the accept level of % BGY is properly selected for the desired control of aflatoxin. The authors conclude that the method should be used in conjunction with chemical tests to confirm the presence of aflatoxin in rejected lots.

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A STUDY OF VARIETAL AND ENVIRONMENTAL FACTORS IN RELATION TO PREHARVEST AFLATOXIN CONTAMINATION OF CORN GROWTH IN THE SOUTHEASTERN UNITED STATES. Leonard Stoloff, FDA, HFF-454, 200 C Street, SW, Washington, DC 20204, Eivend B. Lillejoh, Southern Regional Research Center, USDA, and Marcus A. Zuber, University of Missouri.

The area of the United States in which corn is most susceptible to aflatoxin contamination before harvest is also the area in which corn dry-milled products are a dietary staple, suggesting a possible epidemiological study of the aflatoxin lesion. The change that occurred in corn agronomics in that area, particularly in the corn varieties planted, midway in the life span of the population for which the necessary mortality statistics are available, introduces a question concerning the susceptibility to aflatoxin contamination of the corn grown in that earlier period. In developing an answer to that question, the possibility of finding a corn line resistant to invasion by aflatoxin-

producing molds can also be explored. The cooperative effort to these ends involved, in addition to the principal investigators, seven agricultural experiment stations at selected locations through the Southeast. At each of these stations four widely grown hybrids and eight open-pollinated varieties that were widely used in the region prior to the introduction of the hybrids were grown under simulated pre-1940 agronomic conditions. Plantings were made in 1979 and again in 1980. Hand-harvested ears were scored for insect damage and then thoroughly dried on site before transmission to the analyzing laboratory. Significant aflatoxin contamination was found in all varieties from all stations. At least one open-pollinated variety was statistically less susceptible to aflatoxin contamination than all the other varieties, but environmental factors overshadowed any varietal differences in relation to aflatoxin levels found.

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MECHANISMS OF THE INITIATION OF THE AUTOXIDATION OF SIMPLE ALKENES AND POLYUNSATURATED FATTY ACIDS (PUFA) BY NITROGEN DIOXIDE AND OZONE. William A. Pryor, John W. Lightsey, Donald G. Prier and Daniel F. Church, Department of Chemistry, Louisiana State University, Baton Rouge, LA 70803.

We have studied the reaction of nitrogen dioxide with cyclohexene at concentrations of nitrogen dioxide from 30% to 70 ppm in nitrogen, air and oxygen as carrier gases. At high concentrations, nitrogen dioxide adds to the double bond, as predicted from literature reports; the products are 1,2-dinitrocyclohexane and 1-nitro-2-cyclohexyl nitrite. However, at low ppm levels, nitrogen dioxide reacts with cyclohexene almost exclusively by allylic hydrogen abstraction: the products are typical autoxidation products in the presence of oxygen and primarily 2-cyclohexen-1-ol, 3-nitrocyclohexene and 2-cyclohexen-1-one oxime in its absence. We suggest that nitrogen dioxide addition is reversible; that is, if high concentrations of radical scavengers are not present, the initial addition step reverses and H-abstraction, which is not reversible, is the predominant process observed. Oxygen is not active enough to scavenge the adduct effectively, so H-abstraction is the principal reaction under environmental conditions of low ppm levels of nitrogen dioxide in air. We have verified most of these findings with PUFA esters, and also have shown that nitrogen dioxide acts as a simple free radical initiator in these cases. We have utilized spin traps to demonstrate that ozone reacts with simple olefins and methyl linoleate to produce radicals. Ozonation of the olefin at -78, blowing out unreacted ozone with nitrogen, addition of spin trap at -78, followed by warming gives the electron spin resonance (ESR) of spin adducts. Under various conditions we spin trap alkyl, alkoxyl, peroxyl and acyl radicals. The mechanism by which ozone reacts with olefins to give radicals is not obvious and is the subject of our continuing investigations.

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KINETICS AND ENERGETICS OF AUTOXIDATION OF LIPIDS. Michael G. Simic, Center for Radiation Research, National Bureau of Standards, C-216/Bldg. 245, Washington, DC 20234.

Kinetics and energetics of peroxy radical reactions with a variety of C-H and O-H bonds encountered in lipids and phenolic antioxidants has been evaluated. Resonance and cyclization may result in enormous weakening of C-H bonds from about 95 kcal found in normal saturated compounds to as low as 70 kcal. The kinetics of peroxy radical reactions with corresponding C-H and O-H bonds has been evaluated by pulse radiolysis and found to be critically dependent on the bond energy. Rate constants as high as 10^8 - 10^9 $M^{-1}s^{-1}$ have been measured. Implication of these factors to autoxidation of lipids will be discussed.

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THE FREE RADICAL OXIDATION OF ARACHIDONIC ACID. Ned A. Porter, Karl J. Smith and Laura S. Lehman, Paul M. Gross Chemical Laboratories, Duke University, Durham, NC 27706.

The conversion of the homoconjugated diene structural unit, R-CH=CH-CH_2-CH-CH-R, *1*, to pentadienyl hydroperoxides, R-CH=CH-CH=CH-OOH/CH-R, *2*, is of biological importance. Lipoxygenase enzymes that catalyze this conversion of fatty acids to lipid hydroperoxides are present in blood platelets and leukocytes. Lipid hydroperoxides such as *2* are also formed in random autoxidation of fatty acids; this process is also of interest. We have developed analytical methods that allow us to thoroughly examine the mechanism of the free radical oxidation of arachidonic acid (20:4). Co-oxidation of linoleic acid and arachidonic acid in solutions containing good hydrogen atom donors, followed by careful product analysis, leads to the conclusion that peroxy radical cyclization and β scission is an important pathway in lipid oxidation. The hydrogen atom donating ability of different sites on arachidonic acid (C-7, C-10 and C-13) are measured relative to H atom abstraction from C-11 of linoleic acid. Furthermore, rates of cyclization of arachidonic peroxy radicals at C-8, C-9, C-11 and C-12 may be obtained. The structure of cyclization products will also be discussed with reference to mechanism and stereochemistry.

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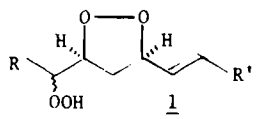
STRUCTURE AND STEREOCHEMISTRY OF NOVEL ENDOPEROXIDES ISOLATED FROM THE SENSITIZED PHOTOOXIDATION OF METHYL LINOLEATE. E.D. Mihelich, The Procter & Gamble Company, Miami Valley Laboratories, P.O. Box 39175, Cincinnati, OH 45247.

Four isomeric diene monohydroperoxides are known to be the primary photosensitized oxidation products of methyl linoleate, but little is known of the more polar materials generated in this reaction. We have isolated and fully characterized a number of these materials and found a remarkable stereoselection operative in their formation. In particular, 1,2-dioxolanes *1* are formed mainly as the *cis*-isomers (19:1 selectivity) and the epoxy alcohol *2* has been demonstrated to be predominantly of the relative configuration shown. The structure proofs and mechanisms of formation of these and other photooxidation by-products will be discussed.



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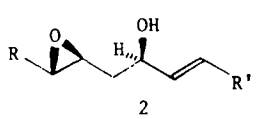

2

R = $(CH_2)_7CO_2CH_3$, R' = $(CH_2)_3CH_3$ and

R = $(CH_2)_4CH_3$, R' = $(CH_2)_6CO_2CH_3$

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SECONDARY OXIDATION PRODUCTS OF AUTOXIDIZED METHYL LINOLENATE AND PHOTOSENSITIZED OXIDIZED METHYL LINOLEATE. HYDROPEROXY-CYCLIC PEROXIDES AND DIHYDROPEROXIDES. W.E. Neff, E.N. Frankel and D. Weisleder, Northern Regional Research Center, 1815 North University, Peoria, IL 61604.

Secondary oxidation of hydroperoxides produces a complex mixture of volatile and nonvolatile compounds that may contribute either directly or as precursors to flavor deterioration in unsaturated fats. Nonvolatile secondary oxidation products have been separated by HPLC and identified by IR, UV, NMR and MS. From autoxidized methyl linolenate, 9-hydroperoxy-10,12-peroxy-*trans,cis/trans,trans*-13,15-octadecadienoate and 16-hydroperoxy-13,15-peroxy-*cis,trans/trans,trans*-9,11-octadecadienoate were isolated as major secondary products, and dihydroperoxides (9-13,12-16-isomers) as minor products. From photosensitized oxidized methyl linoleate, 9-hydroperoxy-10,12-peroxy-*trans*-13-octadecenoate and 13-hydroperoxy-10,12-peroxy-*trans*-9-octadecenoate were isolated as major secondary products, and dihydroperoxides (9-13,10-13-isomers) as minor products. Cyclization of the internal hydroperoxides of linolenate (12- and 13-isomers) and of linoleate (10- and 12-isomers) would account for their lower relative concentrations than the external hydroperoxides (9- and 16-isomers in linolenate, 9- and 13-isomers in linoleate). These secondary oxidation products may not only serve as sources of flavor deterioration in edible fats but also may be involved in biological lipid oxidation.

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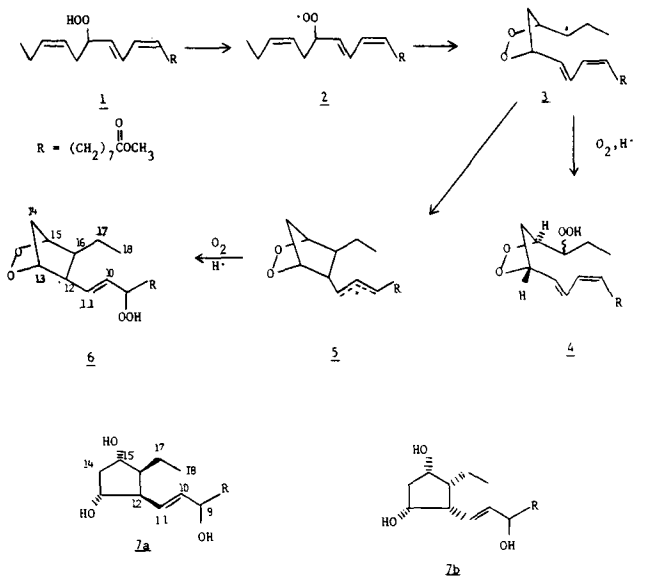
ISOLATION AND CHARACTERIZATION OF BICYCLOENDOPEROXIDES DERIVED FROM METHYL LINOLENATE. David E. O'Connor, Edward D. Mihelich and Milton C. Coleman, The Procter & Gamble Company, Miami Valley Laboratories, P.O. Box 39175, Cincinnati, OH 45247.

The autoxidation of triunsaturated fatty acids is known to form small amounts of prostaglandins and their close structural analogs, presumably by a sequence analogous to that shown in the scheme (1→2→3→5→6→). However, little is known about the stereochemistry of this process. We have investigated this reaction using as a model the autoxidation of methyl 13-hydroperoxy-*cis*-9-trans-11-*cis*-15-octandecatrienoate, which gives *cis*-substituted-1,2-dioxolanes (monocyclic peroxides) and bicycloendoperoxides. The bicycloendoperoxide fraction contains only two major isomers (*6a* and *6b*) whose structures and those of their corresponding triols (*7a* and *7b*) were established. There is significant selectivity in this reaction favoring the formation of bicycloendoperoxides having *cis* substituents; the natural prostaglandin stereochemistry is disfavored.



108

WETTING PROPERTIES OF NONIONIC SURFACTANTS OF HOMOGENEOUS STRUCTURE, $C_{12}H_{25}$ $(OC_2H_4)_xOH$. Anna W. Cohen and Milton J. Rosen,* Department of Chemistry, Brooklyn College of CUNY, Bedford Avenue and Avenue H, Brooklyn, NY 11210.

The wetting of cotton skeins by aqueous solutions of surfactants of structure, $C_{12}H_{25}(OC_2H_4)_xOH$, with homogeneous hydrophilic head groups, where x = 4-8, has been measured at various temperatures by means of the Draves technique. Log-log plots of wetting time vs concentration of the surfactant show the usual linear relationship in certain concentration ranges and illustrate the effect of change on the number of oxyethylene units. Using Fowkes' equation and assumptions, diffusion constants for these compounds have been calculated from wetting and surface tension data. The implications of these calculations are discussed.

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EXAMINATION OF PARAMETERS GOVERNING INTERFACIAL TENSION IN DETERGENCY. K.W. Dillan and G.C. Johnson, Union Carbide Corporation, Old Saw Mill River Road, Tarrytown, NY 10591.

Previously reported model detergency results have shown that the oil/water interfacial tension is a critical factor in oil-removal processes. Consequently, the current studies are concerned with the parameters affecting the oil/water interfacial tension between nonionic surfactant solutions and common oils. The effects of triethanolamine on interfacial tension are extensively described, with particular emphasis on fatty acid-containing oils. In the absence of strong electrolytes, addition of triethanolamine to a nonionic surfactant solution increases the initial interfacial tension, and a subsequent slow decrease is observed over several hours. However, in the presence of strong electrolytes, addition of triethanolamine to a nonionic surfactant solution results in a very low interfacial tension that subsequently increases with time. Electrolyte valence and concentration also markedly affect interfacial tension, as do surfactant concentration and structure, and fatty acid concentration and structure. Explanation of the experimental results is provided, and the implications of the findings in practical laundering systems are discussed. The effects of surfactant concentration and structure on oil/water interfacial tension are reported for nonpolar oils. A notable time dependence is observed with many commercial products even at relatively high use concentrations. A significant concentration dependence is also seen for most of these products, even at concentrations well above the cmc. The implications of these and other findings are discussed.

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SURVEY OF THE PHYSICAL AND ANALYTICAL TECHNIQUES USED IN DETERGENCY. Ramon A. Llenado, Procter & Gamble.

This paper surveys the modern tools available to study detergency and to aid in improving existing detergent products or in creating new ones. The aim is to show, by examples, the criticality of new scientific instruments to effectively manage the overall product development effort in the light of current competitive and regulatory climate. Examples described will include the study of surfactants, builders, enzymes, fluorescers, bleach and so on by such modern and diverse techniques as ion selective membrane potentiometry, gas chromatography, mass spectrometry, high performance liquid chromatography, inductively coupled plasma emission/absorption spectrophotometry, multinuclear magnetic resonance spectrometry, X-ray fluorescence and X-ray Diffraction. The content of the talk will be general and practical in scope and the text geared towards achieving a broad overview of the subject.

*Presenting author

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DETERGENCY OF ALCOHOL ETHOXYLATES IN HEAVY DUTY LAUNDRY POWDERS CONTAINING ZEOLITE AS A BUILDER. L. Kravetz and H. Stupel, Shell Development Co.

The detergency of alcohol ethoxylates incorporated into household laundry powders containing Zeolite A as builder has been studied using radiolabeled multisebum-clay soil removal as the criterion for detergency performance. Alcohol ethoxylates containing alkyl chain lengths ranging from 12-15 and average polyoxyethylene chain lengths ranging from 7-13 were found to perform best with Zeolite A. During a 10-min wash cycle, the detergencies of formulatd composite powders containing alcohol ethoxylates, Zeolite A and sodium silicate were essentially equivalent to those obtained from corresponding formulation ingredients added in-situ to washwater. Zeolite A, sodium tripolyphosphate, carbonate and sodium nitrilotriacetic acid builders formulated with alcohol ethoxylates and sodium silicate provided essentially equivalent detergency performance. The alcohol ethoxylates outperformed linear alkylbenzene sulfonates in all builder systems studied, particularly in Zeolite A-Silicate systems at relatively high water hardness levels.

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TYPE A ZEOLITE AS A DETERGENT BUILDER. Melvin E. Tuvell, Joseph H. Miller and Patrick C. Hu*, Ethyl Corporation.

The objective of this study is to provide a guide for initial formulation work directed at using type A zeolite as a builder for powdered detergents. The fundamental properties of type A zeolite which relate to its effectiveness as a builder were evaluated. The effectiveness of water hardness reduction by type A zeolite was studied as a function of initial water hardness level, temperature, type of water hardness ion (Ca^{++}, MG^{++} and Ca^{++}/mg^{++} mixtures), competition by other cations (Na^+, K^+ and NH^+), and solution pH. Water hardness reduction achieved using combinations of zeolite with other sequestering agents (STPP, TSPP, NTA, and Na Citrate) was also examined and correlated with results of tergotometer evaluations of detergency using artificially soiled fabrics. The results showed that the binding of Ca^{++} by zeolite A was stronger than that of STPP. Also, best results were obtained using a builder system containing sequestering agents in combination with zeolite A. The effect of sodium silicate on forming agglomerated zeolite particles in the wash solution as well as during the crutcher operation was also studied. Data indicated that large amounts of zeolite agglomerates were formed during the crutcher operation after prolonged contact with sodium silicate. Zeolite agglomerate formation in the wash operation was found to be independent of sodium silicate content of the wash powder. A brief discussion on the processability of powdered type A zeolite in dry blending and agglomeration detergent manufacturing processes is also included.

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NEW CARBOXYLATED SURFACTANTS—AN APPROACH TO FORMULATION. K. Schoene, M. Esposito,* M. Naima and H. Wolf, Sandoz Co., Colors and Chemicals Division, Route 10, East Hanover, NJ 07936.

The increasing need for specially tailored surfactants for the changing needs of detergent and cleaning products marketers continuously challenges surfactant manufacturers. The days of helter-skelter "new products" are yielding to more sophisticated approaches to molecular design with specific emphasis on the needs of the formulator. A new series of alkyl alkoxylated methyl carboxylated surfactants, derived via state-of-the-art computer technology, has been prepared. The significant physiochemical properties have been determined and these data have been further modelled into a predictive tool. These unique carboxylates already show combinations of properties novel to the class; future generations, cybernetically created as functions of desired property mixes, can bring the concept of tailored surfactants into the formulator's hands.

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Not available at press time.

115

Not available at press time.

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FATTY CHEMICAL ECONOMICS FOR THE 1980s. E.C. Leonard, Humko Chemical, Box 125, Memphis, TN 38101.

The paper will deal briefly with some myths about fatty chemical economics in the 1970s and describe some possible economic scenarios for various fatty chemicals in the 1980s.

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REACTION OF ACTIVE OXYGEN SPECIES WITH METHYL OLEATE AND ALKYL HALIDES. T.A. Foglia, P.A. Colfer and Y. Nakano, USDA, SEA, Eastern Regional Research Center, 600 East Mermaid Lane, Philadelphia, PA 19118.

Singlet oxygen ($^1O_2$) and superoxide anion (O_2^-), two active oxygen species, react with organic molecules via differing pathways. The chemical reactions of singlet oxygen—a transient excited state of oxygen—are generally of the electrophilic type, whereas superoxide anion—a unique anion radical—undergoes reactions that are classified as either nucleophilic, radical or redox. We have studied the reaction of singlet oxygen with methyl oleate in solution. Singlet oxygen, which was generated photochemically by use of a photosensitizer, reacted with the double bond of methyl oleate to yield an allylic hydroperoxide. The rate of formation and yields of hydroperoxides were studied as functions of the photosensitizer used. The use of a phase transfer catalyst to solubilize the photosensitizer enhanced the photochemical efficiency of this photooxidation reaction. The reactions of superoxide anion with alkyl halides were studied with potassium superoxide (KO_2) used as the source of superoxide anion. The major product formed in this reaction was the symmetrical dialkyl peroxide together with lesser amounts of the alcohol derived from the alkyl halide. The use of a phase transfer catalyst to solubilize the inorganic KO_2 into organic solvents dramatically increased the rate of reaction and yield of reaction products. Reaction pathways accounting for the products of this reaction will be described.

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HYDROSILYLATION OF METHYL OLEATE. W.R. Miller, E.H. Pryde and E.N. Frankel, Northern Regional Research Center, 1815 North University, Peoria, IL 61604.

There are few examples of successful hydrosilylation of internal unactivated olefins such as methyl oleate. This paper is an extension of previous work in which methyl oleate was hydrosilylated with highly reactive chlorosilanes. Development of a reproducible GLC analysis of chlorosilane products, based on replacement of chlorine with methoxyl and stabilized with dimethoxypropane, permitted more detailed examination of the product of hydrosilylation of methyl oleate with dichloromethylsilane. This product was a complex mixture with at least three major components, which were partially separated by distillation and crystallization. Reaction of the product with methanol, butanol, and acetic anhydride gave similar complex mixtures. Less reactive hydrosilylation products were sought through use of trimethoxy-, triethyl-, and triethoxysilane. Triethoxysilane was used to screen seventeen potential hydrosilylation catalysts. None gave a satisfactory yield of isolatable product with methyl oleate under conditions used. GLC analyses of the reaction mixtures indicated that eight platinum and rhodium catalysts had some promise. Methylbis(trimethylsiloxy)silane, with chloroplatinic acid catalyst, gave a hydrosilylation product in about 40% yield, which was isolated by fractional distillation.

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METHANESULFONIC ACID CATALYZED ADDITION OF AROMATIC COMPOUNDS TO OLEIC ACID. Y. Nakano and T.A. Foglia, USDA, SEA, Eastern Regional Research Center, 600 East Mermaid Lane, Philadelphia, PA 19118.

The addition of aromatic compounds to the double bond of oleic acid has been studied with methanesulfonic acid used as the catalyst. The addition reaction was investigated over a range of molar ratios of oleic acid to reactants and to acid catalysts. Best yields of addition products were obtained when the molar ratio of aromatic compound to oleic acid used was 5:1 and that of methanesulfonic acid to oleic acid ratio was 6:1. For example, when toluene was allowed to react with oleic acid under the above reaction conditions, the yield of addition products was 71%, whereas with benzene as the aromatic reactant, the yield of addition products decreased to 46%. In both examples the major side-products formed were the γ- and δ-stearolactones in 18% and 32% yield, respectively. The addition of phenol to oleic acid resulted in two types of addition products, an ether type product and a ring-substituted product. The ratio of the two addition products varied with the amount of methanesulfonic acid employed as catalyst. At a low molar ratio of methanesulfonic acid to oleic acid, such as 0.5:1, the ether type addition product was favored (41%:13% at 80% conversion), whereas at a high molar ratio (6.0:1.0), the ring-substituted products predominated (88%:2% at 98% conversion).

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SYNTHESIS AND PROPERTIES OF FATTY IMIDAZOLINES AND THEIR N-(AMINOETHYL) DERIVATIVES. R.G. Bistline, Jr., J.W. Hampson and W.M. Linfield, USDA, SEA, Eastern Regional Research Center, 600 East Mermaid Lane, Philadelphia, PA 19118.

Cationic high-molecular-weight surfactants were investigated because they hold promise as water repellents for soil. Specifically, the products of the reaction of two moles of fatty acids with one mole of diethylenetriamine were prepared. Optimum conditions for the formation of imidazolines as well as the open chain N-(aminoethyl) derivatives were determined. Saturated fatty acids, pelargonic through behenic, oleic acid, elaidic acid as well as tallow fatty acids and hydrogenated tallow fatty acids, were derivatized. The fatty imidazolines were formed in 6 hr at 150 C under reduced pressure in 92% yield. The crude imidazolines, which are hard waxes, were crystallized from acetone, giving pure crystalline products with sharp melting points. The fatty imidazolines were readily hydrolyzed at the -C=N- bond of the imidazoline ring with water or dilute alcohol. The resulting primary amines, $RCON(CH_2CH_2NH_2)CH_2CH_2NHCOR$, were readily purified by crystallization from alcohol. Water repellency of these compounds was evaluated by contact angle measurements. Saturated fatty imidazolines with a chain length of C_{16} or above gave contact angles greater than 90°. The N-(aminoethyl) derivatives gave higher contact angles than the corresponding fatty imidazolines. The imidazoline derived from elaidic acid gave a contact angle of 55°, and that from oleic acid gave an angle of 0°. The N-(aminoethyl) derivative of oleic acid gave a contact angle of 89°.

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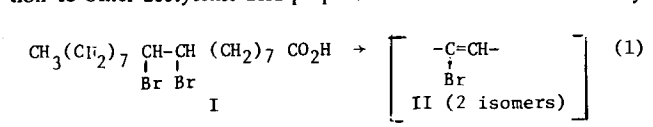
FACILE DEHYDROHALOGENATION OF *vic*-DIBROMO FATTY ACIDS: PREPARATION OF STEAROLIC ACID AND RELATED ACIDS. L.S. Silbert, Eastern Regional Research Center, U.S. Department of Agriculture, 600 East Mermaid Lane, Philadelphia, PA 19118.

Stearolic (9-octadecynoic) acid and analogous acetylenic acids are obtained in poor yields (<50%) and long reaction time (8–12 hr) by current methods of base dehydrohalogenation of the appropriate dibromoacids. The reaction shown for preparing stearolic acid from 9,10-dibromostearic acid (I) proceeds in two stages to give the initial mixture of 9- and 10-bromo-9-octadecenoic acid (II, eq. 1) followed by formation of stearolic acid (III, eq. 2). The alcoholic-potassium hydroxide method has been studied again and dimethyl sulfoxide (DMSO) has been found to be an effective cosolvent-catalyst in *n*-propanol-KOH solution. In the absence of DMSO, the first step is quantitative in less than 10 min at 60°; the second step is quantitative in about 6 hr at 100°. In the presence of DMSO, the second step is completed at 100° in 1–2 hr, the rate depending upon DMSO concentration. A one-pot oleic acid bromination-dehydrobromination has been devised to give the stearolic acid (98% purity of crude product) in 98% yield within 3 hr. Extension of the DMSO catalyzed reaction to other acetylenic acid preparations will be discussed briefly.



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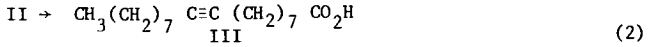

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PRODUCTION OF BRANCHED CHAIN FATTY ACIDS FROM STERCULIA OIL. Yoshinori Kai, Nishin Oil Mills, Ltd., and Everett H. Pryde, Northern Regional Research Center, 1815 North University, Peoria, IL 61604.

Methyl-substituted, branched-chain fatty acids were produced from sterculia oil. Methyl sterculate (sterculic acid, 53.9%; malvalic acid, 6.7%), which was produced from sterculia oil by transesterification, was rearranged to isomeric-conjugated diene fatty acid methyl esters containing both methylene- and methyl-branched isomers by 0.5% of rhodium catalyst. The rearranged products were hydrogenated to saturated methyl-substituted, branched-chain fatty acid methyl esters directly from the rearrangement reaction mixture. It was confirmed that the cyclopropenoid ring was almost quantitatively converted into the methyl group substituted in the position of the cyclopropenoid ring by these procedures. The crude, branched-chain fatty acids from these esters were purified by recrystallization with mixed solvent of ethanol and water (80/20, v/v) and flash distillation; the product contained about 90% of branched-chain fatty acids. (C_{19}:80%, C_{18}:10%). In addition, the esters of the branched-chain fatty acid with 2-ethylhexyl alcohol or trimethylolpropane were produced, and the characteristic properties of these esters were investigated. The branched-chain fatty esters appear to have potential use in lubricants; other uses may also be possible.

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PRODUCTION OF Δ^{23}-,$\Delta^{24(28)}$ and Δ^{25}-STEROL INTERMEDIATES BY *Zea mays*. L. John Goad, Neil Misso and Marie Zakelj, Department of Biochemistry, University of Liverpool, P.O. Box 147, Liverpool, L69 3BX, U.K.

The prime route to the phytosterols proceeds with a transmethylation reaction which uses S-adenosylmethionine (SAM) as the methyl donor and results in the production of a 24-methylene intermediate. This then undergoes either reduction to give a 24-methyl sterol or acts as a substrate for a second transmethylation from SAM to produce a precursor of the typical C_{29} phytosterols. Alternative routes involving either 25-methylene- or Δ^{23}-sterols have now been implicated by the identification of such compounds in higher plants. We have investigated the participation of Δ^{25}- and Δ^{23}-sterols in sterol elaboration in seedlings of *Zea mays*. The results of in vivo incorporations of [2-^{14}C] mevalonic acid and [2-^{14}C,4*R*-4-$^{3}H_1$] mevalonic acid into sterols by *Zea mays* will be described. The use of a cell free homogenate to produce Δ^{23},$\Delta^{24(28)}$ and Δ^{25}-sterols from cycloartenol and SAM will also be discussed.

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STEREOCHEMISTRY OF THE 24-ALKYL GROUP OF STEROLS IN PRIMITIVE PLANTS. Pei-Lu Chiu and Glenn W. Patterson, University of Maryland, Department of Botany, College Park, MD 20742.

The stereochemistry of the 24-alkyl group in 24-methylcholesterol, 24-ethylcholesterol and 24-ethyl-5,22-cholestadienol in 24 species of primitive plants, including 1 lichen, 7 bryophytes and 16 primitive vascular plants, was determined by using 220 MHz NMR spectroscopy. The 24-methylcholesterol in bryophytes and primitive vascular plants was composed of mixtures of both α- and β-epimers. The 24-ethylcholesterol existed as α-epimer in most of the primitive plants except as mixtures of α- and β-epimers in some of the bryophytes, such as *Marchantia, Mastigophora* and *Sphagnum*. The α-epimer of the 24-ethyl-5,22-cholestadienol was found to be in a pure form in all the bryophytes and vascular plants studied here. In the lichen, only the β-epimers of three sterols were detected.

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THE QUANTITATIVE ANALYSIS OF PLANT STEROLS. B.A. Knights, Botany Department, The University of Glasgow, Glasgow G12 8QQ, Scotland.

A wide range of sterols occur in plants, and various reports suggest that the structures of these compounds affect their interactions in membranes. In order to assess their function better, reliable methods for the quantitative analysis of plant sterols are necessary; two will be discussed. The first applies to those mixtures that contain cholesterol, and involves the addition of an aliquot of radioactive sterol. Sterols are recovered by TLC and analyzed by GLC of the TMS ethers after the addition of n-octacosane as internal standard. Recoveries are assessed by the counting of radioactivity in aliquots prior to GLC. The second method, which applies to those mixtures not containing cholesterol, involves the addition of cholesterol to the crude extract at the rate of 1 mg/g of dry tissue analyzed. This serves as the control for both recovery during isolation and for GLC. Examples will be cited.

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THE UTILIZATION AND METABOLISM OF DIETARY STEROLS IN THE HONEY BEE AND THE YELLOW FEVER MOSQUITO. J.A. Svoboda and M.J. Thompson, Insect Physiology Laboratory, Plant Protection Institute, Bldg. 467, Beltsville, MD 20705, and E.W. Herbert, Jr., USDA, Bioenvironmental Bee Lab.

In earlier studies we demonstrated that the honey bee, *Apis mellifera*, does not convert C_{28} and C_{29} phytosterols to cholesterol as might be expected, but instead the workers and queens selectively transfer 24-methylenecholesterol, sitosterol, and isofucosterol from their endogenous sterol pools to the brood larvae, regardless of the dietary sterol. Recent studies, which included administering radiolabeled sterols by feeding and injection, have made it possible to trace this selective transfer through a second generation of the honey bee. In further comparative sterol metabolism studies, preliminary results indicate that the yellow fever mosquito, *Aedes aegypti*, is the first dipterous insect definitely shown to be capable of dealkylating and converting a radiolabeled C_{29} dietary sterol to cholesterol. Results of metabolic studies with dietary sterols and effects of an inhibitor of steroid metabolism in the yellow fever mosquito will be discussed.

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THE METABOLISM OF PHYTOSTEROLS IN *Tenebrio molitor*, F. Nicotra, F. Ronchetti, G. Russo* and L. Toma, University of Milan, Istituto Chimica Organica Fac. Scienze, Via Saldini 50, 20133 Milano, Italy.

Phytophagous insects are able to convert dietary phytosterols into cholesterol through a dealkylation process. We have studied this process in *Tenebrio molitor* and, as far as C-29 phytosterols are concerned, we have found that this insect transforms the C-29 phytosterol, β-sitosterol, into both the 24(28)-ethylidene geometrical isomers, fucosterol (E) and isofucosterol (Z). An analogous lack of stereospecificity is shown by the insect in the metabolsim of the fucosterol-(24,28)-epoxides, which are utilized to about the same extent. A better substrate stereospecificity is shown in the case of the epoxides of isofucosterol, the (24R,28S)-epoxide being utilized ca. ten times better than the (24S,28R)-isomer.

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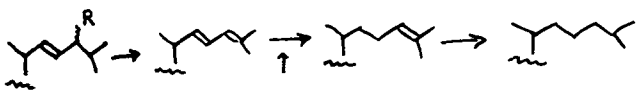
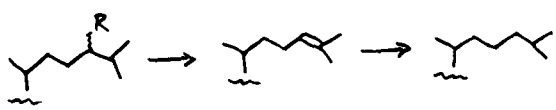
RESPONSE OF *Drosophila* SPECIES TO DIETARY *CIS*- AND *TRANS*-22-DEHYDROCHOLESTEROL. Henry W. Kircher, James Fogleman, Rebecca Phariss, David Baldwin and Fumiko U. Rosenstein, 309 Agricultural Sciences Bldg., Dept. of Nutrition and Food Science, The Univeristy of Arizona, Tucson, AZ 85721.

Species of *Drosophila* vary in their response to *cis*- and *trans*-22-dehydrocholesterol sterols. Some were able to mature from egg to adult with 0.25% (dry wt basis) of either sterol added to a standard medium, others were unable to mature in the presence of the *trans* derivative but were unaffected by the *cis*, and still others were affected by both. Three species were selected for a more detailed study. Sterol deficient diets were supplemented with various combinations of *cis*- and *trans*-22-dehydrocholesterol, cholesterol and Δ^5, $\Delta^{5,22}$ and $\Delta^{5,7,22}$ derivatives in the 3β-hydroxy ergostane and stigmastane series for experiments under axenic conditions. Surface sterilized eggs were placed on various media and where possible, two generations of *Drosophila* were reared successively on the same medium. The results so far suggest that *trans*-22-hydrocholesterol is an inhibitor of the Δ^{22} double bond present in brassicasterol, ergosterol, stigmasterol and 7-dehydrostigmasterol during the biological conversion of these sterols to cholesterol by *Drosophila*.



inhibited by trans-
22-dehydrocholesterol

The dealkylation of dihydrobrassicasterol and sitosterol are unaffected by the *trans*-derivative, and the presence of cholesterol in the medium renders *trans*-22-dehydrocholesterol innocuous. The presumed inhibition of Δ^{22}-reduction does not occur with *cis*-22-dehydrocholesterol.



129

ECDYSONE IN THE BLOWFLY: TRANSPORT AND METABOLISM. Jan Koolman, Physiol.-chem.Institut, Universität Marburg, Deutschhausstr. 1-2, D-3550 Marburg, West Germany.

Steroid hormones are generally transported in the blood by carrier proteins. Whether this also holds true for insects is still an open question. The molting hormone ecdysone, when secreted into the haemolymph of blowfly larvae, is bound with low affinity to the major protein of the larval blood, calliphorin. This was observed by photoaffinity-labeling, a method by which protein-bound ecdysone was covalently linked to the protein. Using an ecdysone-specific immunoadsorbent, calliphorin crosslinked to ecdysone was isolated. In the fat-body, which in insects is the equivalent of the liver, ecdysone is hydroxylated to 20-hydroxyecdysone. This steroid is regarded as the active form of the molting hormone. Inactivation of steroid hormones in vertebrates primarily involves reduction of the 4-en-3-oxo configuration in ring A. Ecdysteroids have a similar structure in ring B; however, no reduction of this structure was observed. Inactivation of the molting hormone includes 26-hydroxylation and formation of highly polar catabolites, some of which are sulfate esters. In pupae catabolism of 20-hydroxyecdysone also includes epimerization of the hydroxyl in position 3. This reaction, which is unique for insects, is catalyzed by the cooperative action of an ecdysone oxidase and a 3-ketoreductase.

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DIETARY MODIFICATION OF LINOLEIC ACID:ARACHIDONIC

ACID RATIOS IN MICE. Luke A. Pallansch, Joseph Sampugna and Mark Keeney, Department of Chemistry, University of Maryland, College Park, MD 20742.

In our continuing study of the metabolic fate and biological effects of dietary *trans* fatty acids, we have compared the effect of experimental and control diets (10% fat) on the fatty acid composition of liver lipids isolated from mice (C57BL/6J) during development and aging. The fat in the experimental diet consisted of partially hydrogenated corn oil from margarine and contained 25% of the total fatty acids as *trans* octadecenoates. To mimic the fatty acid composition of the experimental diet (except that *cis* monoene replaced *trans* fatty acids), the fat in the control diet was blended from corn oil, olive oil and cocoa butter. The incorporation of *trans* octadecenoate isomers in total lipid of liver isolated from mice reared on the experimental diet was lowest at birth (1.9%), highest at 7 days (5.3%) and relatively constant (3.3%) from 3 months of age to the oldest age examined (1.5 years). During development, the 18:2/20:4 ratio in liver lipid of mice fed the experimental diet increased from 0.7 to 1.6 and was always higher than that of animals fed the control diet. The results suggest that some component(s) in the margarine diet (perhaps the *trans* fatty acids) may be affecting the conversion of linoleic acid to arachidonic acid in the experimental animals.

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POSITIONAL SPECIFICITY OF *TRANS* FATTY ACIDS IN FETAL LECITHINS. Carolyn E. Moore, Program in Nutrition and Dietetics, School of Allied Health Sciences, UT Health Science Center at Houston, P.O. Box 20036, Houston, TX 77025, and Govind A. Dhopeshwarkar, University of California at Los Angeles.

Differences in the positional incorporation of 9-*trans* ($1\text{-}^{14}C$) octadecenoic (elaidic) and 9-*trans*, 12-*trans* ($1\text{-}^{14}C$) octadecadienoic (linoelaidic) acids in fetal lecithin of rats were demonstrated. On the 20th day of gestation, a ^{14}C-labeled albumin complex of elaidic or linoelaidic acid was injected into the jugular vein of pregnant rats. For comparative purposes, 9-*cis* ($1\text{-}^{14}C$) octadecenoic (oleic) or 9-*cis*, 12-*cis* ($1\text{-}^{14}C$) octadecadienoic (linoleic) acid was injected into the maternal circulation of rats. Animals were killed 6 hr later. Distribution of label in total lipids and phospolipids (PL) of fetal tissue was measured by TLC. Irrespective of the label, the highest percentage of total radioactivity was associated with PL, 59--67%. Within PL, the major portion of radioactivity was found in choline phosphoglycerides (CPG), 53–67%, and in ethanolamine phosphoglycerides (EPG), 18--33%. Whereas linoelaidic acid was predominantly esterified in the 2 position of CPG, elaidic acid was nearly equally distributed between positions 1 and 2 of lecithin. Distribution of radioactivity within fatty acid methyl esters (FAMES) of CPG measured by radio-GLC suggested that oleic and possibly linoleic acids may be converted to nervonic and arachidonic acid, respectively, in the rat by the 20th day of gestation. Following injection of elaidate, radioactivity of FAMES was distributed between palmitate and elaidic acid, indicating that rat fetal tissue may metabolize elaidic acid via β oxidation. In contrast, following injection of linoelaidiate, radioactivity of FAMES was primarily associated with *tt*-18:2, suggesting little biotransformation to other fatty acids by fetal tissues.

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FATE OF DIETARY *CIS*- AND *TRANS*-13-OCTADECENOIC ACIDS IN HUMAN PLASMA LIPIDS. E.A. Emken, R.O. Adlof and W.K. Rohwedder, Northern Regional Research Center, 1815 North University Street, Peoria, IL 61604, and R.M. Gulley, St. Francis Hospital-Medical Center.

The absorption and distribution of deuterated *cis*- and *trans*-13-octadecenoic acid (13*c*-18:1 and 13*t*-18:1) were compared to deuterated *cis*-9-octadecenoic acid (9*c*-18:1) in two young adult male subjects. A mixture of the triglycerides of these three fatty acids was fed in a multiple-labeled experiment that used fatty acids, each containing a different number of deuterium labels to allow mass spectroscopic analysis. This approach allowed the distribution of the two 13-octadecenoic acid isomers to be directly compared to *cis*-9-octadecenoic acid. Chylomicron triglyceride data indicated all three fatty acids are equally well absorbed. Plasma data showed that discrimination against incorporation of both the 13*c*-18:1 and 13*t*-18:1 isomers occurred in all neutral and phospholipid fractions. Discrimination against incorporation of the 13*t*-18:1 isomer into plasma cholesteryl ester and 2-acyl phosphatidylcholine was nearly absolute. The 1-acyl phosphatidylcholine fraction exhibited a correspondingly large positive selectivity for the 13*t*-18:1 isomer. Differences were found for the relative distribution of the 13-18:1 isomers to 9*c*-18:1 in the various lipoprotein lipid classes. The most negative selectivity values were observed for high-density lipoprotein lipids and the least negative values for the low-density lipoprotein lipids, indicating that the liver is important in the selective utilization of the 13-18:1 isomers.

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THE EFFECT OF DIETARY *TRANS* FATTY ACIDS ON RAT LIVER MICROSOMAL 6- AND 9-ACYL DESATURASE ACTIVITIES. Remi De Schrijver and Orville S. Privett, The Hormel Institute, University of Minnesota, 801 16th Avenue N.E., Austin, MN 55912.

Weanling male Sprague-Dawley rats were fed a semi-synthetic diet containing a 10% fat supplement of safflower oil (SAF) or hydrogenated coconut oil (HCO). At the end of a one year period, animals of each group were shifted to a 10% SAF or HCO fat supplement, which included 10% or 50% of a mixture of linolelaidate, elaidate and *cis*-9, *trans*-12 linoleate for an additional period of 12 weeks. Animals of all groups were killed by exsanguination and the liver microsomal fraction isolated by ultracentrifugation for fatty acid analysis and determination of the 6- and 9-acyl desaturase activities, using $1\text{-}^{14}C$-linoleic acid and $1\text{-}^{14}C$-stearic acid respectively as substrates. Both 6- and 9-acyl desaturase activities were elevated in the rats receiving the HCO, compared to the SAF diet. Switching the animals of these groups to the *trans*-supplement depressed the 6-desaturase activity by 20% and elevated the 9-desaturase activity three-fold, showing significant alterations in the activities of these enzyme systems. These effects were reflected in the fatty acid patterns of the microsomal lipid. Our findings contradict reported in vitro assays, in which *trans* fatty acids exerted inhibitory effects on the 9-desaturase activity in liver microsomal fraction, indicating that in vitro inhibition studies of acyl desaturase activities do not necessarily correlate with in vivo conditions.

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A NEW APPROACH TO EVALUATION OF METABOLIC INTERACTIONS OF PUFA APPLIED TO EFFECTS DUE TO DIETARY *TRANS* FATTY ACIDS. Eldon G. Hill, Susan Johnson and Ralph T. Holman, The Hormel Institute, University of Minnesota, 801 16th Avenue N.E., Austin, MN 55912.

The evaluation of the metabolic interactions was based on a computer programmed treatment of fatty acid analyses of phospholipid fatty acids from heart and liver tissues. This program summarized the data that resulted from the various fatty acid desaturation and elongation processes that take place in the metabolic pathways and involve polyunsaturated acids. The ratios of values in experimental groups to comparable values of control groups indicate directions and magnitude or change from control values. Comparisons were made between groups of weanling male Sprague Dawley rats fed purified diets containing high and low levels of *trans* fatty acids as margarine stock (MS) or hydrogenated coconut oil (HCNO). All groups were fed equal amounts of linoleic acid. The fatty acid elongation products were significantly higher in the MS-fed rats in all lipids studied. The $\Delta 5$ and $\Delta 6$ desaturation products were significantly lower in the MS-fed rats. There were little or no differences in the $\Delta 4$ and $\Delta 9$ desaturation products in the rats.

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PROFILES OF POLYUNSATURATED FATTY ACIDS IN HUMAN DISEASE. Ralph T. Holman and Susan Johnson, The Hormel Institute, University of Minnesota, 801 16th Avenue N.E., Austin, MN 55912.

The profile of polyunsaturated acids in serum phospholipids in human essential fatty acid indicates decreased linoleic acid and polyunsaturated acids are derived from them. Similar profiles from cases of chronic malnutrition indicate that essential fatty acid deficiency is also a component of the malnutrition syndrome. Several diseases have been investigated from this point of view. Some diseases involve decreased linoleic acid as a consequence of fat absorption. The patterns of polyunsaturated acids reveal that in some diseases there are metabolic blocks or inhibitions of the $\Delta 6$, $\Delta 5$, or $\Delta 4$ desaturases or of chain elongation. In many of the diseases there is a compensatory increase in products of $\Delta 9$ desaturation. In several instances, genetically related diseases have been found to involve decreased metabolism of polyunsaturated acids at one or more steps in the metabolic chain. In some diseases the patterns of polyunsaturated acids in free fatty acids of serum indicate increased levels and skewed patterns of polyunsaturated fatty acids—conditions that may influence synthesis of prostaglandins and other antacoids.

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EFFECT OF HEPATOMA ON HOST LIVER, HEART AND LUNG LIPIDS AS TUMOR GROWTH PROGRESSES. Randall Wood, Andrew Zoeller and Martha Matocha, Department of Biochemistry and Biophysics, Texas A & M University, College Station, TX 77843.

Work from this laboratory has demonstrated that host animal plasma lipid class concentrations and compositions changed dramatically as hepatoma 7288CTC growth progressed. This report described the changes that occur in host liver, heart and lung lipids, measured at 3-day intervals during the period of tumor growth. All three organs

showed early changes in lipid class concentrations, but the changes differed for each organ. Generally, all lipid classes of all tissues showed a decrease in 16:1 levels and an increase in C-22 polyunsaturated fatty acid percentages with progressive tumor growth. Early changes in the ratio of oleate to vaccenate of host plasma phospholipids reported previously were detectable in liver phospholipids at the 12th day, but were somewhat less pronounced and occurred later in heart and lung. Similar isomeric profiles were also observed in liver, heart and lung hexadecenoate isomers. These data add further evidence that the lipid metabolism of the host animal is affected soon after tumor growth is initiated, and thus some organs reflect the change more quickly than others. This work was supported by Public Health Service Research Grant No. CA-20136 from the National Cancer Institute.

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LIPID METABOLISM IN RAT TESTICULAR SERTOLI AND GERMINAL CELLS. John G. Coniglio, Department of Biochemistry, Vanderbilt University, Nashville, TN 37232.

Male reproductive tissue has significant concentrations of lipids, including polyunsaturated fatty acids. Both fatty acid synthesis and conversion of unsaturated fatty acids to higher polyenes take place in rat testes. Because the testis is composed of many different cell types, it is important to determine what reactions can occur in these various cell types. Ongoing investigations in this laboratory are examining the incorporation of ^{14}C-substrates into fatty acids and lipids of isolated Sertoli and germinal cells of rat testes. Incubations of enriched fractions of Sertoli or germinal cells with ^{14}C-malonyl CoA resulted in ^{14}C incorporation into saturated and unsaturated fatty acids and lipids of both cell types. Most of the ^{14}C in the total fatty acids was in the 16-carbon fatty acids, followed by 18-carbon and by the fraction containing 22:4. Minor amounts were present in other fatty acids. Most of the ^{14}C was in unesterified fatty acids, but significant quantities were also present in the phospholipid and triacylglycerol fractions. There were no major differences between the two cell types. Fatty acids from the various lipid classes were separated by preparative GLC and monitored for ^{14}C. The results obtained on phospholipids and triacylglycerols reflected those obtained from analysis of the total fatty acids. Almost all of the ^{14}C in the free fatty acid fraction was in the 16- and 18-carbon fractions. Only minor activity was present in the longer chains and in the polyunsaturated fatty acid fractions. (Supported in part by USPHS grant no. 07694 and Institutional grant no. BRSG RR05424-19).

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MODIFICATION OF FUNGAL LIPIDS DURING AGING AND TREATMENT WITH α-TOCOPHEROL. Satruken Ramsammy and R. Cecil Jack, Department of Biological Sciences, St. John's University, Jamaica, New York, NY 11439.

In this presentation, we report results on the effects of α-tocopherol supplementation and aging on the positional distribution of fatty acids from phosphatidylethanolamine (PE) and phosphatidylcholine (PC) in the fungus *Glomerella cingulata*. The organism was grown in a chemically defined medium for 48–120 hr with or without α-tocopherol (1-g/l) and PE and PC were analyzed by standard procedures. At the ages studied (48, 60, 72, 96 and 120 hr) sn-1 of PC was 1.7 to 4.8 times more unsaturated than sn-1 of PE,but sn-2 of PC was only 0.3 to 0.9 times as unsaturated as sn-2 of PE. At all ages except 72 hr, sn-2 of PC had a constant ratio (12.0 to 1) of unsaturated to saturated fatty acids (U/S), whereas at sn-1, U/S varied between 2.9 to 1 and 6.5 to 1 with age. In PE, U/S at sn-2 varied between 15.0 to 1 and 43.0 to 1; but in both PE and PC, the number of double bonds/mol decreased with age at sn-1 and sn-2. Contrary to the commonly held view, sn-1 was not completely saturated; it contained up to 80% unsaturated fatty acids. α-tocopherol induced increases of up to 100% in U/S at sn-2 of PE and PC, but the number of double bonds/mol remained constant with added α-tocopherol.

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LIPID PROFILES OF NORMAL AND TRANSFORMED CELLS GROWN IN CULTURE. Richard A. Pierce-Ruhland, J. Martyn Gunn and Randall Wood, Dept. Biochem. & Biophys., Texas A&M Univ., College Station, TX 77843.

Lipid metabolism of some neoplastic cells is known to differ fundamentally from normal cells whereas other neoplasms show only marginal deviations. We examined the lipids from 10 cultured cell lines (1, NRKWT; 2, NRK442; 3, BALB; 4, BALB/SV40; 5, IMR90; 6, AG2804; 7, RH35; 8, MH1Cl; 9, 3T12; 10, IM9). Cell lines 1 and 2, 3 and 4, and 5 and 6 represent paired normal and virally transformed cells from rat kidney, mouse fibroblast and human lung, respectively. We determined the neutral lipid and phospholipid class distribution, fatty acid composition of individual classes, and positional isomer identification for each of these cell lines to determine whether neoplastic cells exhibit a distinguishable lipid profile. Generally, total neutral lipid and phospholipid concentrations were not dramatically different among the 10 cell lines. Two pairs of normal and transformed cells contained noticeable amounts of glyceryl ether diesters. The relative percentages of phosphatidylcholine (45.1 ± 4.7%) and phosphatidylethanolamine (25.4 ± 1.7%) were similar for the 10 cell lines. Except for "normal kidney" cells which exhibited an abnormal fatty acid profile, the transformed cells showed a dramatic decrease relative to normal cells in C-20 and C-22 polyunsaturated fatty acids. Positional isomer analysis of octadecenoates revealed that all transformed cell lines contained quantitatively less vaccenate (18:1 *cis* Δ11) than corresponding control cells. Except for the kidney cell lines, the transformed cells contained a higher concentration of palmitoleate (16:1 *cis* Δ9) than normal cells. These data suggest that elongation of monoenes is reduced in transformed cells. This view is supported by the observation that palmitoleate, the metabolic precursor of vaccenate, is elevated in transformed cells whereas vaccenate concentrations were significantly reduced.

This work was supported by PHS research grant no. CA-20136 from MCI.

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COTTON DUST STANDARDS FOR THE RAW COTTON INDUSTRIES. Phillip J. Wakelyn, National Cotton Council, Box 12285, Memphis, TN 31882.

In 1978, OSHA issued two cotton dust standards: one for the ginning industry, and a general industry standard covering all other sectors of the cotton handling and processing industries except harvesting. The courts have vacated and remanded to OSHA the standard for the ginning industries and affirmed the general industry standard except as it relates to cottonseed oil mills. The oil mill part of the standard was remanded because OSHA's position with regard to economic feasibility was "too unclear." OSHA suspended enforcement of the standard in the cotton classing and cotton warehousing industries. What we can expect from OSHA concerning present and future actions on cotton dust will be discussed.

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EVALUATION OF OCCUPATIONAL COTTON DUST CONTROL TECHNOLOGY IN COTTONSEED OIL MILLS. R.M. Bethea, C.L. Burford, J. Jacobi and J.C. Kao, Department of Chemical Engineering, Texas Tech University, Lubbock, TX 79409.

Respirable dust concentrations are reported as measured by paired vertical elutriators in the cleaning, delintering, hulling/separating and baling areas of nine cottonseed oil mills. Mills processing seed from irrigated and dry-land, stripper-harvested cotton and irrigated and rain-belt, machine-picked cotton were evaluated. The best available dust capture and control technology in current use is identified for each of the four dry processing areas. Recommended improvements in housekeeping and maintenance are also discussed.

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ECONOMICS OF OCCUPATIONAL COTTON DUST CONTROL IN COTTON SEED OIL MILLS. C.L. Burford, R.M. Bethea, J. Jacobi and J.C. Kao, Department of Industrial Engineering, Texas Tech University, Lubbock, TX 79409.

This paper provides cottonseed oil mill managers with a means of estimating the installed and operating costs of various occupational dust control approaches in a model 500 ton/day oil mill. Data pertaining to equipment and installation costs from mills were obtained by using the various devices or complete systems or both, wherever possible. In cases where these data were not available, estimates were obtained from several firms that manufacture and install similar equipment.

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THE ROLE OF THE DUST CONTROL CONTRACTOR IN REDUCING EMISSIONS FROM THE EQUIPMENT IN COTTONSEED OIL MILL HULLING AND SEPARATING ROOMS. Walter Godchaux, Jr., Nadustco, Inc., New Orleans, LA 70177.

The cottonseed dust standards proposed by OSHA have spurred efforts of operating cottonseed oil mills to reduce the level of ambient cotton dust in the work area. The hulling and separating room of the mill produces more dust than any other part because of finer materials and the type of equipment used. This paper describes attempts and progress made in providing suitable enclosures around this equipment that will not impede operations but will permit the maintenance of a negative pressure sufficient to prevent dust emissions into the operating room. The paper also discusses proposed design concepts that must be considered to accomplish these goals.

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STATUS OF EFFORTS BY OIL MILL MACHINERY MANUFACTURERS TO CONTROL FUGITIVE DUST EMISSIONS. Barry Sanders, W.C. Cantrell Company, Ft. Worth, TX.

The main problem facing the manufacturer of processing machinery for the cottonseed oil mill industry is that cottonseed is not a free-flowing material until after the removal of linters. The effect of this characteristic is compounded by varying degrees of moisture, rendering a totally enclosed cottonseed cleaner in a dust tight shroud that is impractical due to periodic choke-ups, "tail-over" from the top trays and the frequent necessity to manually clean the screens. Delintering equipment has been successfully equipped with canvas drapes connecting the feeder to the top of the roll box front as well as hinged doors that connect the black seed chutes to the bottom of the roll box. Fugitive dust emissions and noise levels have thus been reduced, but not eliminated. Rock and shale traps between the white seed tank and cleaning room, as well as within the lint and separating room, help reduce free fly lint within the processing streams. Rock and shale traps that operate under positive pressure can be potential dust sources that can be eliminated by a dual fan arrangement. After delintering, cottonseed becomes more predictable regarding flowability, and thus conventional methods of dust control can be applied. Separators can be enclosed as long as maintenance accessability and visibility of the operator control is not hindered. The operating air requirements for the machine can be put to additional use in maintaining a negative air flow into the enclosure.

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SAMPLING FOR RESPIRABLE COTTON DUST. K.Q. Robert, Jr., and Albert Baril, Jr., Southern Regional Research Center, SEA, USDA, New Orleans, LA.

The nature of the problem of sampling from a dust cloud containing both fine dust and lint fragments is reviewed. The definition of "respirable" cotton dust as promulgated in the OSHA Cotton Dust Standard is compared with the quantity measured by the NIOSH (Lumsden-Lynch) vertical-elutriator (VE) cotton dust sampler. Theoretical and empirical factors that affect the accuracy and precision of VE measurements are discussed. Technologies for alternative sampling strategies and for improving VE sampling are described.

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COTTON DUST PARTICLE SIZE DISTRIBUTIONS IN OIL MILLS. Devron P. Thibodeaux, Southern Regional Research Center, SEA, USDA, New Orleans, LA.

Analytical procedures have been developed for characterizing the size and shape of cotton dust particulates collected by the vertical elutriator (VE) sampler. Data is reported for dust distributions on VE filters collected from cleaning, delintering, hulling, separating and baling areas in cottonseed oil mills. Results of particle volume distribution obtained with a Coulter counter are compared with data obtained from an image-analysis system designed to classify cotton dust into fibrous and nonfibrous (particulate) components. The image-analysis data includes distribution of lengths and widths of fibers and areas and diameters of particles present on the VE filters.

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BOTANICAL TRASH ANALYSIS OF COTTONSEED PROCESS STREAMS. P.R. Morey and R.M. Bethea, Departments of Biological Sciences and Chemical Engineering, Texas Tech University, Lubbock, TX 79409.

The objective of this study was to determine the content of bract and leaf (likely carriers of suspect byssinotic agent[s]) in process and trash streams in a cottonseed oil mill. The amount of bract and leaf in cottonseed received at the oil mill (about 0.1%) is less than that (0.3–6%) found in cleaned seed cotton entering the gin stand feeder. Progressively less bract and leaf is found in the seed process stream at the oil mill after cleaning, delintering and hulling. Approximately 3–6% of the trash in the cotton materials coming off the bottom shelf of the shaker cleaner separator is bract and leaf. A material balance is presented to pinpoint major sites of loss of these botanical materials either as gross trash or as fugitive emissions.

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IDENTIFICATION AND ELIMINATION OF THE CAUSATIVE AGENT OF BYSSINOSIS. Ralph J. Berni, Southern Regional Research Center, USDA, P.O. Box 19687, New Orleans, LA 70179.

Separation and identification of possible causative agents of byssinosis have been top priority research activities at the Southern Regional Research Center since 1975. The Center serves as a focal point for several cooperating agencies also active in the search for this elusive agent. Several examples of our recent research in the area of high performance liquid chromatography will be discussed. We include analyses of dust and other materials obtained from oil mills to show the obvious contrast between this dust and our "standard active" cotton dust.

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AFLATOXIN IN FRESHLY HARVESTED 1979 GEORGIA CORN AND FORMATION AFTER COLLECTION. O.L. Shotwell, W.F. Kwolek and C.W. Hesseltine, Northern Regional Research Center, 1815 N. University Street, Peoria, IL 61604.

In the crop year 1979, freshly harvested corn was collected in 57 sets of two equivalent samples per set. One set was dried the day of collection in Georgia; the other set was shipped to Peoria before drying. The set that was not dried in Georgia was shelled and dried as soon as possible to prevent further aflatoxin formation. Aflatoxin was detected in levels ranging from 2 to 449 ng/g in 22 Peoria-dried samples; it was not detected in the matching samples dried the same day of collection in Georgia. It took at least 4 days to ship samples from Georgia. In the 57 samples dried in Georgia, aflatoxin was not detected in 63%; aflatoxin was not detected in violative levels ($\geqslant$20 ng/g) in 82%, and the average aflatoxin level in all samples was 36 ng/g. In the matching 57 samples dried in Peoria after shipment, aflatoxin was not detected in 37%; aflatoxin was not detected in violative levels in 72% of the samples, with an average aflatoxin level in all samples of 78 ppb. Apparently, aflatoxin formed in the freshly harvested corn samples during shipment from Georgia to Peoria.

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YIELD EFFECTS ON TOLERANCE TO IN VITRO ACCUMULATION OF AFLATOXINS IN PECAN MEAL. J.L. McMeans, Southeastern Fruit and Tree Nut Research Laboratory, P.O. Box 87, Byron, GA 31008.

Unautoclaved pecan meal, [*Carya illinoensis* (Wangenh.) K. Koch], from selected trees, ten each with high or low yields, averaging 104 and 1 kg per tree, respectively, were inoculated with a spore suspension of *Aspergillus parasiticus*. *A parasiticus* developed more rapidly on substrates from high-yielding trees, but no growth differences were noted between substrates at the termination of the 7-day test. Growth of *A. niger* and *Rhizopus* Sp. was present on all samples but there was no difference in growth between the substrates. Significantly greater concentrations of aflatoxins ($B_1+B_2+G_1+G_2$) occurred in substrates from high-yielding trees. Refractive index determinations indicated more unsaturated oils in substrates from high-yielding trees. Concentrations of potassium, magnesium, calcium, zinc and iron were greater in meals from high-yielding trees, but no differences were found in manganese or copper. There were no differences in phenolic content of the two substrates. The data suggest that pecan yield may be a factor in field infection by *A. parasiticus*. The accumulation of aflatoxins in the meal from high-yielding trees may be influenced by oil quality, as indicated by the refractive index, or the concentration of some minerals.

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AFLATOXIN FORMATION ON WHOLE AND GROUND CUMIN AND ANISE SEEDS. G.C. Llewellyn and E.C. Dixon, Virginia Commonwealth University, Dept. of Biology, Richmond, VA 23284; T. Eadie, Richmond, VA; W.V. Dashek, West Virginia University, Morgantown, WVA 26506; and C.E. O'Rear, George Washington University, Washington, DC 20052.

The purpose of this study was to evaluate the potential productivity and growth of *Aspergillus parasiticus* (NRRL 2999) and the resultant toxin production on natural and autoclaved (cooked) cumin and anise spice seed substrates. Both whole and ground cumin and anise seeds are capable of supporting mycelial growth, sporulation and toxin production when the seeds are moist and maintained at room temperature. Toxin yields were higher on ground sterile seed substrates. Of the commercial samples tested, neither the resultant cultures of natural flora nor dry whole seeds were found to contain aflatoxin or aflatoxinlike producing organisms. The anise substrates were more conducive to mycelial growth, sporulation and aflatoxin production than the cumin. Toxin levels in the various anise substrates ranged from 0.83 to 6.5 μg/g total for the four aflatoxins—B_1, B_2, G_1, and G_2. Cumin seed substrates usually showed only B_1 and G_1 at total levels ranging from 0.23 to 0.63 μg/g. Both seeds had mycelial growth and sporulation occur at some time during the experimental period. Both substrates could be considered as low-level producers of aflatoxins, and anise seeds should be monitored occasionally for aflatoxin contamination when the commodities are purchased and used in large quantities.

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ZEARALENONE FORMATION ON CORN BY FIELD INOCULATION. Genoveva Garcia Aguirre, Universidad National Autonoma de Mexico, Donald G. White, University of Illinois, and Odette L. Shotwell, Northern Regional Research Center, 1815 N. University Street,

Peoria, IL 61604.

In a study of zearalenone formation on corn in the field, two hybrids, A632 X Pa 762 and B73 X Mo 17, were inoculated in the field with two strains of *Fusarium graminearum* known to produce zearalenone, and five strains of Fusaria recently isolated from corn with ear or stalk rot. Corn was analyzed for zearalenone by the method approved by the Association of Official Analytical Chemists and the American Association of Cereal Chemists. Comparisons of zearalenone measurement by thin layer chromatography and gas chromatography revealed no significant difference in the results obtained by the two methods. The strains NRRL 3376 and NRRL 5864 produced at harvest low yields of zearalenone (range 0.308–2.805 mg/kg; average 1.188 mg/kg) compared with yields of the five recent isolates (range 2.307–37.400 mg/kg; average 18.871 mg/kg). More zearalenone was produced by all strains except NRRL 5864 on A632 X Pa 762 (average 17.863 mg/kg) than on B73 X Mo 17 (average 8.760 mg/kg). The moisture in the kernels of freshly harvested hybrid A632 X Pa 762 that had been field-inoculated with NRRL 3376, NRRL 5864 and five Fusaria isolates was adjusted to 28% and the kernels were incubated at 15 C. After 4 weeks, zearalenone levels had increased from an average of 17.9 mg/kg to 67.0 mg/kg.

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NATIONAL SURVEY OF MYCOTOXIN PROBLEMS IN CANADA. R.I. Andrews, Deloitte Haskins & Sells Associates, 2300, 255 - 5 Avenue, S.W., Calgary, Alberta, T2P 3G6, Canada, and H.L. Trenholm, Agriculture Canada.

Mycotoxins continue to be an animal health problem in various regions of Canada. A survey of research institutions across Canada revealed that mycotoxins—zearalenone, ochratoxin A, tricothecenes and aflatoxins—have been detected in animal feedstuffs. These mycotoxins have produced mycotoxicoses in poultry, hogs and cattle. Estrogenic syndromes in hogs are caused by the fusarium toxin zearalenone developed on grain corn in southern Ontario. T-2 Toxin developed on overwintered barley created an outbreak of fusariotoxicoses in swine in northern Alberta. Central and eastern Canada seem to be the major focus of mycotoxin occurrence and will be the object of further field level examination to discover patterns of occurrence and economic impact.

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1980 SURVEY OF MYCOTOXINS IN ONTARIO AND QUEBEC. H.L. Trenholm, J.I. Elliot, E.R. Farnworth, D.W. Friend, R.M.G. Hamilton, J.F. Standish, W.P. Cochrane, H. Cohen and G.A. Neish, Animal Research Institute, Research Branch Agriculture Canada, Ottawa, Ontario K1A 0C6, Canada.

In early autumn 1980, red fungal discoloration was noted on white winter wheat harvested in southern Ontario. Chemical analysis indicated the presence of vomitoxin levels in the range of nondetectable to 1 ppm for most samples, and a few contained up to 8 ppm vomitoxin. Samples were analyzed for other mycotoxins; levels with either nondetectable or approaching detectable limits. Isolated outbreaks of feed refusal, loss of weight and illness were reported by producers. Research studies with livestock and poultry indicate feed refusal when winter wheat contaminated at 1.2 ppm vomitoxin was included in rations.

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EVALUATION OF THE MONOMETHYLAMINE:$Ca(OH)_2$ METHOD FOR THE DECONTAMINATION OF AFLATOXIN-CONTAMINATED PEANUT MEAL. Douglas L. Park, Food and Drug Administration, Rockville, MD 20857, Mongi Jemmali, Institut National de la Recherche Agronomique, Paris, France 75013, and Charles Frayssinet, Christiane LaFarge-Frayssinet, and Mireille Yvon, Institut de Recherches Scientifiques sur le Cancer, Villejuif and Paris, France.

Radiolabeled aflatoxin B_1 was added to naturally contaminated peanut meal, and the fate of aflatoxin-related by-products produced after decontamination by monomethylamine-$Ca(OH)_2$ was monitored. The decontamination process resulted in 94–100% reduction in aflatoxin levels depending on the level of contamination and chemical structure of aflatoxin. Following extractions with chloroform, methanol, acetic acid and water, the majority of the decontamination by-products remained with the residue (79–91%). A significant concentration of aflatoxin B_1 (12.5%) and aflatoxin-related compounds (27.6%) was liberated from the residue following enzymic digestion. Isolation and identification studies revealed a wide variety of aflatoxin-related decomposition by-products. HPLC and TLC separation of chloroform-soluble compounds revealed some compounds exhibiting some degree of toxicity. Comparative toxicity tests showed that although some decontamination by-products exhibited elevated responses to specific toxicity tests, the degree of toxicity was inferior to aflatoxin B_1. The moisture, protein, and nitrogen levels did not change significantly. There was a significant change in the mold flora following the decontamination process and the product is susceptible to recontamination.

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THE ROLE OF SINGLET OXYGEN IN BIOLOGICAL OXIDATIONS. Michael J. Thomas and Lawrence R. DeChatelet, Department of Biochemistry, Bowman Gray School of Medicine, Winston-Salem, NC 27103, and William A. Pryor, Louisiana State University.

We have recently developed a sensitive, quantitative test for singlet oxygen ($^1O_2$) participation that is compatible with many biological systems. This test is based on the observation that $^1O_2$ oxidizes linoleate, yielding, in addition to two conjugated hydroperoxides, two nonconjugated hydroperoxides that are not formed by free radical autoxidation: 12-hydroperoxy-*cis*-9,*trans*-13-octadecadienoic acid ($1^{\curvearrowright}$OOH) and 10-hydroperoxy-*trans*-8,*cis*-12-octadecadienoic acid ($2^{\curvearrowright}$OOH). Therefore the isolation of $1^{\curvearrowright}$OOH or $2^{\curvearrowright}$OOH, or their hydroxy derivatives, is proof of $^1O_2$ participation. We have examined linoleate oxidation induced by xanthine oxidase (an enzyme that generates superoxide anion radical), soybean lipoxidase, and a human white blood cell, the polymorphonuclear leukocyte (PMNL), to determine whether significant quantities of $^1O_2$ are generated by these systems. Singlet oxygen was not detected in oxidations induced by xanthine oxidase or soybean lipoxidase. The xanthine oxidase oxidation of 1 mM linoleic acid was found to depend on both the generation of superoxide and the presence of preformed linoleate derived hydroperoxides in the solution. A direct interaction of linoleate-derived hydroperoxide and superoxide ion ($k = 7 \times 10^3$ $M^{-1}s^{-1}$) is postulated to be responsible for inducing free radical autoxidation of linoleic acid. Polymorphonuclear leukocytes are reputed to generate $^1O_2$ when they attack invading microbes. Since the PMNL is considered to be one of the human organism's more important defenses against bacterial and yeast infection, the question of $^1O_2$ participation in microbicidal activity is of vital interest. To test for $^1O_2$ participation, human PMNLs (4×10^8 cells/vial) were induced to ingest paraffin oil droplets doped with ^{14}C-linoleic acid. After one hr the cells were lysed, the fatty acid hydroperoxides extracted, reduced with methanolic $NaBH_4$, and then converted to p-bromophenacyl esters in the presence of nonradiolabeled hydroxyoctadecadienoates. The components were separated by high performance liquid chromatography using a column packed with 10 μ totally porous particles. The effluent was fractionated and the radioactivity of the fractions correlated with the optical absorption of each fraction at 254 nm. Only one of the four possible $^1O_2$ products ($2^{\curvearrowright}$OH) and none of the autoxidation products was observed. These results suggest that neither $^1O_2$ nor a free radical chain reaction is responsible for linoleic acid peroxidation under our conditions. Studies of PMNL-derived luminescence are consistent with the lack of $^1O_2$ participation in linoleate oxidation.

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A CYTOSOLIC FACTOR WHICH CONTROLS LIPID PEROXIDATION IN BIOLOGICAL MEMBRANES. Paul B. McCay and Donald D. Gibson, Biomembrane Research Laboratory, Oklahoma Medical Research Foundation, 825 N.E. 13th Street, Oklahoma City, OK 73104, and K. Roger Hornbrook, University of Oklahoma, Health Sciences Center.

Lipid peroxidation (and oxidative stress in general) in living cells has been considered to be controlled by several factors: antioxidants such as α-tocopherol, superoxide dismutase, catalase, and glutathione peroxidase. The enzymes are believed to reduce oxidative stress as follows:

$$O_2^- + O_2^- + 2H^+ \xrightarrow{S:O.D.} H_2O_2 + O_2$$

$$2H_2O_2 \xrightarrow{Catalase} 2H_2O + O_2$$

$$H_2O_2 + 2GSH \xrightarrow[Peroxidase]{Glutathione} 2H_2O + GSSG$$

But it is also generally accepted that a glutathione peroxidase functions to reduce lipid peroxides in biological membranes to lipid alcohols, thus preventing chain cleavage of the unsaturated fatty acid chains and consequent membrane disruption. This concept appears to be incorrect. Our studies have demonstrated that glutathione peroxidase cannot reduce lipid peroxides in biological membranes. There is, however, a heat-labile factor in the cytosolic fraction of all tissues that have been tested (rat liver, lung, heart and guinea pig liver) which, in the presence of glutathione, prevents lipid peroxidation from occurring under conditions that would otherwise cause rapid peroxidation in biological membranes. The heat-labile factor is nondialyzable and is neither glutathione peroxidase nor a glutathione

transferase. The requirement for glutathione for the cytosolic factor to inhibit lipid peroxidation is not specific. Among the substances that can substitute for glutathione are dithiothreitol, cysteine, cystine, $Na_2S_2O_5$ and Na_2S. Treatment of the cytosolic factor with iodoacetate impairs its capacity to inhibit lipid peroxidation. The mechanism of the inhibition of lipid peroxidation by the cytosolic factor is not known, but sulfhydryl groups appear to be involved. Since the factor inhibits both enzymic and nonenzymic lipid peroxidation, the system appears to constitute a major defense against lipid peroxidation and other types of oxidative stress in animal tissues. (Supported in part by NIH Grant AM08397).

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PHOTOOXIDATION OF POLYUNSATURATED LIPIDS INVESTIGATED WITH A GAS CHROMATOGRAPHIC REACTOR. J. Assis F. Faria, UFV-Brazil, and Seymour G. Gilbert, Rutgers University.

A gas chromatographic reactor can be used to investigate the prooxidant activity of different sources of light energy on linoleic acid, soybean oil and safflower oil. The rate of oxidation was followed from the early "induction phase" by measuring oxygen uptake using a thermal conductivity detector. The experiments were carried out at low-oxygen concentrations and at a broad range of temperatures. To monitor the effect of light on the oxidation of linoleic acid, methylene blue was used as a sensitizer, and beta-carotene was used as an inhibitor of photooxidation. This method is presently being developed as a technique to predict the stability of fatty foods packaged in transparent or translucent materials.

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AUTOXIDATION PRODUCTS IN PHOSPHATIDYLCHOLINE LIPOSOMES AND IN MYCOPLASMA MEMBRANES. Guey-Shuang Wu, Eric Sohlberg, Robert A. Stein and James F. Mead, Laboratory of Nuclear Medicine and Radiation Biology, UCLA, 900 Veteran Avenue, Los Angeles, CA 90024, and Ronald N. McElhaney, University of Alberta, Edmonton, Alberta, Canada.

Several systems, including both artificial phospholipid bilayers and isolated biomembranes, have been chosen to study in particular the relationship of membrane fatty acid composition to the nature of autoxidation products. The autoxidation of soybean phosphatidylcholine (PC) liposomes (containing 8% 16:0, 4% 18:0, 12% 18:1, 70% 18:2 and 6% 18:3) was found to give mainly hydroperoxides. The autoxidation of egg PC liposomes (containing 34% 16:0, 16% 18:0, 34% 18:1 and 15% 18:2) under the same condition, however, gave only a small proportion of hydroperoxides and the major products were epoxides derived from oleic and linoleic acid. In both systems, soybean PC and egg PC, the incorporation of dipalmitoyl PC into the liposomes effectively increases the production of hydroxyepoxy fatty acids and their hydrolysis products, trihydroxyoctadecenoic acids. Membranes of *Acholeplasma laidlawii* (containing 40% 16:0 and 60% 18:2 as major fatty acids), upon incubation with ferrous ion and ascorbate, gave rise extensively to fatty acid epoxides and particularly hydroxyepoxy and trihydroxy fatty acids. Mechanisms will be proposed to account for the formation of the different products in these systems.

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EFFECT OF RANDOMIZATION ON THE OXIDATION PRODUCTS OF CORN OIL. Flora Lau and E.G. Hammond, Department of Food Technology, Iowa State University, Ames, IA 50010.

Randomization of fat usually causes an increase in its rate of autoxidation. The reason for this is unclear. For the purpose of study, natural and randomized corn oils were purified by being passed through alumina and oxidized to peroxide values of 30–40 at 28 C. The hydroperoxides were reduced to alcohols with iodide. The oxidized products were isolated from unoxidized glycerides by thin layer chromatography on Silica Gel G, and the separate products were converted to methyl esters by methanol and sodium methoxide. The methyl esters that contained hydroxy groups were converted to trimethylsilyl ethers and the esters were analyzed by gas chromatography. Two major bands of oxidized products were separated from the unoxidized triglycerides on thin layer plates. The proportion of the uppermost of these two bands was much greater in randomized than unrandomized oils. The upper band was a triglyceride containing an azelal group. The lower was a triglyceride containing one hydroxy acyl group.

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AN IMPROVED HPLC METHOD FOR THE DETERMINATION OF ETHYLENE OXIDE DISTRIBUTIONS IN NONIONIC SURFACTANTS. M.C. Allen and D.E. Linder, Conoco Inc., Ponca City, OK 74601.

A one-step HPLC separation using a p-Porasil column and a linear gradient with ethylene dichloride and 2-propanol solvents has been developed for the determination of ethylene oxide (EO) distribution in alcohol ethoxylate nonionic surfactants. This method allows the ethylene oxide distributions to be determined in as little as 30 min after sample derivatization with phenyl isocyanate. This method is also applicable for determining the molar EO distributions in diverse ethylene oxide adduct compounds such as alkylphenol ethoxylates, branched alcohol ethoxylates and secondary alcohol ethoxylates. Nonionic surfactant samples containing adducts up to 25 mol have been successfully separated and the individual adducts quantitated.

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DETERMINATION OF WATER HARDNESS RESIDUES ON CLOTHS AFTER TERG-O-TOMETER TESTING. Karl Van Dyke, Amway.

A rapid, simple technique has been developed for monitoring deposition of insoluble water hardness residues on cloth. Over the past 10 years, various methods, including ashings, EDTA titrations and AA techniques have been used. The present procedure involves a single extraction with 0.1 *M* HCl followed by atomic absorption quantitation of calcium and magnesium, the two primary water hardness ions. Development of this technique coincides with the large-scale introduction to the market of no-phosphate detergents. Use of large quantities of sodium carbonate in place of complex phosphates would be expected to cause precipitation of calcium carbonate on fabrics washed in hard water. An intensive search for a phosphate replacement needed a method to monitor performance under simulated conditions. Existing techniques did not provide an accurate measure of residues. Early work demonstrated the ability to deposit more than 15% by weight of calcium carbonate on cotton cloths washed repeatedly in a laboratory terg-o-tometer. The present method has been developed as a complement to standard detergency evaluations. Methodologies investigated included gravimetric determination following ashing. This technique has several drawbacks. Titration of acid extracts with EDTA is possible, but suffers from a lack of selectivity. Use of masking agents improves selectivity; however, it does not adequately distinguish between calcium and magnesium ions. Atomic absorption measurement of individual metals provides the required selectivity. Additional benefits include simplified sample preparation and large time savings. Correlation between EDTA titrations and AA determinations is good. Deposition of calcium carbonate varies dramatically with cloth type. Unfinished cotton cloth shows the greatest tendency to retain residues. Other cloth types including cotton with finish, and cotton/synthetic blends show not only different levels of residue, but also different ratios of metal ions.

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GEL PERMEATION CHROMATOGRAPHY OF POLYETHER SURFACTANTS. S.J. Brauer and T.M. Schmitt, Analytical Research Department, BASF Wyandotte Corporation, 1609 Biddle Avenue, Wyandotte, MI 48192.

Block polymer nonionic surfactants can be separated on the basis of molecular size. Molecular weights can then be calculated by comparison to a series of well-characterized polyethers. We will discuss our experiences with μStyragel and μBondagel (Waters Associates) using tetrahydrofuran and alcohol/water mixtures. GPC has been found to be effective for determining the molecular weight distribution of polyether surfactants and for resolving some mixtures. Because of its indifference to small product variations, GPC is more useful for research or trouble-shooting than for quality control.

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DETERMINATION OF ETHYLENE OXIDE DISTRIBUTIONS IN ALCOHOL ETHOXYLATES BY HPLC USING A ROTATING DISC-FLAME IONIZATION DETECTOR. J.D. McClure, Shell.

An HPLC method has been developed for the quantitative determination of ethylene oxide (EO) distributions (% w) in acetylated alcohol ethoxylates from EO = 0,1 to EO = 30 using a rotating disc-flame ionization detector. Both single-carbon number and mixed-carbon number alcohol-based (NEODOL®) samples have been analyzed by gradient elution with two different solvent systems on a μPorasil column. With both solvent systems 95% hexane is the initial solvent, but with one system 100% acetone is the final solvent and with the other 10% methanol-90% acetone is employed. The latter solvent elutes the higher ethoxylates from EO = 21 to EO = 30 quantitatively from the μPorasil column, which the 100% acetone solvent fails to do. The 100% acetone solvent separates EO = 2 and EO = 3 from EO = 0,1 which the methanol-containing solvent does not do. Response factors for EO = 3 and EO = 8 have been experimentally determined and the response factors for the other EO numbers have been calculated from these two results. The corrected ethylene oxide distributions for both NEODOL® 25-9 and NEODOL® 23-6.5 determined by HPLC are in good agreement with those determined

earlier by circular thin layer chromatography (up to EO = 16 can be determined by this method). The average EO numbers determined by the HPLC method and by a wet chemical (phthalic anhydride) method are in excellent agreement for the above two samples and a sample of NEODOL® 23-7.5. The results are discussed in terms of Snyder's theory for gradient elution in HPLC using the gradient steepness parameter.

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Cancelled.

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THE SYNTHESIS OF DOUBLE-LABELED NONIONIC SURFACTANTS AND THEIR APPLICATION TO BIODEGRADATION STUDIES. W.T. Shebs and L.S. Smith, Shell Chemical Co.

Two nonionic surfactants labeled with tritium in the hydrophobe and carbon-14 in the hydrophile were synthesized for use in comparing the ultimate biodegradation to carbon dioxide and water of commercially available materials in the presence of high levels of organic carbon typical of a domestic sewage treatment plant. A C_{12-15} linear primary alcohol, tritium-labeled predominantly on the alpha and gamma carbons, was condensed with ^{14}C-labeled ethylene oxide. (EO) Nonylphenol was brominated and then reduced with tritium gas to give the [ortho-^{3}H]-nonylphenol which was then condensed with ^{14}C-labeled ethylene oxide (EO). EO/alkyl was approximately 9 for both surfactants. Conditions necessary to preserve samples from activated sludge sewage treatment (clarifier effluent and mixed liquor suspended solids) were investigated. Labeled linear primary alcohol ethoxylate (LPAE), at 0.5 ppm, was added to samples preserved chemically (formalin or mercuric chloride) or by refrigeration at 5 C, or by a combination. Primary biodegradation of the LPAE is by cleavage of the hydrophobe-hydrophile bond, which releases tritium as water. The presence of tritiated water after 24 hr is evidence of continued degradation of the surfactant in the preserved sample. Refrigeration alone was not adequate to prevent primary degradation of the surfactant. Refrigeration in combination with 1% formalin or 200 ppm $HgCl_2$ prevented any degradation of the surfactant.

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NONBIODEGRADABLE NONIONIC DETERGENTS IN MUNICIPAL SEWAGE (IN ISRAEL). Uri Zoller, Division of Chemical Studies, Haifa University–Oranim; P.O. Kiryat Tivon, Israel.

Synthetic detergents–a part of which are the nonbiodegradable nonionic detergents–constitute a significant factor of the water quality profile in Israel and in many of the industrial countries as well. This factor, in turn, determines the possibility of water reuse without or after purification and appropriate recovery processes. The resistance to biological degradation is characteristic for a substantial portion of the existing different types of nonionic detergents–the branched-chain alcohol- and alkyl phenol-ethoxylates–and is responsible for the various aspects of short- and long-term environmental problems involved with their use (i.e., economic-technological, biological-ecological, aesthetic-psychological). Within our on-going research program we are working on the following. (1) Development of methods and procedures that will make possible the in vivo application of the existing methods for nonionic detergents determination to the complex system of "typical" real sewage effluents that contain both biodegradable and nonbiodegradable anionic and nonionic detergents simultaneously. (2) Determination (to the first approximation) of the relative contribution of the various cleansing agents produced and/or consumed in the country to the presence of nonionic detergents in municipal sewage. (3) Determination of the present characteristic concentrations of nonionic detergents in typical "representative" municipal sewage, including the monitoring of the ratio between biodegradable and nonbiodegradable nonionics in the inspected sewage. Preliminary progress report and gathered data will be presented followed by discussion of selected problems and issues involved. Our effort seems to us not only to be a vital prestep to any legal action to be undertaken, but also to be a meaningful contribution towards the constructive solution of one critical aspect of water quality and the design and planning of alternatives for its useful reuse in the future. (Project supported by the EPA of Israel, Office of the Interior).

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GLYCEROLYSIS OF FATS AND METHYL ESTERS–STATUS, REVIEW AND CRITIQUE. Norman O.V. Sonntag, 306 Shadowood Trail, Red Oak, TX 75154.

With the possible exception of catalytic hydrogenation, perhaps no unit operation within the realm of oleochemistry is as complex as that of glycerolysis. Among the misconceptions and half-truths that are currently prevalent concerning the glycerolysis of fats is the notion that it involves a strictly "random" distribution of acyl groups among all the available hydroxyl groups, that the solubility of glycerol in the fat at the reaction temperature determines the yield of monoglyceride that may be obtained, and, more importantly, that there is an equivalence of emulsification properties of the chief products of glycerolysis, namely, the *alpha* and *beta* monoglycerides in both food and industrial emulsifier uses. Numerous examples from recent international literature establish the limitations that prevail on temperature and agitation in batch glycerolysis reactions, but the practical limits for glycerolysis under superemulsification remain to be established. The disadvantages of glycerolysis in homogeneous solvents are still insufficient to justify the use of those that are available, but the use of either or both pressure and gaseous catalysts such as carbon dioxide appear to offer the greatest hope for improvement in yields. Substantial energy savings may dictate choosing methyl ester glycerolysis processing for future plants, especially for those that may be built in the international sphere. Pros and cons of monoglyceride analytical methodology are evaluated.

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VEGETABLE OILS AS DIESEL FUEL: PROBLEMS AND POSSIBLE SOLUTIONS. E.H. Pryde and A.W. Schwab, Northern Regional Research Center, 1815 North University Street, Peoria, IL 61604.

Successful use of vegetable oils in diesel engines depends upon a number of factors, one of the most important being engine design. Unfortunately, the direct-injection, water-cooled diesel engines used in most farm equipment are tightly designed around No. 2 diesel oil specifications and are not the most appropriate for viscous, nonvolatile vegetable oils. Incomplete combustion, even in vegetable oil-diesel oil mixes, is the direct cause of injector tip coking, coke and gum formation on rings, and thickening and gelation of the lubricating oil. As stated by J.J. Bruwer (Republic of South Africa) who has worked with sunflower oil, either the engine or the vegetable oil needs modification. Modification of vegetable oils, such as transesterification, microemulsion formation, and use of viscosity reducers as aids to improving combustion, will be discussed.

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DEGUMMING OF SOYBEAN OIL: QUANTITATIVE ANALYSIS OF PHOSPHOLIPIDS IN CRUDE AND DEGUMMED OIL. Linda M. Drews and A. Philip Handel, Department of Food Science and Technology, University of Nebraska, Lincoln, NE 68583.

In the refining of soybean oil, the degumming process is the major step in removing phospholipids. However, a portion of the phospholipids are not removed by the water degumming step. These nonhydratable phospholipids must be removed by alkali refining techniques. Since an excess of alkali is required to remove the nonhydratable phospholipids, a loss of neutral also occurs because of saponification. If phospholipids are not removed during refining, an oil that is dark in color and has an off flavor and odor results. The objective of this study is to identify and quantify the phospholipids present in degummed soybean oil and to compare those findings to crude soybean oil phospholipids. The results indicate that the major phospholipids present in crude and degummed soybean oils are phosphatidylethanolamine, phosphatidic acid, phosphatidylcholine and phosphatidylinositol. After the degumming process, there is a reduction in all of the phospholipids; however, this reduction is not equal for all phospholipids. The implications of these variable reductions will be discussed in relationship to the degumming process and soybean oil stability.

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SELECTIVE HYDROGENATION OF SOYBEAN OIL: XII. TRIALKYL ALUMINUM-COPPER STEARATE COMPLEX HOMOGENOUS CATALYSTS. S. Koritala, Northern Regional Research Center, 1815 North University Street, Peoria, IL 61604.

The soluble complex catalyst formed by reacting copper stearate with triethyl aluminum was used for the selective hydrogenation of soybean oil. This homogeneous catalyst is more active than copper-chromite. The activity was enhanced by the addition of silica, alumina or titania to the reaction mixture. Ethyl alcohol in small amounts also improved the activity, but hydrogenation was retarded when increased amounts were added. More active homogeneous catalysts resulted when triethyl aluminum was replaced by tri-isobutyl aluminum, tri-n-hexyl aluminum, tri-n-octyl aluminum or tri-n-decyl aluminum. Among other organometallics tested, diethyl magnesium formed an active catalyst. The linolenate selectivity (k_{Le}/k_{Lo}) of these homogeneous catalysts was much less (3.5) than a selectivity ratio of 10 normally achieved with copper-chromite catalyst. Isomerization with the homogeneous catalysts as measured by the percentage of *trans*-isomers formed was similar to that of heterogeneous catalysts (% *trans*/Δ I.V. = 0.6–0.7).

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KINETICS OF BLEACHING OF VEGETABLE OILS. Ulla I. Brimberg, Alfa-Laval AB, Food Technology Division, Box 500, S-147 00 Tumba, Sweden.

A recent paper determined that the concentration (c) of remaining chlorophyll or carotene in rapeseed oil during the bleaching process follows the rate formula $\log c/c_0 = -k \cdot Vt$, characteristic of flocculation of colloids. Thus, the pigments are particulate and colloidally dispersed in the oil. The rate constant (k) was proportional to the added amount of clay. This paper reports experiments with palm oil. The same kinetics as with rapeseed oil are valid. The effects of various parameters upon the rate have been studied and the mechanism of the process is discussed.

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COMPARISON OF VEGETABLE OILS AND METHYL ESTERS OF FATTY ACIDS AS ACCELERATORS FOR DRYING RAISINS. Glenn Fuller and A.E. Stafford, Western Regional Research Center, USDA, 800 Buchanan Street, Albany, CA 94710, and V.E. Petrucci, California State University, Fresno, CA.

Preparation of raisins by drying grapes is a simple process in which solar energy or heat from natural gas is used to remove water to <18% moisture content. Methyl ester emulsions applied to the grape skins significantly reduce drying time. The purpose of the experiments reported in this paper was to test the effectiveness of unmodified vegetable oils compared with methyl esters. Small-scale field drying tests were conducted at California State University vineyard plots, in which grapes were sprayed with emulsions of methyl oleate and two vegetable oils. Application was a 2% emulsion of oil or ester, 2% potassium carbonate and 0.01% of a commercial emulsifier sprayed with a 1-gallon garden sprayer. Control grapes were sprayed with water. Drying rates of ester-treated grapes and those dried with vegetable oil were similar; their drying times were approximately half those of the water-treated controls. Residues of oil or ester on the raisins were measured by a GC method. Moisture and color differences were determined by standard procedures. The color of all emulsion-treated grapes was significantly lighter than that of controls. The results of a 90-day accelerated storage study will be reported.

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EMULSIFIED TALLOW AS AN ANTITRANSPIRANT TO REGULATE WATER USF EFFICIENCY OF CROPS. William N. Lipe, Michael D. Gerst and Charles W. Wendt, Texas Agricultural Experiment Station, Route 3, Lubbock, TX 79401.

Antitranspirants have been shown to reduce water use and increase tuber size and yield of potatoes. The effectiveness of tallow, a natural resource, as an antitranspirant was tested on potatoes and onions in greenhouse and field studies. Successful emulsions of tallow in water were prepared with the aid of nonionic surfactants. Emulsion sprays containing up to 12% tallow by weight and levels to 54 kg tallow/ha were not toxic to potato plants. In lysimeter measurements during greenhouse trials, water use decreased, leaf resistance to water vapor loss increased and turgor pressure increased as a result of tallow treatment with an application level as low as 40 kg/ha. In field trials on potatoes and onions, tallow treatments reduced soil moisture stress between irrigations and resulted in increased yields. Treatment 2 weeks before harvest on onions resulted in an 18% increase in yield from 109 to 119 sacks/ha (23 kg each) due to larger bulb size. In large-scale field trials with potatoes, the tallow treatment (approximately 12.5 kg/ha) resulted in significant increases in both tuber size and yield. The value of the crop was increased by more than $1250/ha, primarily due to the increase in premium grades. The effect of tallow on soil moisture (neutron probe and tensiometer data), leaf resistance to vapor loss, turgor pressure and plant response were all equal to or better than treatment with a commercial antitranspirant.

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AROMATIC RING C STEROIDS. W. Basil Whalley and Clive L. Yeates, Department of Pharmaceutical Chemistry, The School of Pharmacy, University of London, 29-39 Brunswick Square, London WC1N 1AX, U.K.

This paper will describe the application of a novel process for the elimination of the C-18 methyl group from appropriate steroids, together with the concomitant conversion of ring C into an aromatic system. The structures of various products based upon chemical and X-ray crystallographic examination will be presented, together with associated chemistry.

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8,14-DIENES IN THE FUNCTIONALIZATION OF STEROID NUCLEUS. Mario Anastasia, Pietro Allevi, Alberto Fiecchi and Antonio Scala, University of Milan, Istituto di Chimica, Via Saldini 50, 20133 Milan, Italy.

The oxidation of the steroidic 7,9(11) and 7,14-diene systems is useful in the functionalization of B,C and B,D ring systems, respectively. Often the product formed is an epoxide ring, which is then transformed into more oxidized compounds, depending on the ratio and the nature of the oxidant, on acidic conditions or both. The action of chromic acid, substituted peroxybenzoic acids, $KMnO_4$ and $NaIO_4$ on an 8,14-diene system has been studied in order to functionalize B, C and D rings at specific positions. At least in the case of action of 3-chloroperoxybenzoic acid on 3β-acetoxy-5α-cholesta-8,14-diene (*1*), a mixture of 3β-acetoxy-8α,9α-epoxy-5α-cholest-14-ene (*2*) and 3β-acetoxy-14α,15α-epoxy-5α-cholest-8-ene (*3*) is formed. Compounds 2 and 3 are transformed into 3β-acetoxy-9α,15α-dihydroxy-5α-cholest-8(14)-ene (*4*) and 3β-acetoxy-15α-hydroxy-5α-cholesta-8(14),9(11)-diene (*5*), when the acidity is not buffered. The unsaturated diol (*4*) is also isolated in the oxidation of *1* with either $NaIO_4$ or $KMnO_4$. Chromic acid gives products functionalized in C,D or B,C,D rings by simply modulating the oxidant ratio and the reaction conditions. The utility of these reactions in steroid synthesis will be discussed.

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STEREOSELECTIVE INTRODUCTION OF HYDROXY GROUP ON THE SIDE CHAIN OF STEROL—SYNTHESIS OF BRASSINOLIDE AND VITAMIN D METABOLITES. Nobuo Ikekawa, Laboratory of Chemistry for Natural Products, Tokyo Institute of Technology, Nagatsuta, Midori-ku, Yokohama, 227, Japan.

The recent discoveries of various biologically active steroids, such as calcidiol lactone—a new metabolite of vitamin D_3, brassinolide—a new plant growth promoter, and antheridiol—the sex hormone of watermold, have facilitated challenges to stereocontrolled preparation of steroidal-side-chain-possessing hydroxy groups. Recently, the stereoselective construction of steroidal side chain was completed in our laboratory. The synthesis of those sterols will be discussed. Asymmetric reduction of steroidal 25-en-24-on was achieved by a complex of $LiAlH_4$ and 2,2'-dihydroxy-1,1'-binaphthyl, which led also to a stereoselective introduction of hydroxy group on the cholesterol side chain at C-24, 25 and 26 positions.

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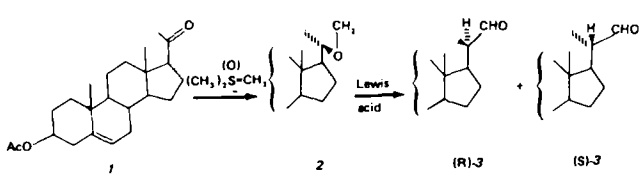
THE PREPARATION OF (20R)-3β-ACETOXY-22,23-BISNOR-5-CHOLENAL FROM ITS (20S)-EPIMER. Wolfgang Sucrow and Michael Van Nooy, Lehrstuhl für Organische Chemie, Universität Paderborn, Warburger Str. 100, 4790 Paderborn, Germany.

A larger number of experiments designed to separate the 20-epimeric 3-keto-22,23-bisnor-4-cholenals or 3β-acetoxy-22,23-bisnor-5-cholenals is described; none of them, however, was satisfying. Reaction between pregnenolone acetate (*1*) and either dimethylsulfonium or dimethylsulfoxonium methylide gives one single epoxide with the former reagent. The structure of the epoxide is probably *2*. In our hands, however, isomerization of *2* with boron trifluoride gave only 1:1 mixtures of the epimeric aldehydes (R)- and (S)-*3*, even at lower temperatures.



Some other Lewis acids furnished better results; gallium tribromide proved to be the best choice giving 80% (20R)- and 20% (20S)-3β-acetoxy-22,23-bisnor-5-cholenal. Pure (20R)-aldehyde can be obtained from this mixture by two crystallizations from diisopropyl ether. The purity of the epimeric aldehydes was judged from their ^{1}H-NMR-spectra and their gas chromatograms.

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STUDIES ON THE BIOSYNTHESIS OF THE OOGONIDE.

Not available at press time.

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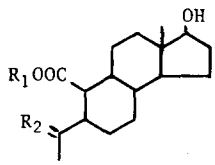
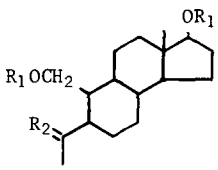
A ^{1}H NMR ANOMALY FOR STEROIDAL ALCOHOLS; REACTIONS OF A STEROIDAL γ-KETOACID. David M. Piatak, Kirk A. Ashline, George Angelos and Rebecca Swenson, Department of Chemistry, Northern Illinois University, DeKalb, IL 60115, and Eliahu Caspi, Worcester Foundation for Experimental Biology.

Huang-Minlon reduction of ketoacid **1**, methylation of the resultant acid **2**, and lithium aluminum hydride reduction of methyl ester **3** yielded a methylene alcohol **4**, whose acetate **5** and tosylate **6** derivatives exhibited ^{1}H NMR singlets for the C-1 methylene protons. Two alternate preparations of **5** revealed the iden-

tity of the compound to be correct. ^1H NMR spectra of the intermediates, particularly thioketal 7, indicate the NMR anomaly to be characteristic for compounds with only the ethyl moiety at C-5. These results and comparisons with results by Gut and coworkers for 21-hydroxycholesterols epimeric at C-20 and with other 21-hydroxysterols will be presented.





1. $R_1=H; R_2=O$
2. $R_1=H; R_2=H_2$
3. $R_1=CH_3; R_2=H_2$
4. $R_1=H; R_2=H_2$
5. $R_1=CH_3CO; R_2=H_2$
6. $R_1=Ts; R_2=H_2$
7. $R_1=CH_3CO; R_2=$ 

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OZONIZATION OF CHOLESTEROL. Jerzy Gumulka and Leland L. Smith, Hendrix Lab. Bldg., University of Texas Medical Branch, Galveston, TX 77550.

We have completed studies of the reactions in aqueous media of cholesterol with the several species of dioxygen and with the hydroxyl radical, and are presently involved in extending this interest to the reactions of cholesterol with the triatomic species ozone. Although the ozonization of cholesterol in organic solvents has been repeatedly described, the reaction in water is not recorded. Cholesterol in aqueous dispersion (1 mg/mL) is converted rapidly to two more polar peroxidic products and to one nonperoxidic product more polar than cholesterol but more mobile than the peroxides. At longer times a fourth minor, very polar, nonperoxidic product appeared. Isolation of pure peroxides has proven elusive, as these products appear to be unstable during manipulations. We are progressing in the purification and characterization of these several products. (Supported financially by the Robert A. Welch Foundation, Houston, Texas).

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BIOLOGICAL FILTRATION OF PARTIALLY HYDROGENATED FISH OIL IN A NONHUMAN PRIMATE SPECIES. R.G. Ackman and J-L. Sebedio, Fisheries Research and Technology Laboratory, Technical University of Nova Scotia, P.O. Box 1000, Halifax, N.S. B3J 2X4, Canada.

The feeding of partially hydrogenated herring oil at a high level to the nonhuman primate species *Macaca fascicularis* for up to 30 months resulted in depot fats obviously containing high proportions of monoethylenic acids, and some diethylenic acids from the dietary fat. The depot fat C_{16}, C_{18}, C_{20} and C_{22} monoethylenic acids and C_{18} diethylenic acids were examined to evaluate the selectivity in metabolizing the dietary fatty acids. Chain length isolates were converted to methoxy-bromomercuric adducts and fractionated on TLC plates by degree of unsaturation. Monoethylenic acids were recovered and fractionated by $AgNO_3$-TLC into *cis* and *trans* groups for oxidative fission by O_3 in BF_3-MeOH. The ratio of *cis* to *trans* materials was examined by direct GLC analysis on Apiezon-L, by $AgNO_3$-TLC and GLC (internal standard), and by Iatroscan analysis on Chromarods-S impregnated with $AgNO_3$. The C_{18} acids contained a significant proportion of diethylenic acids other than linoleic. Their classification and structures will also be discussed in detail.

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POSSIBLE ROLE FOR LUMINAL LECITHIN IN THE SELECTIVE ABSORPTION OF CHOLESTEROL BY THE INTESTINE. P. Child and A. Kuksis, C.H. Best Institute, University of Toronto, 112 College Street, Toronto, Ontario M5G 1L6, Canada.

Earlier studies on sterol absorption in vitro have led to the conclusion that isolated preparations of mucosal tissue are incapable of the selective uptake of cholesterol over sitosterol that is seen in vivo. We have recently confirmed the lack of discrimination between the two sterols using isolated rat jejunal villus cells. All of these earlier studies have been conducted in the presence of bile salts, which are known to adversely affect the integrity and permeability of cell membranes, but these effects may be reduced by inclusion of albumin and phospholipid in the incubation medium. In this paper, freshly isolated villus cells were incubated with 6.6 mM sodium taurocholate, 500 μM oleic acid, 400 μM 2-monoolein and 300 μM radioactively labelled cholesterol and sitosterol. The results demonstrated that the addition of egg yolk lecithin (0.50–1.35 mM) to the incubation media leads to a marked decrease in the overall rate of sterol absorption which is, however, associated with a qualitative reestablishment of the preferential uptake of cholesterol by the isolated cells. Using equimolar sterol solutions, the cholesterol/sitosterol cellular uptake ratio increased from 1.00 ± .01 (X ± S.D.n = 6) at zero time, which reflects the media ratio, to 1.21 ± .03 at 30 min, while the ratio in the absence of lecithin did not differ significantly from that in the medium. The effects of lecithin did not appear to depend upon the concentration in the range tested. Possible explanations for the effect include: reorganization of the bile salt-phospholipid micelle in which the sitosterol may be less available for absorption; a preservation or restoration or both of plasma membrane integrity, allowing a discrimination between the two sterol structures; increased chylomicron assembly stimulated by the presence of phosphatidylcholine or a combination of the above. Experiments are in progress to distinguish among these possibilities and to determine the physicochemical or metabolic basis of the discrimination between cholesterol and sitosterol. (Supported by the Medical Research Council of Canada and the Ontario Heart Foundation).

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ESSENTIAL FATTY ACID DEFICIENCY AS INFLUENCED BY THE TYPE OF DIETARY CARBOHYDRATE. K. Ananth Narayan and John J. McMullen, Food Sciences Laboratory, Food Biochemistry Group, U.S. Army Natick Research and Development Laboratories, Natick, MA 01760.

Since the classical experiments of Burr and Burr, essential fatty acid deficiency has been induced in rats using sucrose as the primary carbohydrate in fat-free diets. Our experiments with dietary glycerol demonstrated a significant difference between dietary glucose and glycerol with respect to the accumulation of triglycerides and cholesterol in livers of rats maintained on essential-fatty-acid-deficient diets. Other studies showed that dietary glycerol and sucrose, but not glucose, caused fatty livers in rats. Additional experiments were therefore carried out to assess the cumulative effects of fat-free diets containing starch (corn and wheat, 1:1) without and with 30% glycerol or sucrose and 30% glycerol as well as glucose and 30% glycerol supplemented with marginal or optimum level of corn oil. Over a 29-week period, the starch, fat-free diet failed to produce fatty livers in male Holtzman rats (starting weight and age, 72 g and 24 days), whereas the addition of 30% glycerol to the same diet caused extensive fat deposition. The combination of 30% glycerol and 45% sucrose exacerbated the response in the rat liver. While the addition of 5% corn oil prevented fatty livers, a marginal level of 0.5% corn oil was insufficient to counteract the deleterious effect of glycerol. Taken in conjunction with other data from this laboratory, which indicated that as little as 10% glycerol caused extensive fatty livers in rats given a fat-free diet, it would appear that there is a fundamental difference in the way in which dietary glucose or starch is metabolized as compared with sucrose or glycerol.

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CHANGES IN HDL-CHOLESTEROL AND HDL-PHOSPHOLIPIDS DURING PROLONGED ABSOLUTE FASTING. A. Christophe and G. Verdonk, Lab. of Gerontology, Dietetics, State University, Ghent, Belgium.

Serum high density (HDL) cholesterol and serum HDL phospholipids were determined in five obese women before starvation and after 10 and 21 days of absolute fasting. In the initial period of absolute fasting, there was a decrease in HDL-cholesterol, (5/5) from 34 to 23 mg/dl as an average after 10 days. After 21 days of absolute fasting, HDL cholesterol was higher than after 10 days (5/5), averaging 28 mg/dl. Only in one individual were prestarvation values surpassed. Ten days of absolute fasting had no significant effect on HDL phospholipid concentration (77 vs 76 mg/dl before fasting). As a result, there was a significant decrease in the cholesterol/phospholipid ratio of the HDL (4/5) after 10 days of absolute fasting (0.30 vs 0.44). Prolongation of the fast resulted in a slight increase in HDL phospholipids (4/5, 6 mg/dl as an average). As HDL cholesterol rose to about the same extent in this period (5/5; 5 mg/dl as an average) there was a small but consistent (5/5) increase in the HDL cholesterol/HDL phospholipid ratio (to 0.34). These results clearly illustrate that the changes HDL cholesterol and phospholipid levels caused by fasting depend on the length of the fast. They also demonstrate that absolute fasting results in a change in the HDL lipid composition. Mechanisms that may explain the observed changes will be discussed.

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UNFAVORABLE EFFECT ON FASTING HDL-CHOLESTEROL LEVELS OF DIETS THAT RESULT IN REDUCED LYMPHATIC FAT TRANSPORT. A. Christophe and G. Verdonk, Laboratory for Gerontology, Dietetics and Nutrition Research, State University of

Ghent, Belgium.

Isocaloric diets, in which fat is severely restricted (as in carbohydrate-enriched diets and intravenous glucose feeding) or which contain fats that do not yield chylomicrons (e.g., MCT, monoglycerides) result in low fasting HDL-cholesterol levels. Moreover in patients on such diets, the fraction of the serum cholesterol carried by the high-density lipoproteins was much lower (about 13%) and less variable than in subjects on usual fat-containing diets (in which 22% of the total cholesterol was found to be carried by the HDL as an average. After 4 days of feeding energy-restricted diets (2800kJ/day) to obese patients, the decrease in HDL-cholesterol was greater in case the fat intake was restricted to about 20 g/day than in case the fat intake amounted 40 g/day (no reduction of HDL chol as an average). These findings suggest that in individuals with undisturbed lipoprotein metabolism, severe restriction of fat intake is contra-indicated. Thus, in an isocaloric framework, reduction of saturated fat intake, which remains advisable, is best achieved by replacement of these fats by polyunsaturated fats rather than by carbohydrates.

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EFFECT OF INTERESTERIFICATION OF OILS AND FATS ON SERUM LIPID CONSTITUENTS OF CHOLESTEROL BILE SALT-STRESSED RATS. Grace George and D.P. Sen, Discipline of Lipid Technology, Central Food Technological Research Institute, Mysore-570 013, India.

Blends of Sal (*Shorea robusta*) fat and groundnut (*Arachis hypogaea*) oil (30:70 by weight) and (b) Sal fat and safflower (*Carthamus tinctorius*) oil (50:50) and cotton (*Gossypium* Sp) seed oil were interesterified to get plastic fats with capillary slip points of 33 C, 33.5 C and 34 C respectively. These test materials had linoleic acid contents of 25.4, 41.3 and 48% and saturated fatty acid contents of 32.3, 32.1 and 32.9% respectively. Interesterified products and the original materials at a 10% level of the diet providing 23% of total calorie intake were fed to adult male rats of Wistar strain that were made hyperlipidemic with a pretest diet containing vanaspati (partially hydrogenated vegetable oil, also called Indian margarine), cholesterol and bile salt. Compared to vanaspati, different products and corresponding original stocks had significant hypolipidemic effects ($P = 0.05$) that could be correlated in a general way with their linoleic acid contents. Both the original stocks and their corresponding rearranged products had statistically identical effects on terminal serum total cholesterol, total lipids, triglycerides and phospholipids. Cholesterol content of liver tissue was also significantly lowered by different test materials. Rearranged fats behaved similar to the starting stock material. Determination of triglyceride composition indicated that compared to starting material, there was considerable migration of saturated fatty acids from 1, 3-position to 2-position and unsaturated fatty acids from 2-position to 1, 3-position of glycerol moiety. Thus, the hypolipidemic effect of test fats was dependent on their total linoleic acid contents, and not on the position it occupied in the triglyceride molecules.

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EFFECT OF DIETARY LIPID TYPE ON THE COMPOSITION OF PLASMA CHOLESTERYL ESTERS IN THE MALE MONGOLIAN GERBIL AND PLASMA LECITHIN:CHOLESTEROL ACYLTRANSFERASE. Nina J.H. Mercer and Bruce J. Holub, Department of Nutrition, University of Guelph, Guelph, Ontario, Canada, N1G 2W1.

Male Mongolian gerbils (*Meriones unguiculatus*) were fed semi-purified diets containing 20% by weight safflower oil (SO), lard (L), or beef tallow (BT), balanced for endogenous levels of plant sterol and cholesterol. The SO-fed gerbils exhibited the lowest plasma cholesterol concentration and also the highest percentage of cholesterol in the esterified form. Animals fed BT had total plasma cholesterol levels greater than those of gerbils fed L or SO. SO-fed gerbils exhibited an increase in the percentage of 18:2 with lowered levels of 16:0, 16:1, 18:0 and 18:1 relative to the L-fed controls. The BT-fed gerbils displayed higher levels of 16:0; 16:1, 18:0 and 18:1 with a lower percentage of 18:2 relative to L-fed controls. The percentage of esterification of endogenous-free cholesterol to CE via plasma lecithin:cholesterol acyltransferase (LCAT) activity was always highest in the plasma of SO-fed gerbils and lowest in plasma from BT-fed gerbils, whereas the L-fed group was intermediate between the SO and BT dietary treatments. LCAT activity may be partly responsible for the change in CE/C ratio observed when fats with widely differing P/S ratios are fed. (Supported by the Ontario Heart Foundation.)

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EFFECTS OF METHYLMALONYL CoA ON CHAIN ELONGATION OF γ-LINOLENIC ACID. James J. Peifer and J. Morgan, Department of Foods and Nutrition, University of Georgia, Athens, GA 30602.

Liver microsomes from essential-fatty-acid-deficient rats were used to test the effects of methylmalonyl CoA on chain elongation of γ-linolenic acid. Labeled γ-linolenic acid was prepared by aerobic incubation of the microsomal preparation with [1-^{14}C] linoleic acid. Anaerobic incubation of 30 nM of malonyl CoA with 21 nM of γ-linolenic acid promoted 6.9% chain elongation to form dihomo-γ-linolenic acid and some arachidonic acid. Further additions of either 58 nM or 251 nM of methylmalonyl CoA did not significantly affect the malonyl CoA-dependent chain elongation of γ-linolenic acid.

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CHAIN ELONGATION OF POLYUNSATURATED FATTY ACIDS BY BRAIN. IS ACTIVATION WITH COENZYME A ESSENTIAL? Harold W. Cook, Dalhousie University, Room C-R1, C.R.C., 5849 University Avenue, Halifax, N.S. B3H 4H7, Canada.

Polyunsaturated fatty acids, derived from essential fatty acids by desaturation and elongation, are significant components of brain membrane lipids, particularly those with gray matter. To complement our previous in vitro studies of Δ9, Δ6 and Δ5 desaturation by brain preparations, we have investigated chain elongation of polyunsaturated acids using microsomes from developing rat brain. With 18:3(n-6) in 0.05% detergent as acceptor and [2-^{14}C)malonyl-CoA as 2-carbon donor, incorporation of radioactivity into 20:3(n-6) was maximal (and incorporation into other acyl chains was minimal) in the presence of 100 μM substrate, 200 μM p-bromophenacylbromide and 10 mM KCN. Up to 30% of the labeled products were incorporated into phospholipids and triacylglycerol. Maximal microsomal elongation activity was observed at 3–4 weeks of age. Several other fatty acid or acyl-CoA acceptors tested in this system were elongated at slower rates compared to 18:3(n-6) [e.g., 16:0-CoA–75%; 20:4 (n-6)–57%; 18:3(n-3)–13%; 18:2(n-6)–10%; 20:3(n-6)–6%]. Rates of elongation of chemically synthesized 18:3-CoA were only 50% that of detergent-suspended acid and were optimal at 6 μM substrate; the inhibition above 6 μM 18:3-CoA was reduced by bovine serum albumin but incorporation of label into palmitate was greatly stimulated. Coenzyme A markedly inhibited elongation of 18:3(n-6) or 18:3-CoA; N-ethylmaleimide at equimolar amounts reversed this coenzyme A inhibition but did not alter the inhibition caused by concentrations of 18:3-CoA above 6 μM. ATP was absolutely required for elongation of either the free acid or the acyl-CoA derivative, whereas exogenous $MgCl_2$ had little effect. These in vitro results suggest that the polyene elongation system of developing brain is active with 18:3(n-6) and 20:4(n-6) in the free acid form and that acyl activation to a coenzyme A derivative may not be an obligatory step.

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DIETARY HYDROGENATED FAT AND LIPOGENIC ENZYMES IN RAT ADIPOSE TISSUE. Beth A. Wilck and Brian L. Walker, Department of Nutrition, University of Guelph, Guelph, Ontario, Canada N1G 2W1.

Female rats were fed purified diets containing 10% hydrogenated or nonhydrogenated fat. The offspring of these animals were weaned at 30 days of age to the diet of the dam. Activities of fatty acid synthetase (FAS), glucose-6-phosphate dehydrogenase (G6PDH), malic enzyme (ME), and citrate cleavage enzyme (CCE) were determined in adipose tissue from 30-, 60- and 120-day-old progeny. In general, enzyme activities were higher in female rats. Dietary hydrogenated fat resulted in significantly elevated activities of G6PDH, ME and CCE in adipose tissue from male rats and their was also a tendency for FAS to be elevated in this group.

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INHIBITION OF AcylCoA:CHOLESTEROL ACYLTRANSFERASE (EC 2.3.1.26) BY LOCAL ANESTHETICS IN VARIOUS TISSUES FROM THE RAT. Frank P. Bell, Diebetes-Atherosclerosis Research, The Upjohn Company, Kalamazoo, MI 49001.

The local anesthetic lidocaine has been found to be a potent inhibitor of acylCoA:cholesterol acyltransferase (ACAT) in rat adrenal, liver, and aorta. The effect of lidocaine is concentration-dependent over the range 1–5 mM and selective in that inhibition of the synthesis of lipids other than cholesteryl esters is minimal. The inhibition of ACAT by lidocaine can be observed in vitro in intact tissues, tissue homogenates or isolated microsomes. Assay of ACAT in adrenal, hepatic and aortic microsomes by following the incorporation of ^{14}C-oleoylCoA into ^{14}C-cholesteryl esters demonstrates that 50% inhibition of ACAT is achieved at lidocaine levels between 0.5 and 1.0 mM. Other local anesthetics are also effective inhibitors of ACAT, with some showing greater or less effectiveness than lidocaine.

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SIMULTANEOUS QUANTIFICATION OF PROSTAGLANDINS E_2 AND E_3 BY ISOTOPE DILUTION GC-MS. A. Ferretti, N.W.

Schoene, V.P. Flanagan and J.M. Roman, Lipid Nutrition Laboratory, BHNRC, USDA, Room 122, Bldg. 308, Beltsville, MD 20705.

A method for the simultaneous quantitative analysis of prostaglandins E_2 (PGE_2) and PGE_3 is described. The PGs were analyzed by selected ion monitoring as the methyl ester-trimethylsilyl ether derivatives of PGB_2 and PGB_3, respectively. The internal standard for the quantification of both species was [3,3,4,4-$^2H_4$] PGE_2. A linear response over the range 0.6-50 ng (1.7-143 pmoles) was demonstrated for PGE_3. New standard curves for PGE_3 must be obtained each time the ion source parameters are changed. The use of the procedure is exemplified by its application to the PG analysis of incubated rat kidney medullae. Data on precision and accuracy of the method are presented. (We are indebted to Drs. U.F. Axen and J.E. Pike, The Upjohn Co., for generous supplies of PGE_2, PGE_3, and [3,3,4,4-$^2H_4$] PGE_2.)

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THE EFFECT OF THROMBIN ON THE FATE OF ARACHIDONIC ACID IN THE PHOSPHOLIPIDS OF HUMAN PLATELETS. Bruce J. Holub, Department of Nutrition, University of Guelph, Guelph, Ontario, Canada N1G 2W1, and Vincent A. Ziboh, University of Miami School of Medicine.

The release of arachidonic acid from platelet phospholipids is enhanced by platelet aggregating agents such as thrombin. The free acid can then be metabolized to various derivatives, including thromboxane A_2, which is pro-aggregatory. In this study, platelet-rich plasma was prepared from the blood of human donors and incubated [^{14}C] arachidonic acid. A suspension of washed platelets was then prepared and suspended in buffer so that almost all of the radioactivity was associated with the cellular phospholipids. Exposure to thrombin (5-30 min) decreased the amount of radioactivity associated with all phospholipids, although the greatest absolute loss was from phosphatidylcholine (PC) followed by phosphatidylinositol (PI), whereas the ethanolamine-containing phospholipid (PE) showed a significant increase in the radioactivity associated with it. The losses were also accompanied by increases in the phosphatidic acid fraction and free arachidonate plus its metabolites. These results suggest that thrombin exposure (1 U/ml for 5-30 min) promoted the release of free arachidonic acid from cellular phospholipid (predominantly PC), the conversion of arachidonoyl PI to arachidonoyl phosphatidate via PI phosphodiesterase and diacylglycerol kinase activities, and the transfer of arachidonate from PC to PE. (Supported by NSERC of Canada [BJH], Grant AM14941 of the U.S. Public Health Service and the American Heart Association [VAZ].)

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MONOGLYCERIDE LIPASE ACTIVITY IN OB_{17} CELL LINE AS A FUNCTION OF ADIPOCYTE DEVELOPMENT. M.G. Murphy, Department of Pharmacology, Sir Charles Tupper Medical Building, Dalhousie University, Halifax, N.S. B3H 4H7, Canada, R. Negrel and G. Ailhaud, Centre de Biochimie, LP 7300, Université de Nice, France.

The main lipolytic enzymes of adipose tissue are lipoprotein lipase (LPL), involved in the utilization of exogenous triacylglycerol, and hormone-sensitive lipase (HSL), involved in the mobilization of intracellular triacylglycerol. However, the role of monoglyceride lipase (MGL), already characterized and purified from rat adipose tissue, is far from understood. This study has been conducted with ob_{17} cells (a preadipose clonal line originating from "dedifferentiated" epididymal adipocytes of genetically obese mice) which are able, in culture, to convert into adipose cells at the resting state. Monoacylglycerol hydrolysis (MGL activity) was first shown to be distinct from LPL and from HSL based on: (a) selective assay conditions in the presence of Triton X-100; (b) deactivation rate; (c) turnover rate in the presence of cycloheximide; and (d) differential rate of release by heparin. Inclusion of differentiation-blocking agents (bromodeoxyuridine, $PGF_{2\alpha}$) in the culture medium led, for MGL as for LPL, to levels similar to those obtained in exponentially growing cells, in contrast to unspecific monoester hydrolase. In differentiated cells, MGL was partially released in the culture medium or by short-term treatment with heparin. Therefore, the above results indicate that MGL is part of the differentiation program leading to adipose cells. They are in favor of its involvement, in conjunction with LPL, in the hydrolysis of exogenous triacylglycerol.

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THE INFLUENCE OF AGE ON THE FATTY ACID COMPOSITION AND CONTENT OF LIVER LIPIDS FROM ETHANOL-FED RATS. Steven C. Goheen, Elaine E. Lahue, Edward C. Larkin and G. Ananda Rao, Veterans Administration Medical Center, Hematology Research Laboratory (151H), 150 Muir Road, Martinez, CA 94553.

When rats of four different age groups (23-27 d, 39-42 d, 51-54 d and 95-120 d) were fed ad libitum a liquid diet containing ethanol (Lieber-DeCarli diet) for 30 d, the youngest rats consumed the least (44.1 ml/d) while the oldest consumed the most (96.4 ml/d). However, the diet consumption per g body weight was the highest among the youngest rats (0.263 ml/g for youngest rats; 0.189 ml/g for oldest rats). The body weight gain of rats in the oldest group was significantly lower than the gain of other age groups. Rats in all groups developed fatty liver. Quantities of total lipids, TG, PL and CE/g liver were unaffected by age. Fatty acid composition of various liver lipids were similar in all groups. Only minor changes in the fatty acid composition of lipids were attributed to age. Relative levels of 16:0 increased significantly with age in rat liver TL, TG and CE. This increase in the level of 16:0 was also observed in adipose tissue lipids. Levels of 20:0, 18:3, 20:3, 22:0, 24:0, 22:4 and 22:6 from various lipid classes also decreased consistently with age. Therefore, the degree of fatty liver does not vary significantly with age in alcohol-fed rats, whereas liver lipid fatty acid composition does change.

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LIPOLYSIS OF HUMAN MILK FAT BY MILK BILE SALT STIMULATED AND HUMAN LINGUAL LIPASES. Robert G. Jensen, Mark B. Fey and Lisa G. Lambert, Department of Nutritional Sciences, U-17, University of Connecticut, Storrs, CT 06268, and Margit Hamosh, Georgetown University.

The bile-salt-stimulated lipases (BSSL) in human milk, activated in this study by freezing and thawing, produced mostly 1,2-diacylglycerols (DGs) from human milk fat. The presence of 1,2-DGs indicates specificity for primary esters. The free fatty acids (FFA) contained among others: 16%, 18:0; 44.7%, 18:1 and 20.1%, 18:2. Since these acids are esterified mostly to the primary positions of human milk triacylglycerols (TGs), specificity for primary esters is again indicated. There was 11.2%, 16:0 in the FFA, because this acid is found mostly in the 2-position of the TGs. The DGs had quantities of 16:0, 18:0 and 18:1 representative of the 1,2-isomer, and the monoacylglycerols were mostly 16:0; thus the 2-isomer, which provides more data supporting the concept of primary position specificity for BSSL. This milk enzyme hydrolyzes fats in the small intestine. Human lingual lipase (LL), present in stomach aspirates from infants, had a slightly different pattern of lipolysis. When human milk, pasteurized to inactivate BSSL, was incubated with LL, we found the following fatty acid compositions: FFA, 55.8%, 18:1, and 25.4%, 18:2. Whereas these data may suggest a specificity for unsaturated fatty acids, a more plausible explanation is specificity for primary esters for TGs; both acids are located mostly in the primary positions. This enzyme hydrolyzes fats in the stomach.

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TECHNICAL COOPERATION AMONG DEVELOPING COUNTRIES IN VEGETABLE OILS AND FATS INDUSTRY. Raja Jaffan, UNIDO.

The main purpose of this article is to identify the means for technical cooperation among the developing countries in the vegetable oils and fats industry. Different technologies used for oilseed processing in the developing countries are reviewed. Underutilization of plant capacities was a common dominator to almost all the production units of the developing countries. This was mainly due to a poorly developed to nonexistent productive vegetable oils system, and to the absence of effective technical infrastructure. Four main elements of technical infrastructure were examined. Several sources for technology transfer were reviewed and assessed to determine the optimal partner with minimum cost. The article concludes that technology transfer is a mean for technical cooperation within developing countries in the vegetable oils sector, provided there is a technological gap between them.

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CHARACTERIZATION OF COMPLEX MIXTURES OF PLANT PROTEINS BY AUTOMATED GEL FILTRATION CHROMATOGRAPHY. Marshall L. Fishman, Eastern Regional Research Center, Agricultural Research, Science and Education Administration, 600 E. Mermaid Lane, Philadelphia, PA 19118.

The extraction of plant proteins for use as food and feed often yields a complex mixture of proteins with a broad molecular weight distribution. An automated gel filtration chromatograph has been developed to analyze quantitatively up to 5 samples with one loading. Analysis time on the chromatograph is typically 15 hr/5 samples. Samples ranging in molecular weight from 1 x 10^6 to 400 can be characterized. In addition to molecular weight data, information on solubility and on changes in protein composition caused by side reactions with endogenous aromatic compounds is obtained. Data are collected simultaneously in analog form for easy visualization and in digital form for rapid off line processing by a programmable electronic calculator. At present, the method has been applied successfully in characterizing proteins extracted from leaves and seeds. The results from several of these applications will be presented.

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THE EFFECT OF ANIONIC HYDROCOLLOIDS ON THE SOLUBILITY OF ISOLATED SOYBEAN PROTEINS. Philip A. Jaroslow and Michael V. Taranto*, Rm 104 Dairy Manufactures Building, University of Illinois, Urbana, IL 61801.

This research investigated the effects of hydrocolloids on the aqueous solubility of commercial and laboratory-prepared isolated soy proteins. The protein solubility characteristics of the soy isolates under different conditions of pH, concentration of NaCl, protein and alginate were evaluated. The dependence of these reactions on pH and ionic strength confirmed that electrostatic interactions between the negative charges of the alginate chain and negative and/or positive charges of the protein are responsible for the observed behavior. Following this, various commercial gums were screened for soy protein reactivity under optimal conditions for interaction. Differences in soy protein reactivity among the hydrocolloids can be explained on the basis of differences in their molecular charge and structure. Finally, the formation of soy protein-polysaccharide complexes were investigated using polyaerylamide gel electrophoresis. Characterization of the above interactions provide a theoretical framework for interpreting present and potential uses for these substances in engineered foods.

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EFFECTS OF CHEMICAL MODIFICATION OF COTTONSEED PROTEINS ON CHEMICAL AND FUNCTIONAL PROPERTIES. Y.R. Choi, E.W. Lusas and K.C. Rhee*, Food Protein Research and Development Center, Texas A & M University, College Station, TX 77843.

To study the relationship between protein structure and functional properties, protein was extracted at pH 10.0 from defatted cottonseed flour, and modified with maleic, acetyl, succinyl and 2-methylglutaryl anhydrides and Na_2SO_3. Protein recovery and selected functional and physicochemical properties of the modified proteins were then determined. Acylation of proteins with acetyl, maleic, succinyl and 2-methylglutaryl anhydrides increased protein recovery, whereas Na_2SO_3 modification showed no significant effect. Maleylation, succinylation and 2-methylglutarylation increased water solubility but decreased heat coagulability and calcium precipitability of the protein markedly; however, acetylation increased heat coagulability and calcium precipitability. Changes of other functional properties resulting from protein modifications were also studied, and attempts were made to elucidate the relationships between protein structure and functionality, and deacylation and in vitro digestibility of the resulting products.

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INVESTIGATION OF THE PARAMETERS AFFECTING THE FUNCTIONALITY AND QUALITIES OF SOY PROTEINS IN EXTRACTION PROCESS—II. A.H. Chen, Anderson Clayton Foods, Richardson, TX 75080, P.M.T. Hansen, Ohio State University, and R.A.M. Delaney, Pillsbury Incorporated.

The soy isolate process was investigated with a three level, fractional factorial experimental design. The extraction process parameters of pH, temperature and nitrogen solubility index of soy flour were studied within the range of 7–11, 30–70 C and 27–84 respectively. Response surfaces were generated for the quality attributes including color, flavor and lysinoalanine content of the isolate; and the process responses such as yield of isolate and suspended solid content in the extract. Analysis of coefficient ratio from the Canonical Transformation were used to illustrate the significance of the parameters to the quality attributes and the process responses. A gel electrophoretic technique was used to detect the molecular alteration.

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FORMULATION OF NONDAIRY COFFEE WHITENERS WITH MODIFIED COTTONSEED PROTEINS. Y.R. Choi, E.W. Lusas* and K.C. Rhee, Food Protein Research and Development Center, Texas A & M University, College Station, TX 77843.

Nondairy coffee whiteners were produced with cottonseed protein isolates prepared by four different procedures: aqueous extraction, coventional alkaline extraction and acid precipitation, and partial modification of proteins through succinylation at levels of 40 and 54%. The feasibility of utilizing these four cottonseed isolates in the formulation of analog coffee whiteners was investigated. Analog coffee whiteners formulated with succinylated proteins showed significant enhancement in whitening ability, dispersibility and oil retention ability, while reducing the syneresis of coffee and whitener mixtures.

*Presenting author.

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ISOLATION AND PURIFICATION OF DEOXYNIVALENOL AND A NEW TRICHOTHECENE BY HIGH-PRESSURE LIQUID CHROMATOGRAPHY. G.A. Bennett, R.E. Peterson and R.D. Plattner, Northern Regional Research Center, 1815 N. University Street, Peoria, IL 61604.

Deoxynivalenol (3,7,15-trihydroxy-12,13-epoxytrichothec-9-ene-8-one) was isolated from corn with methanol:water (80:20, v/v) and purified by liquid:liquid partitioning and by preparative high-pressure liquid chromatography (HPLC) on a Prep PAK 500™ silica column [methylene chloride:methanol (98:2, v/v)]. This procedure was used to prepare quantities of toxin from field-inoculated corn for reference standards. Analysis of the isolated deoxynivalenol by analytical HPLC, gas liquid chromatography (GLC), and gas liquid chromatography/mass spectroscopy (GC/MS) indicated the presence of a second compound similar to deoxynivalenol. This compound comigrates with deoxynivalenol on thin layer chromatography plates in chloroform:methanol (90:10, v/v), but can be separated by HPLC on a reverse phase C_8 column with methanol:water (10:90, v/v). GC/MS of the compound and the trimethylsilyl ether derivative gave parent ions of m/e 280 and 424, respectively. These data with UV and NMR data suggest that the compound is a dihydroxy-12,13-epoxytrichothec-9-ene-8-one—a previously unreported trichothecene.

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ISOLATION OF ALTENUISOL AND ALTERTOXINS I AND II, MINOR MYCOTOXINS ELABORATED BY *ALTERNARIA*. F.S. Chu, Food Research Institute, 1925 Willow Drive, University of Wisconsin, Madison, WI 53706.

A method for the isolation of mg quantities of three minor *Alternaria* mycotoxins—altenuisol (AS), altertoxin I (AT-I), and altertoxin II (AT-II)—was developed. Crude toxin preparation was first subjected to a preparative HPLC step using PrepLC/System 500 and a silica gel type column. The three minor toxins were eluted from the column with 25% ethyl acetate in hexane and were separated from the major *Alternaria* toxins. Further purification of these toxins was achieved by passing the partially purified toxins once through a small Sephadex LH-20 column (2.5 x 25 cm) and again through a large Sephadex LH-20 column (3.5 x 37 cm). A solvent system of hexane: methylene chloride:methanol (1:1:1, v/v/v) was used in the Sephadex step. Under those conditions, AT-I was eluted from the Sephadex column first, followed by AT-II and AS. The distribution of various *Alternaria* mycotoxins in different fractions obtained from the Sephadex step and some of the physicochemical properties of AT-I and AT-II will be described.

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AFLATOXIN-INDUCED MEMBRANE ALTERATIONS IN SOYBEAN. W.V. Dashek, J.M. Danley, S.J. Walker and G.C. Llewellyn,* Departments of Biology, WVU, Morgantown, WV, and VCU, Richmond, VA.

Isolates of aflatoxin (AFB_1)-producing, *Aspergillus* strains can grow on autoclaved and to a lesser extent on field-grown soybeans. Exogenous AFB_1 can inhibit bean germination and elongation of both attached and cultured, excised *Glycine max*, cv. "Essex" roots. Reduced [^{14}C]-leucine uptake by the latter suggests that AFB_1 may impair amino acid transport by modifying membrane structure/chemistry. To test this, crude plasmalemma pellets, (80,000 x g, 30 min following precentrifugations of root homogenates) were characterized chemically. Statistically significant differences in acid-insoluble protein (but not sterol or lipid phosphorus) between AFB_1-treated and nontreated roots were observed for the 80,000xg pellet that was cross-contaminated with mitochondria, Golgi Bodies and endoplasmic reticulum. Discontinuous sucrose gradient centrifugation of the 80,000 x g pellet yielded three organelle bands. Band 2 (34–40% interface) contained most of the pH 6 (plasmalemma marker) and 9 (mitochondrial marker) K+ stimulated ATPase activities that were recovered from the gradient, possessed some IDPase activity (dictyosome marker) and exhibited statistically significant differences in acid-insoluble protein between treated and nontreated roots. Results of an in progress Sephadex gel filtration analysis of acid-insoluble or detergent-released plasmalemma membrane proteins will be presented. This analysis is to determine whether AFB_1 reduces the content of a specific or, alternatively, every plasmalemma associated protein. (This investigation was supported by American Cancer Society Grant IN-127 [WVD], a Sigma Xu award [JMD] and funds from the WVU and VCU Departments of Biology.)

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DISTRIBUTION AND METABOLISM OF (^{3}H)-ZEARALENONE IN A LACTATING COW. C.J. Mirocha, Department of Plant Pathology, University of Minnesota, 304 Stakman Hall of Plant Pathology, 1519 Gortner Ave., St. Paul, MN 55108.

Within 48 hr after administration (per os) of (^{3}H)-Zearalenone, more than 85% of the radioactivity could be accounted for in the feces; within 72 hr, 92% was excreted. The urine accounted for 0.6% of the administered radioactivity, followed by bile (0.02%) and milk (0.02%). The highest radioactivity appeared in feces about 32 hr after administration; in the urine at about 28 hr and in the milk at about 60–72 hr. Analyses of zearalenone in the urine by RIA revealed free zearalenone (15%) and averaged 0.24 ppm; the conjugate (85%) averaged 1.29 ppm. Analysis by GC-MS revealed zearalenone (1.4 ppm), α-zearalenol 0.63 ppm and β-zearalenol 2.8 ppm. The feces contained a total of 93.2 ppm zearalenone metabolites, zearalenone at 43.4 ppm, β-zearalenol at 38.4 ppm, and α-zearalenol at 15.4 ppm. The muscle contained 0.5–11.8 ppb of zearalenone and the liver contained 19.0–26.8 ppb; no zearalenol could be found in the muscle. Bovine milk (RIA analysis) contained 16–76 ppb total metabolites; both α- and β-zearalenols were present. Blood serum contained 34–48 ppb zearalenone.

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THE DISTRIBUTION OF AFLATOXINS IN CONTAMINATED BEEF LIVER AND OTHER TISSUES. R.D. Stubbiefield and O.L. Shotwell, Northern Regional Research Center, AR, SEA, U.S. Department of Agriculture, 1815 N. University, Peoria, IL 61604.

A calf was fed subacute toxic levels of aflatoxins added to feed. After the calf was slaughtered, the liver, spleen, heart, kidney and skeletal muscle (flank) were investigated to determine the concentration and the uniformity of aflatoxin distribution in the animal tissues. Aflatoxins B_1, B_2, G_1, G_2 and M_1 were found and confirmed in the liver, the target organ of aflatoxicosis. Levels of 14–54 ng/g total aflatoxin were present in the liver subsections. When values for subsections <100 g were omitted, aflatoxin distribution throughout the liver was uniform.

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THERMAL INTERACTION OF OXIDIZING LINOLEATE WITH THREONINE. A. Witchwoot and W.W. Nawar, Department of Food Science and Nutrition, Chenoweth Lab, University of Massachusetts, Amherst, MA 01003.

Studied on thermal oxidation of lipids provide information on the variety of decomposition products that may be formed during the frying, cooking, baking and broiling of foods. However, other food components may interact with the lipids during the heating process, which results in a modification of the thermal decomposition pattern. In this study, model systems were used to study thermal interaction of unsaturated fatty acids with amino acids. Threonine, a mixture of threonine with ethyl linoleate, and a mixture of threonine with propyl linoleate, were heated in air at 185 C. The volatiles were fractionated into polar and nonpolar fractions, which were then analyzed by gas chromatography and mass spectrometry. The major oxidative products of linoleate, i.e., hexanal, t,t-2,4-decadienal, ethyl-9- and propyl-9-oxononanoate, either disappeared or were markedly reduced in the volatile patterns when threonine was present. On the other hand, new compounds which are currently being identified were formed in the heated mixtures. These must be considered products of interaction since they did not form when the esters or the amino acid were heated alone.

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ANALYSIS OF AUTOXIDIZED FATS BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY. VII: VOLATILE THERMAL DECOMPOSITION PRODUCTS OF PURE HYDROPEROXIDES FROM AUTOXIDIZED AND PHOTOSENSITIZED OXIDIZED METHYL OLEATE, LINOLEATE, AND LINOLENATE. E.N. Frankel, W.E. Neff and E. Selke, Northern Regional Research Center, 1815 North University, Peoria, IL 61604.

To clarify the sources of undesirable flavors, pure hydroperoxides from autoxidized and photosensitized oxidized fatty esters were thermally decomposed in the injector port of a gas chromatograph-mass spectrometer system. Major volatile products were identified from the hydroperoxides of methyl oleate, linoleate and linolenate. Although the hydroperoxides from autoxidized esters are isomerically different in position and concentration than those from photosensitized oxidized esters, the same major volatile products were formed, but in different relative amounts. Distinguishing volatiles were, however, produced from each type of hydroperoxide. The 9- and 10-hydroperoxides of photosensitized oxidized methyl oleate were thermally isomerized in the injector port into a mixture of 8-, 9-, 10-, and 11-hydroperoxides similar to that of autoxidized methyl oleate. Under the same conditions, the hydroperoxides from autoxidized linoleate and linolenate did not undergo significant interconversion with those from the corresponding photosensitized oxidized esters. The compositions of the major volatile decomposition products are explained by the classical scheme involving carbon-carbon scission on either side of alkoxy radical intermediates. Secondary reactions of hydroperoxides are also postulated, and the endoperoxide hydroperoxides from methyl linoleate (photosensitized oxidized) and methyl linolenate (both autoxidized and photosensitized oxidized) are suggested to be important precursors of volatiles.

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THE QUANTIFICATION OF CARBONYL COMPOUNDS IN OXIDIZED FAT BY GAS CHROMATOGRAPHY OF THE TRICHLOROPHENYLHYDRAZONES. Pamela J. White and Earl G. Hammond, Department of Food Technology, Dairy Industry Building, Iowa State University, Ames, IA 50011.

A rapid, reliable determination of the carbonyl flavor compounds in oxidized fats and oils has proved elusive, especially because of the ease with which hydroperoxides can generate additional carbonyl compounds during isolation procedures. Carbonyl compounds can be converted to trichlorophenylhydrazones (TCPH) and isolated from fat in a simple one-step procedure by passing a solution of fat and TCPH in cyclohexane-ether through a Florisil column. The TCPHs, which elute before the triglyceride, can be resolved and quantified by gas chromatography on a 10-m capillary column coated with SE-30. To study and avoid possible formation of carbonyl artifacts from hydroperoxides during the isolation procedure, methods were devised to reduce the peroxides in fats to alcohols by passing the fat through reaction columns of stannous chloride or hydroiodic acid. These methods, which do not require solvent dilution of the fat, may prove useful in other methods for the determination of carbonyls and volatiles in fats and oils. The usefulness of the TCPH method is illustrated by application to stability tests on glyceride oils and is correlated with other methods of determining oxidation.

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TWO SIMPLE MICROBIOLOGICAL ASSAYS FOR DAMAGE TO UNSATURATED LIPOPHILIC AGENTS. J.A. Sands, Lehigh University, Bethlehem, PA 18015.

Two simple microbiological assays utilizing lipid-containing bacterial viruses have been developed that can be used to easily determine the extent of damage to unsaturated fatty acids, fatty acid derivatives, detergents and lipophilic vitamins. The first assay is based on the observation that *cis*-unsaturated fatty acids and many fatty acid derivatives are very efficient inhibitors of the entry process of bacteriophage PR4. The second assay is based on the potent virucidal activity of these compounds against bacteriophage $\phi 6$. Either of these simple assays can be used to quantitate damage to *cis*-unsaturated lipophilic agents. We have used both assays to study photodynamic damage to oleic and linoleic acids and photochemical damage to retinoids. From these studies, we conclude that photodynamic (hydrophobic photosensitizer acridine plus near ultraviolet radiation) damage to oleic acid and photochemical (near ultraviolet radiation) damage to retinal (vitamin A aldehyde) result in products that have no activity against viruses, and do not interfere with the activity of undamaged molecules.

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USE PROPERTY ADVANTAGES OF NOVEL PEAKED ETHOXYLATE DISTRIBUTION. K.L. Matheson, Ted P. Matson and Kang Yang, Conoco Inc.

A process has been developed for ethoxylating alcohols which produces a peaking of the ethylene oxide adducts around the desired ethylene oxide content. This decrease of low- and high-mole ethoxylates provides advantages in several detergent applications. Improvements include (1) better detergency on oily soil, (2) improved formulatability in heavy-duty laundry liquids resulting in lower hydrotrope needs, (3) greater liquidity of the nonionic, and (4) improved stability in liquid formulations.

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THE ROLE OF DETERGENT ENZYMES UNDER CHANGING WASHING CONDITIONS. F.W.J.L. Maase, Gist-Brocades N.V., Delft, The Netherlands. G.B. Fermentation Industries, Inc., USA.

Washing habits and detergent formulations have shown a remarkable change during recent years. The role of detergent enzymes to meet the new requirements will be discussed. It will be shown that proteolytic enzymes offer a valuable contribution to the performance of detergents under these changed conditions, such as reduced temperatures and phosphate replacement.

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A SPRAY DRIED α-OLEFIN SULFONATE FROM CONCEPT TO MARKETPLACE. Carl P. Cullotta and Andrew Shultz, Stepan Chemical Company, Edens and Winnetka Roads, Northfield, IL 60093.

This paper will examine spray-dried and drum-dried forms of alpha olefin sulfonates, while concentrating on the spray-dried form.

Topics that will be covered are the spray drying process for alpha olefin sulfonates, important parameters and considerations in that spray drying process, and an examination of the product from the spray tower. The many applications of dry alpha olefin sulfonates will be discussed, and the spray-dried form will be compared to the drum-dried form in a number of the more common applications. Finally, a projection of the future potential of dry forms of alpha olefin sulfonates will be discussed.

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A PRACTICAL DISHWASH TEST METHOD FOR SMALL COMPANY USE. Walter Felt, Detergents, Inc., 12143 Altamar Pl., Santa Fe Springs, CA 90670.

Previously reported test methods for evaluating dishwash detergents have been modified and updated to provide a practical method for use by the small detergent company laboratory. Use of a kitchen mixer to generate foam gives good control and consistent results even when different laboratory technicians perform the test. This allows the use of part-time personnel, which are frequently employed by small companies. When lard oil or liquid tallow are used as the oily soils (defoaming agents) in this test, there is a favorable correlation with "real-world" dishwashing conditions, foam end-points are better defined, and results appear to be more consistent than with other types of soils. Test results can be fed into a computer to provide foam profiles, which frequently give a better picture of comparative performance of liquid dishwashing detergents than the usual plates washed end-point.

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A SHAMPOO TEST FOR MEASURING FOAM IN THE PRESENCE OF SOIL. Nelson F. Borys and Ted P. Matson, Conoco Inc.

A test method has been developed to allow evaluation of the foam stability of shampoo formulations with reliability and reproducibility. The procedure, which reproduces trends observed in shake flask tests, involves a modification of a German Standard Test (DIN 53 902). The subject method allows for six tests to be run simultaneously, resulting in greater reliability in side-by-side comparisons. This technique allows the utilization of sebum soil, resulting in a more practical and valid test. Results are given comparing alcohol sulfates and olefin sulfonates under normal use conditions. Other formulation variables are also evaluated.

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Not available at press time.

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AN IMPROVED NIR METHOD FOR MEASURING OIL, PROTEIN, AND MOISTURE IN SOYBEANS, COTTONSEEDS, AND SUNFLOWER SEEDS. Ronald D. Moen, Neotec Corporation, 2431 Linden Lane, Silver Spring, MD 20910.

A review of current NIR instrument techniques and collaborative test results are given. Spectra for different types of oil are shown and different methods of quantification of absorption bands are discussed. A study of soybeans, cottonseeds and sunflower seeds was done using NIR scanning instruments correlated to standard laboratory methods for moisture, protein and oil. Wavelength selections based on optimization techniques are discussed. Optimization results were installed in a low-cost NIR instrument. Accuracy and precision results of this instrument at three different field sites are reported.

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PULSED NUCLEAR MAGNETIC RESONANCE DETERMINATION OF SOLID FAT CONTENT. Jack H. Mellema, Kraft, Inc., R&D, 801 Waukegan Road, Glenview, IL 60025, Bryan L. Madison, The Procter & Gamble Co., and Robert G. Manning, Glidden Durkee Foods.

The use of pulsed nuclear magnetic resonance was shown to be a viable means of determining the solid fat content of edible oils. The previous collaborative study indicated a need for recalibration of the instruments used. A method was devised for calibration that allowed all instruments to give comparable readings on a series of tristearin in olive oil standards. Each collaborator ran a series of sixteen unknown oils. Mean values and standard deviations were determined within each laboratory and between laboratories. An improved correlation coefficient was obtained in this second collaborative study when compared to the original study. A correlation equation was derived to allow the conversion of data from solid fat index by dilatometry to solid fat content by PNMR.

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A COMPARISON OF VISUAL AND ELECTRONIC METHODS OF OIL COLOR EVALUATION. Robert F. Conley, Mineral and Resource Technology, P.O. Box 1218, Mountainside, NJ 07092.

Process development technology in the field of vegetable oil clarification and preparation requires relatively accurate oil color measurements for unit operation evaluation. Variations in acid activation of clays or chemical bleach processes, for example, may go undetected when oil color is determined inaccurately and imprecisely. Shift fatigue, variations in operators, and other psychophysical factors often significantly influence the reported color indices of an oil product or intermediate. This study is a review of variations in response given by trained operators for a group of over 75 oils from various refining stages, both bleaching and chemical modification, using the AOCS Tintometer and other visual color matching instrumentation, compared with electronic readout instrumentation. In support of the electronic system, minor effects due to foreign particulates tend to be nullified, eye fatigue is virtually eliminated, variation in color sensitivity of the operator is unimportant and, most significantly, color error is greatly reduced. For example, with a single skilled operator the average reading error over a variety of oil samples was approximately 5% on red scale and 2.5% on yellow scale with visual instruments. Variations between different operators were far greater. A relatively untrained operator, by contrast, produced errors of only about 2% and 1.5%, respectively, with the electronic readout system and variations between operators was approximately the same.

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EVALUATION OF THE FACTORS THAT INFLUENCE THE PRECISION AND ACCURACY OF THE ANALYSIS OF SHORT-CHAIN FATTY ACIDS. A POSSIBILITY FOR IMPROVEMENT. Giovanni Bigalli and Robert D. Houseal, Jr., Hershey Foods Corporation, Research Department, 1025 Reese Avenue, Hershey, PA 17033.

Recent collaborative studies have shown that the analysis of fatty acid distribution has reached a satisfactory level of accuracy and precision; however, the short-chain fatty acids do not satisfy the same level of confidence and quality. In this paper we are presenting a study of the causes for this low level of precision. The volatility of the methyl esters is not the primary problem. Chromatographic conditions affect more directly the quantitation and probably the recoveries as well as the coefficient of variation of collaborative studies within and between laboratories. New alternative procedures for better precision and accuracy for the analysis of these fatty acids will be presented.

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LIPID COMPOSITION OF THE MANGO (*Mangifera indica*) KERNEL FAT. J. Hemavathi, J.V. Prabhakar and D.P. Sen,* Discipline of Lipid Technology, Central Food Technological Research Institute, Mysore-570 013 India.

The mango kernel (Alphanso variety) contains an average 10% solvent extractable fat. Recently, there has been a growing interest in commercial utilization of this fat as a cocoa butter extender. Whereas studies on extraction, processing and fractionation of the fat are underway in our laboratory and other laboratories in India, characterization of the lipids of mango kernel has assumed importance in view of its intended food uses. The total lipids from mango kernel (Alphanso variety) were fractionated into neutral, glyco-and phospholipids by silicic acid column chromatography. The neutral lipids were 97.4% of the total, and 2.6% were accounted for by the polar lipids. Glycolipids (72.9%) comprised the major fraction of the polar lipids, whereas phospholipids were only 27.1% of the polar lipids. The fatty acid composition of total lipids (% $C_{12:0}$ = 2.5; $C_{14:0}$ = trace; $C_{16:0}$ = 7.8; $C_{16:1}$ = trace; $C_{18:0}$ = 40.2; $C_{18:1}$ = 45.1; $C_{18:2}$ = 4.4; $C_{20:0}$ and $C_{18:3}$ = traces), and of neutral lipids (% $C_{12:0}$ = 0.6; $C_{14:0}$ = trace; $C_{16:0}$ = 7.0; $C_{18:0}$ = 42.2; $C_{18:1}$ = 47.2; $C_{18:2}$ = 2.3; $C_{20:0}$ = 0.6 and $C_{18:3}$ = trace) were almost similar. Stearic acid content was comparatively low and linoleic acid content was high in polar lipids, glycolipids and phospholipids, in comparison with total and neutral lipids. The percentage fatty acid compositions of the total polar lipids, glycolipids and phospholipids respectively were: $C_{12:0}$ = 4.3, 0.1, 0.7; $C_{14:0}$ - 1.1, 0.2, 4.4; $C_{16:0}$ - 13.4,13.8,13.2; $C_{16:1}$ - 0.4, trace, trace; $C_{18:0}$ - 19.0, 27.3, 7.3; $C_{18:1}$ - 42.1,48.8.49.4; $C_{18:2}$ - 19.3, 9.7, 15.8; $C_{20:0}$ - trace, 0.1, 3.7; and $C_{18:3}$ - trace, 0.5, trace.

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FRACTIONATION OF DHUPA FAT (*Vateria indica*). B.P. Baliga and A.D. Shitole, M/S. Tata Oil Mills Company Limited, Sewri, Bombay 400 033, India.

Dhupa, a potentially useful indigenous fat, has been evaluated by GLC for its characteristics, e.g., AV, IV, SV, UM and fatty acid composition. The fat has been refined, bleached and subsequently segregated by acetone fractionation into suitable solid fractions having properties closer to cocoa butter. Dhupa fat and these fractions have been studied along with the samples of cocoa butter and hydrogen-

*Presenting author

ated fat for their solidification characteristics, dilatometric behavior, SFI values, and so on. The samples, after their admixture with cocoa butter in equal proportions, have also been evaluated to assess their compatibility with cocoa butter. Acetone fractionated dhupa fat samples could be successfully used as partial substitutes for cocoa butter.

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SOAP STABILIZATION USING SODIUM BOROHYDRIDE. Richard A. Mikulski, Alice M. Devaney and Michael M. Cook, Thiokol Corp./Ventron Division, 150 Andover Street, Danvers, MA 01923.

Sodium borohydride can be utilized at several points during soap manufacturing to improve the color, odor and/or stability of the materials. Purifications involving sodium borohydride at the tallow or saponification stages supplement or replace traditional contact bleaching with activated clays. Low levels of sodium borohydride can be added to the soap following saponification to improve stability of the final soap. This presentation concentrates on the use of sodium borohydride for this application and compares the improvements obtained to the stabilization results with other commercial additives. Also, the effects of SBH on tallow purification or its use during saponification on the subsequent stability of the final soap (and on the quality of lower grade soaps) will be discussed.

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IMPROVING FLOW AND ANTICAKING PROPERTIES OF HEAVY DUTY DETERGENTS USING FUMED SILICA. Terence F. Conlon, Vaughn W. Taylor and William F. Moll, CAB-O-SIL Division, Cabot Corporation, Tuscola, IL 61953.

Fumed silica functions very well as a free flow and anticaking agent for heavy duty detergents, even in relative humidities exceeding 90%. The amount needed is much smaller than that for other free-flow agents. Often as little as 0.1% fumed silica can impart exceptional flow properties. These improvements become very important in handling the detergent in plant storage and packaging operations. The unusual efficacy of fumed silica arises from its extreme purity, very small particle size and very large surface area. The surface can immobilize large amounts of moisture. The small particle size ensures full coating of the detergent particles. The silica particles also act as "ball bearings," aiding flow. Fumed silica is amorphous and is safe to use from a health standpoint. Motionless mixers can rapidly and thoroughly incorporate these small amounts into the detergent with virtually no energy expenditure.

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MANUFACTURE AND PROPERTIES OF SYNDET BARS. Martin Hollstein, Zschimmer & Schwarz Chemische Fabriken, P.O.B. 2179, D- 5420 Lahnstein, West Germany.

The state of the art in the field of syndet bars is reviewed, including recent results of my own investigations concerning water takeup, abrasion and other usage parameters. The first part of this report covers composition and production of syndet bars. Surfactants, plasticizers, fillers and additives are described as standard and main ingredients. Their chemical composition and concentration clearly determine the properties of the final product such as hardness, lathering power, and wear resistance. Production equipment is discussed in view of deviations from normal soap manufacturing technology. The second part of this report describes and evaluates usage properties such as lathering, abrasion, water take-up, storage stability and skin irritation potential. The influence of composition and special additives on the first three of these is discussed. Thus, water take-up can be reduced by factors of 0.5–0.3 by the addition of 1–3% of aluminium-triformate. Finally, several formulas are given for syndet bars under different marketing aspects, e.g., medicated, luxury and special application bars.

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BIOLOGICAL EFFECTS IN RATS OF DIETARY CYCLOPROPENOID FATTY ACIDS NATURALLY PRESENT IN COTTONSEED OIL. Lucy L. Fan, Barney W. Hilton and Alan Wohlman, Research Department, Frito-Lay, Inc., 900 N. Loop 12, Irving, TX 75061.

The biological effects of cyclopropenoid fatty acids naturally present in cottonseed oil has been investigated in rats by feeding them diets containing 0, 60, 300, 600 and 3,000 ppm cyclopropenoid fatty acids for 6 months. At the end of 3 and 6 months feeding, rats were sacrificed for histopathological and biochemical evaluations. Based on observations of body weight, food consumption, physical appearance, and organ weight, there were no significant differences among the five groups of rats. However, there was one detectable difference among the five feeding groups, which was a positive correlation between the amount of cyclopropenoid fatty acid deposited in the body fat and the content of this fatty acid in the diets. Furthermore, hematological profiles and histopathological examinations of five groups failed to reveal any apparent biological effects of dietary cyclopropenoid fatty acids. The measurements of liver microsomal protein, the enzymatic activity of NADPH-cytochrome c (P-450) reductase, and the hepatic contents of cytochromes P-450 and b_5 were evaluated and no significant differences among the five groups were detected. The significance of the results obtained is discussed.

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THE FATTY ACID ANALYSIS OF THE TISSUE LIPID OF RATS FED BROMINATED CORN OIL AND BROMINATED MONOGLYCERIDES. Barbara A. Jones, Ian J. Tinsley, Robert R. Lowry and Glenn Wilson, Department of Agricultural Chemistry, Oregon State University, Corvallis, OR 97331.

Semisynthetic diets containing 2% brominated corn oil (BCO), 2% monodibromostearin (DBS), 2% monotetrabromostearin (TBS), or a mixture of the brominated monoglycerides corresponding to the BCO diet (BMG) were fed to Wistar rats for 35 days. Histopathological analysis indicated the different diets had varying degrees of toxic effects on cardiac and hepatic tissues and little effect on renal tissue. Total lipid bound bromine concentrations varied with diet and tissue, the DBS giving 3 times the bromine concentrations in the cardiac lipids as the other diets and the BCO, TBS and BMG giving 4 times the bromine concentrations of the DBS in hepatic lipids. Lipid concentrations were significantly elevated in cardiac and hepatic tissues with all the brominated oils and were diet dependent. The order of decreasing effect of diet on cardiac lipid content was BCO>DBS ≅TBS>BMG, with 1–3% of the lipid in the form of brominated fatty acids (BFAs) in the BCO, TBS and BMG diets and 9–10% as BFAs in the DBS diet, which gave the greatest overall organ enlargement. The lipid increases in hepatic tissue were much more dramatic, with the order of effect being BCO>TBS>BMG>DBS and 9–10% of the lipid as BFAs in the BCO, TBS and BMG diets and only 3–4% as BFAs with the DBS diet. In adipose tissue the BFAs comprised 2% of the lipid with the BCO, TBS and BMG diets and 5% of the lipid with the DBS diet. Analysis of the BFA fractions of the various tissue lipids revealed metabolites of the original BFAs in the form of di and tetra brominated myristric and brominated palmitic acids, with the concentrations of these metabolites being diet and tissue dependent. (NIEHS Grant #ES 01377.)

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DIETARY FATTY ACIDS AND THE INCIDENCE OF MYOCARDIAL LESIONS IN THE C3H MOUSE. Ian J. Tinsley, John A. Schmitz, Donald A. Pierce and Eric B. May, Oregon State University, Corvallis, OR 97331.

Focal or multifocal cardiomyocardiolysis of varying severity was observed in C3H mice fed semisynthetic rations containing 10% fat. Twenty different diets were fed using either one of eleven different fats and oils (lard, beef tallow, butter, coconut, olive, cottonseed, corn, safflower, linseed, rape or span) or combinations of these fats and oils. After an 80-week feeding period, the cumulative incidence of these lesions ranged from 14% (cottonseed) to 65% (beef tallow). A high incidence (55%) was also observed in mice ingesting rape seed oil. The different fats and mixtures were selected so that the levels of nine fatty acids varied over a reasonable range and were not highly correlated. Using multiple regression, it has been demonstrated that the incidence of heart lesions was directly correlated with levels of palmitic and erucic acids and inversely correlated with levels of linoleate ($p = .005$). Regression coefficients for the six other fatty acids (12:0, 14:0, 18:0, 18:1, 20:1 and 18:3) were much smaller in magnitude and not statistically significant. (Supported by P.H.S. grant no. CA 20998.)

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THE EFFECT OF FEEDING DI-(2-ETHYLHEXYL) PHTHALATE AND RELATED COMPOUNDS ON LIPIDS IN THE LAYING HEN. Joel Bitman and D.L. Wood, U.S. Department of Agriculture, Bldg. 309, Beltsville Agricultural Research Center, Beltsville, MD 20705.

Di-(2-ethylhexyl) phthalate (DEHP), a commonly used plasticizer which is now classified as an environmental pollutant, inhibits lipid and sterol synthesis in rats, mice, rabbits and chickens. In order to relate structure to biological activity, hens were fed DEHP or several structurally related side chain analogs: 2-ethylhexanol (EH-OL), representative of the alcohol portion of the ester; 2-ethylhexanal (EH-AL), the aldehyde; and 2-ethylhexanoic acid (EH-ACID). Hubbard White Rock laying hens were fed either a standard laying mash control diet (C) or the control diet containing 2% DEHP, 1% EH-OL, 2% EH-OL, 1% EH-AL, or 1% EH-ACID for 28 days. All treatments lowered feed consumption and decreased body weight. After 2 weeks on the diet, egg production was 15–25% less in treated hens. The 2% EH-OL and DEHP diets lowered plasma cholesterol and total lipid concentrations. Liver weights were not affected but liver fat decreased. Lipid classes were measured by quantitative TLC densitom-

etry. The decreases observed in plasma and liver lipids occurred primarily in the triglyceride fraction. Hypolipidemic effects were observed with all of these structural analogs of the DEHP side chain, but 2-ethylhexanol was the most active analog. These results suggest that the active portion of the plasticizer, DEHP, may be the metabolite, 2-ethylhexanol, formed in vivo from DEHP by hydrolysis of the ester bond.

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SUBCELLULAR LOCALIZATION OF DOLICHOL AND OF ENZYMES OF DOLICHOL METABOLISM IN RAT LIVER. J.W. Rip, Department of Biochemistry, University of Western Ontario, London, Ontario, Canada, N6A 5C1; C.A. Rupar, University of Cambridge; N. Chaudhary and K.K. Carroll, University of Western Ontario.

Dolichols are primary alcohols consisting of 14–24 isoprene units linked head to tail and containing an α-saturated unit. They are present in mammalian cells as free alcohols, as fatty acid esters, and as phosphorylated derivatives, including dolichyl mono- and pyrophosphate. These phosphorylated forms are functionally important as intermediates in the biosynthesis of asparagine-linked glycoproteins, but normally constitute less than 1% of the total cellular dolichol. This has led to suggestions that the concentration of dolichyl phosphate may be a rate-limiting factor in glycoprotein biosynthesis. In rat liver, dolichol is present mainly in the microsomal fraction (90 ng/mg protein), although the highest concentration (300 ng/mg protein) was found in plasma membranes. The idea that microsomes are the primary site of dolichol metabolism is reinforced by the observed subcellular localization of enzymes that utilize dolichol substrates. Dolichol kinase, dolichyl ester synthetase and dolichyl glycosyl transferases each showed the highest specific activity in microsomes. An exception was dolichyl phosphate phosphatase, which was concentrated in plasma membranes. Dolichol phosphokinase was also clearly present in plasma membranes, whereas the other enzymes, although present in small amounts, could be attributed to this fraction with less certainty. Nuclei contained about 70 ng dolichol/mg protein, together with significant amounts of each of the above enzymes. Mitochondria and cytoplasm each contained only about 30 ng dolichol/mg protein, and little of the associated enzymatic activity. The presence of both dolichol phosphokinase and dolichyl phosphate phosphatase in cellular membranes provides a possible means of enzymatically controlling levels of dolichyl phosphate. This in turn raises the possibility that these enzymes may play a significant role in the control of glycoprotein biosynthesis. (Supported by the Medical Research Council of Canada.)

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THE BEHAVIOR OF LIPOXYGENASE IN HYDROCARBON MICELLAR SOLUTION. Peter Meier, Sandro Palmieri and Pier Luigi Luisi, Swiss Federal Institute of Technology, Switzerland.

Certain surfactants, when solubilized in apolar media, tend to form spherical aggregates (the so-called reverse micelles), in which the polar heads of the surfactant molecules are directed towards the interior, and form a polar ionic core that is able to solubilize water and other polar, hydrophilic molecules. Recently, conditions have been found under which enzymes can be solubilized in the water pool of reverse micelles without loss of an activity. Thus, enzymes can maintain their catalytic power in hydrocarbon media containing as little as 1% water and the kinetics and spectroscopic properties can be investigated as if it were a normal aqueous solution. The enzymatic properties of chymotrypsin, alcohol dehydrogenase, ribonuclease, lysozyme and other enzymes dissolved in isooctane with the help of the surfactant di-(2-ethylhexyl) sodium sulfosuccinate have already been investigated. One of the advantages of these new enzymatic systems is that lipophylic substrates, which are insoluble in water, can also be added directly to the micellar hydrocarbon solution. This is the case of lipoxygenase and its natural substrate, linoyc acid. We have found that the enzyme is very stable in the presence of this substate, with a K_m around 0.2 mM. The activity has a maximum at pH 10 (turnover number 155 min^{-1} at 30 C), and increases by increasing the water content of the hydrocarbon micellar solution. These data will be discussed in detail, in view of the general problem of the utilization of enzymes in hydrocarbon and lipid solutions.

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BY-PRODUCT UTILIZATION FROM OILSEED PROTEIN PROCESSING. J.W. Finley, R.H. Edwards and G.O. Kohler, USDA, SEA-AR, WRRC.

Significant quantities of by-products are produced when oilseeds are processed into oil and protein concentrates or isolates. Large volumes of "whey" result from the production of protein isolates. The whey consists of a dilute water solution containing all of the soluble material from the flour that is not precipitated isoelectrically with protein. The manufacturer is caught between energy and capital expenses for further processing of the whey and environmental pressures to eliminate waste stream "pollution." A review of alternative methods for processing wheys, including evaporation, evaporation in a waste heat evaporator, ultrafiltration and fermentation will be considered in detail. Some critical considerations are holding capacity for fermentation, potential uses for fermentation products, energy costs, and the availability and quality of waste heat from the plant. Capacity and capitilization costs will also be considered.

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OHIO CURD. Andrew C. Peng, Department of Horticulture, The Ohio State University, Columbus, OH.

Ohio Curd was made by coagulation of soybean and cheese whey protein mixture with glucono-delta-lactone (GDL) or a combination of GDL and calcium sulfate or magnesium chloride. It was a white gelatinous mass with an acceptable aroma and texture, higher yield and protein content, and promising amino acid composition. The basic cost of the Ohio curd is low and the product is nutritious. It may provide an inexpensive protein source in the form of nondairy pudding, yogurt or other analogs to the third world. The Ohio process is simple and can be readily adapted to any existing food processing plant, especially dairy product manufacturing facilities.

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PETROLEUM-FREE EXTRACTION OF SOYBEANS WITH SUPERCRITICAL CO_2. J.P. Friedrich, G.R. List and A.J. Heakin, Northern Regional Research Center, Agricultural Research, Science and Education Administration, U.S. Department of Agriculture, Peoria, IL 61604.

There is increasing concern regarding the use of hexane for extraction of soybeans. Problems include the escalating costs, unpredictable supply and inherent plant hazards involved with the use of a petroleum product. In addition, small quantities of high-boiling residues present in hexane are concentrated in the oil and meal, posing potential health hazards. Carbon dioxide, however, is an ideal solvent for edible products because it is nontoxic, readily available, low in cost, nonflammable, nonexplosive, and easily separated from the substrate. With carbon dioxide, processing can be carried out at lower temperatures than with hexane and should result in improved flavor and stability of both meal and oil. Full-fat soyflakes were readily extracted with supercritical CO_2 at a pressure of 5000 psi and 50 C to a residual oil content of $<0.5\%$. The equilibrium solubility of the oil in CO_2 under these conditions was 1.2–1.4% by weight. Because supercritical CO_2 has the density of a liquid and the diffusivity of a gas, equilibrium can be established rapidly to afford high flow rates. The oil was separated from the gas phase by reducing the pressure. The solvent-free oil was compared to hexane-extracted oil from the same beans. Free fatty acid, trace metals, peroxide value, fatty acid composition, chromatographic refining loss and unsaponifiable content were similar for the two oils. However, phosphorus content of the CO_2-extracted oil was significantly lower and was comparable to a degummed crude. Decreased solubility of phospholipids is therefore indicated.

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TOMATO SEEDS–A POTENTIAL SOURCE OF PROTEIN. J.R. Geisman, Department of Horticulture, The Ohio State University, Columbus, OH.

Tomato seeds contain 23–34% crude protein. Using a small conveyor belt and waste heat from other unit operations, this valuable by-product can be recovered. Since these seeds also contain 28–32% lipids, protein can be obtained by existing solvent extraction techniques. Tomato seed protein (TSP) has a good amino acid profile that ains eight essential amino acids. Although the sulfur-bearing amino acids are limiting, TSP is higher in lysine than eggs, soyflour and high lysine corn, suggesting that it could be used in human diets. Furthermore, there are no antinutritional factors in TSP. Through selective breeding programs, the protein content could be increased. The oil can be refined and contains about 80% unsaturated fatty acids and 20% saturated. Its taste is bland and nutlike. Assuming seed content as 7%, a 7 million ton tomato crop would produce 490,000 tons of seeds annually. Estimating protein content at 25% yields 122,500 tons of protein that is normally discarded annually. With worldwide shortages of protein, this resource becomes too valuable to waste.

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COMMERCIAL CONSIDERATIONS IN PRODUCING VEGETABLE PROTEIN ISOLATES AND CONCENTRATES. Dale W. Johnson and Sidney J. Circle, Food Ingredients, Inc., 2300 East Higgins Road, Suite 213, Elk Grove Village, IL 60007.

Oilseed products generally have a high protein content and can be used to increase protein levels and improve protein quality of many

foods economically. In producing vegetable protein isolates and concentrates, commercial considerations include: crop availability, presence and elimination of toxic principles, waste disposal, process conditions, yield, color, flavor, functionality characteristics, by-product utilization and cost of final products.

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TEXTURIZATION OF SOY PROTEINS–A REVIEW. Joseph G. Endres, Central Soya.

This paper will review the commercial processes available for the texturization of soy proteins. Process and product characteristics, functionality and economics of end products will be discussed.

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PROTEIN DETERMINATION IN OIL SEED CROPS USING NUCLEAR MAGNETIC RESONANCE. Raymond F. Bailey, Newport Instruments, Milton Keynes, England.

With the growing importance of determining total protein in oil seed crops, any technique that speeds the measurement is of much benefit, not only to breeders but, more importantly, to processors. The technique described in this report uses a simple, relatively cheap nuclear magnetic resonance pulse spectrometer. The method is such that a reagent based on copper or iron salts is used as a "blank" whereby the instrument measures the relaxation time of the blank. A quantity of ground oil seed is then mixed with a quantity of reagent and allowed to react—the protein in the material under measurement complexing with the copper or ion salts, changing the relaxation time of the reagent. The sample is then placed in the measuring coil of the instrument and the change in relaxation time is measured. Simply, the difference in the relaxation times of the blank and the reacted sample can be shown to be proportional to the protein content of the material under test. Measurement time in the spectrometer is about 20 sec per sample. Disposable plastic vials are used for holding the sample. The instruments are fully microprocessor-controlled and display the protein content digitally or on paper reel. Results compare directly to protein values determined by conventional methods. The paper is based on work carried out in the Newport Instruments' laboratory and by other users.

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TOXICITY AND METABOLISM OF PENICILLIC ACID. A. Wallace Hayes and Peter Chan, Rohm and Haas Company.

Penicillic acid (PA) is a carcinogenic and hepatotoxic mycotoxin that occurs naturally in foodstuffs and feeds. The earlier reported hepatotoxicity of PA was substantiated because it (1) increased pentobarbital sleeping time; (2) decreased pentobarbital metabolism in vivo and in vitro; (3) decreased hepatic-reduced glutathione (GSH); (4) elevated serum transaminases and bilirubin; and (5) increased sulfobromophthalien and indocyanine green retention in male mice exposed to PA. The acute toxicity of PA was increased by pentobarbital and 3-methylchloanthrene but decreased by SKF-525A. Cysteine protected animals against the diethylmaleate potentiated PA toxicity. The differences observed in the toxicity of PA following different routes of administration can be explained by the kinetic data for PA if the liver were assumed to be the site of PA bioactivation. In general, well-profused organs such as the liver, kidneys, heart, lung and spleen contained greater concentrations of radioactivity than less well-profused tissues such as muscle and fat. Blood contained the highest concentration of radioactivity; however, only a fraction was detected as the parent compound. Liver contained the largest amount of tissue radioactivity and the brain contained the least. Most of the recovered PA radioactivity in the liver was in the cytosol fraction. No prolonged accumulation of radioactivity was observed. More than 18% of an IP dose of PA was recovered in the duodenum. ^{14}C-PA was readily metabolized in the liver, excreted in the bile and effectively cleared by the kidneys. Fecal matter and respiratory CO_2 were minor excretory routes. Over 90% of urinary and 99% of biliary metabolites were not extracted with polar organic solvents. Three water-soluble metabolites (derived from GSH or cystiene) were resolved by HPLC in both urine and bile. About 10% of the urinary metabolites were detected as glucuronide conjugates. These data support the hypothesis that an active metabolite that can be detoxified by GSH is involved in the toxicity of PA.

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DEFENSES AGAINST AFLATOXIN CARCINOGENESIS IN MAN. M. Sid Masri, Western Regional Research Laboratory, U.S. Depart. of Agriculture, Science and Education Administration, Berkeley, CA 94710.

The concentrated effort around the world, following the discovery of aflatoxins about 20 years ago, achieved important strides and insights in delineating the nature and magnitude of the problem and finding practical means of prevention and control. The U.S. Department of Agriculture, including our laboratory and the other sister Regional Research Laboratories, contributed in this direction. Walter Pons, Jr., in whose memory we dedicate this symposium, was a pioneer and prolific contributor to these achievements, which constitute important defenses to protect our crops and agricultural economy, and to guard the public health against the potential of aflatoxin carcinogenesis. His contributions include: (a) improved analytical methodology and detection; (b) sound management of crop harvest or storage; (c) knowledge of effect of aflatoxins in farm animals and extent of transmission of aflatoxin or its metabolites from the feed into edible tissues and milk; (d) practical methods to remove, inactivate or prevent formation of aflatoxin in agricultural crops; and (e) comparative toxicological and metabolic studies in different species and relation to susceptibility to aflatoxin carcinogenesis. The following recent results from our laboratory will be reviewed: (a) significance of aflatoxin Q_1, the major metabolite of B_1 in primates, as a successful major detoxifying mechanism in primates; (b) ultrasensitive mass spectral methods for mixtures of aflatoxins with proof of structural identity; (c) use of ammonium carbonate for the prevention of aflatoxin elaboration in inoculated agricultural products; and (d) inactivation of aflatoxin M in milk by ultraviolet light irradiation.

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SOME PERSPECTIVES ON MYCOTOXIN CARCINOGENICITY AND HUMAN HEALTH. T. Colin Campbell, Division of Nutritional Sciences, N206 MVR, Cornell University, Ithaca, NY 14853.

Among the plethora of mycotoxins that have been identified in the past few decades, aflatoxin continues to hold center stage as the principal but putative health offender. Its carcinogenicity is exquisitely potent in several animal species. Human population studies have also provided impressive data implicating aflatoxin as an "official" human carcinogen, according to the International Agency for Research on Cancer. In addition to aflatoxin, other mycotoxins have also been shown to be carcinogenic in experimental systems. In terms of human health, then, the principal question is how the real hazard for human cancer derived from aflatoxin and other carcinogenic mycotoxins. (It is recognized that other toxicities may also be significant but these will not be considered in this paper.) Although there appears to be quasiacceptable data for a risk analysis of aflatoxin, thus permitting the setting of regulatory action levels, a closer examination of these analyses for different population groups indicates that other factors may also exercise considerable influence on the ultimate human carcinogenicity for this compound. Therefore, the still more fundamental question should be to what extent aflatoxin and other carcinogenic mycotoxins contribute to the human cancer load, given the several other environmental factors that are undoubtedly contributing to liver cancer. This paper will consider the broader perspectives of aflatoxin-induced liver cancer in terms of these other factors. (Supported by NCI P01CA26755 and American Cancer Society Grant PDT-104.)

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INFLUENCE OF VITAMIN E ON LUNG AND LIVER MICROSOMAL LIPID PEROXIDATION. Alex Sevanian, Nabil Elsayed and Allen D. Hacker, University of California, School of Medicine, Department of Pediatrics, Los Angeles, CA 90024.

Lipid peroxidation in lung (lg) and liver (lr) microsomes was studied as influenced by ferrous ion ($FeSO_4$, 1 mM) and cofactors that can serve as chain initiators or propagators. Peroxidation, measured by malonaldehyde (MDA) formation, was compared between microsomes obtained from either dietary vitamin-E-supplemented (+E, 50 IU/kg diet) or deficient (-E, O IU/kg diet) female Sprague-Dawley rats. The results indicated that maximal MDA formation occurred in all cases in the presence of either Fe^{+2} or Fe^{+2} + NADPH (0.4 mM), mediated largely by nonenzymatic processes. Preparations containing Fe^{+2} + ascorbate (0.25 mM) showed lower peroxidation levels and resulted from enzymatic and nonenzymatic processes. The reduction in lipid peroxidation in the presence of ascorbate varied with microsomal vitamin E levels predominantly in lg and the addition of ascorbate to +E reduced MDA formation more than its addition to -E. A vitamin E-ascorbate interaction in the microsomal peroxidation process is indicated under these experimental conditions. A partial explanation may be that lg and lr vitamin E levels in +E were 5 times greater than those in -E microsomes, but +E lr contained 10 times less vitamin E than +E lg. These findings indicate major differences between lg and lr in terms of factors promoting lipid peroxidation and may be partially explained by differences in microsomal vitamin E levels.

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FURTHER STUDIES ON THE MECHANISM OF BHT PHOTOPROTECTION. Homer S. Black and Virginia McCann, Photobiology

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Butylated hydroxytoluene (BHT) is a phenolic antioxidant widely used in this country as an additive for food preservation. The diversity of physiologic effects evoked by BHT is gradually becoming recognized. BHT has been shown by other investigators to produce hemorrhagic death in rats and to induce cardiovascular toxicity in isolated, perfused atrial preparations and cultured myocardial cells. On the other hand, BHT possesses chemopreventive qualities for specific chemically induced carcinogenesis. We have shown that BHT inhibits both ultraviolet light (UV)-induced erythema and carcinogenesis. To examine the mechanism of BHT's photoprotective properties, hairless mice were fed a commercial meal supplemented with 0.5% (w/w) BHT. Beginning with the initiation of the dietary regimen, uniformly ring-labeled ^{14}C-BHT (8.3 μCi; sp act 13.8 mCi/mmol) was administered ip on days 1, 7 and 14. Total radioactivity in urine, feces and skin was determined 72 hr postinjection for the respective time periods. Initially, 40% of the radiolabel administered was recovered in the urine and feces, with 0.14% present in skin. Recovery declined by about 50% at day 7 and remained constant at day 14. Less than 0.05% radiolabel was present in skin at days 7 and 14. Skin radiolabel was recovered in the organic extractable fraction. Treatment of skin homogenates with β-glucuronidase had no appreciable effect on recovery of lipophilic radiolabel. Radioactivity recovered from skin migrated with the same Rf as authentic BHT when subjected to thin layer chromatography. Autoradiography of histologic skin sections indicated a relatively equal distribution of radiolabel between cytoplasm and nuclei. These data support the contention that insufficient BHT resides in skin, even after continued ingestion, to absorb significant levels of incident UV. The previously observed photoprotection probably occurs as a result of BHT-induced alteration of cutaneous metabolism. This work was supported in part by USPHS grant CA-13464-09 from the NCI.

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A GAS CHROMATOGRAPHIC REACTOR TO MEASURE THE EFFECTIVENESS OF ANTIOXIDANTS FOR POLYUNSATURATED LIPIDS. J. Assis F. Faria, UFV-Brazil, and Seymour G. Gilbert, Rutgers University.

Modern methods of food processing and handling require the addition of antioxidants to ensure high storage stability. The mechanism of these free-radical terminators or reducing agents at initial stages of oxidation (induction period) has not been well understood because of the difficulty in measuring the low extent of oxidation reactions by existing conventional methods. The use of a gas chromatographic reactor, initially used to measure lipid oxidation, is here extended to determine the relative efficiencies of BHA (butylated hydroxyanisole), BHT (butylated hydroxy toluene), PG (propyl gallate), vitamin E (α-tocopherol), and vitamin C (ascorbic acid). The method was found to be rapid and reproducible in comparing the protection efficiency of these antioxidants for fatty acids and some commercial vegetable oils and in obtaining kinetic and thermodynamic data at a broad range of temperatures and reactant concentrations.

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SIMULTANEOUS ANALYSIS OF BHA, TBHQ, BHT, AND PROPYL GALLATE BY GAS CHROMATOGRAPHY AS EXTRACTED FROM REFINED VEGETABLE OIL. David M. Wyatt, Building 230, Eastman Chemical Products, Inc., Kingsport, TN 37662.

A method has been developed in our lab for the simultaneous gas chromatographic analysis of four antioxidants extracted from refined cottonseed oil. The antioxidants extracted were BHA, TBHQ, BHT and propyl gallate (PG).The method involves extraction with acetonitrile, followed by silyl derivatization prior to GC injection. The method was applied to a designed study to measure the percentage recovery of each antioxidant at the 100-ppm level over a 2-week period of time. Statistical treatment of the results indicate there is no significant time trend in any of the four antioxidants. The percent recoveries range from 84% to 108%. The standard deviation for single extraction-single GLC analysis for the antioxidants range from 8 ppm to 10.2 ppm. The work also defines the linearity of calibration for each antioxidant, and contains a discussion on the derivatization of BHT.

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TBHQ ANTIOXIDANT IN REFINED SUNFLOWER OIL. Dan F. Buck, B-230, Eastman Chemical Products, Inc., Kingsport, TN 37662.

The sunflower is a major new source of vegetable oil in the United States and production is rapidly increasing. Sunflower oil is highly unsaturated and has an iodine value of approximately 140 and a linoleic acid content of 65–70%. This high degree of unsaturation makes sunflower oil susceptible to oxidative rancidity. Laboratory and commercial testing have shown TBHQ (tertiary-butylhydroquinone) to be the most effective food-grade antioxidant for preventing oxidative deterioration in highly unsaturated vegetable oils. Current testing, which substantiates the effectiveness of TBHQ in refined sunflower oil, is reported. Also discussed is a comparison of the effectiveness of BHA, BHT and TBHQ antioxidants in protecting frying systems using refined sunflower oil as a frying medium.

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EVIDENCE FOR ALDEHYDES BOUND TO LIVER MICROSOMAL PROTEIN FOLLOWING CCl_4 OR $BrCCl_3$ INTOXICATION. M. Comporti and A. Benedetti, Istituto di Patologia Generale, Via del Laterino, 8 (53100) Siena, Italy; H. Esterbauer, University of Graz, Austria; M. Ferrali and R. Fulceri, University of Siena, Italy.

Peroxidation of liver microsomal lipids results in the evolution of products provided with cytopathological activities. Some of these products have been isolated from the peroxidizing system and have been identified as 4-hydroxyalkenals (mainly 4-hydroxynonenal). Evidence for alkenals being bound to liver microsomal protein was therefore searched for in in vivo conditions–such as the CCl_4 and $BrCCl_3$ intoxications–in which peroxidation of lipids of liver endoplasmic reticulum has been demonstrated. Since alkenals bind mainly to -SH groups of low molecular weight thiols and proteins by a thioether linkage, the reaction of the free aldehyde group with 2,4 dinitrophenylhydrazine (DNPH) results in the formation of the respective hydrazone derivative, which shows a characteristic absorption spectrum. The absorption spectrum over the 300–400 nm range of the DNPH-treated nonlipoidal residue of liver microsomes indicates the presence of DNPH-reacting groups, the level of which is higher in the $BrCCl_3$-poisoned rats compared to the CCl_4-poisoned rats. The amount of DNPH-reacting groups in the nonlipoidal residue of liver microsomes peroxidizing in the NADPH-Fe dependent system increases with the incubation time and strictly parallels the amount of thiobarbituric acid-reacting products formed. The presence of DNPH-reacting groups in the microsomal protein is therefore indicative for the aldehyde binding.

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BLOCK POLYMER SURFACTANTS IN THE TEXTILE INDUSTRY. Irving R. Schmolka, BASF-Wyandotte Corp., 1419 Biddle Wyandotte, MI 48192.

Textiles have offered an exceptionally fertile field for the use of the block polymer surfactants due to their versatility, which results from small finite variations in structures. This enables the textile chemist to optimize properties for specific applications. The block polymers are briefly defined and described and shown to have uses ranging from the scouring and rinsing of raw wool, to carbonizing, oiling, sizing, softening, dye dispersing, defoaming and lubricating of textile fibers. They are shown to be useful in viscose processing and fiber finishing operations, to provide antistatic properties and to serve as processing aids in general. Some of these polymers also have the property of imparting good cleansing properties to textile cleansing formulations.

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NEW DEVELOPMENTS IN SHRINK RESIST TREATMENTS FOR WOOL. M.R. Porter, Diamond Shamrock Europe, Process Chemicals Division, P.O. Box 1, Eccles, Manchester M30 OBH, England.

A number of shrink resist treatments for wool and woolen garments have been available for some years, but the most successful have been those incorporating a chlorination stage. Attempts have been made to develop water dispersible, one-step systems that can be applied on normal side-paddle machines to finished garments and need no significant heat treatment after curing. Recently, such a progress was patented by International Wool Secretariat and developed commercially by Diamond Shamrock. The process utilizes the chemical known as Bunté Salt, which is the reaction product between sodium thiosulphate and an organochlorine compound. An alcohol is esterified with chloro-acetic acid and then subsequently reacted with sodium thiosulphate. The appropriate choice of alcohol can give a water dispersible product which can be exhausted on to woolen garments and subsequently cured in the wet stage at 50–60 C. The process is similar for most types of wool, has minimal effect on the shades and fastness of dyed wool, gives minimum hardening of handle and meets the International Wool Secretariat standard for machine washability of woolen garments. The technical problems encountered, such as the development of sticky handle, yellowing of pale shades and odor, have all been overcome. The mode of action of the Bunté Salt is a combination of polymerization and some chemical reaction with the wool. Further applications of this system are currently under examination.

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THE CLEANING OF KERATIN FIBERS WITH AQUEOUS SURFACTANT. Miklos M. Breuer, Gillette Research Institute, 1413 Re-

search Boulevard, Rockville, MD 20850.

Cleansing of keratin fibers and, in particular, of human hair, represents a difficult and unusual problem, since it differs in many respects from the washing of textile materials. The difficulty stems from the fact that, under certain conditions, surfactants interact with keratins, which affects their structure and physical properties in a detrimental way (e.g., high pH values, high temperatures). In general, two types of materials soil keratin fibers: the oily constituents of sebum, and organic or inorganic particulate matter originating from the environment. The removal of these types of substances by surfactants occurs by diverse mechanisms, often necessitating different approaches. As with other fibers, the efficacy of soil removal depends on the physical state of the soil, the energy and topography of the fiber surface, the nature of the surfactants and the properties of the surfactant solution (e.g. pH, ionic strength, temperature). This paper reviews the current state of knowledge regarding the effects of these factors on the cleaning of keratin fibers and, in particular, of human hair by detergent solutions. The interactions between detergent molecules and keratin fibers and their impact on the cleaning process will also be considered. Finally, evaluation techniques developed for assessing the cleanliness of keratin fibers will be reviewed and critically discussed.

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DETERGENCY IN NONAQUEOUS SYSTEMS. Manfred Wentz, School of Family Resources and Consumer Sciences, 1300 Linden Drive, University of Wisconsin, Madison, WI 53706.

After a brief review of the processes involved in nonaqueous detergency, this paper focuses on the removal of water-soluble soils from textiles in perchloroethylene systems. Small amounts of water were solubilized in the nonpolar solvent with the help of surfactants. The partition of water between hydrophilic textiles and the solvent was determined over a wide range of water activity (solvent relative humidity). Experimental data will be presented that show that the partition of water between solvent and textile has a pronounced effect on the rate and the amount of water-soluble soil removed from textiles. Sodium chloride was used as a model soil for this study. At low solvent/textile ratios, salt is redeposited on clean textiles, which leads to noticeable changes in sorption isotherms of hydrophilic and hydrophobic textiles.

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CATIONIC SURFACTANTS IN TEXTILE MATERIALS. Giuliana C. Tesoro, Room 3-334, Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, MA 02139.

The role of cationic surfactants in the processing, finishing and use of fibers and fabrics is reviewed in the context of the sorptive capacity of fibrous substrates for this class of compounds. The chemical structures of the most important classes of cationic surfactants are indicated, with reference to those correlations between chemical structure and effectiveness that determine the selection of particular types of compounds for specific applications. The major applications of cationic surfactants in the fiber and textile industry are then discussed. These include uses of the compounds as processing aids, as finishes, and in household products. The important improvements in functional properties attained in these applications demonstrate the continuing utility of cationic surface active agents as softeners, antistatic agents and bacteriostats.

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TEXTILE SOFTENERS. Richard A. Reck, Armak Company, 300 S. Wacker Drive, Chicago, IL 60606.

Textile softeners are usually cationic in nature in both fiber and consumer products and are the largest single use for nitrogen derivatives. Almost all of the compounds used are derived from natural fats and oils. The most common method of introducing the nitrogen atom is the conversion of fatty acids to nitrile. The nitriles are then converted to primary, secondary or tertiary amines by various hydrogenation processes. The final textile softener is then produced by quaternization of the tertiary amines. Depending on the starting amine and the quarternizing agents such as methyl chloride, benzyl chloride, dimethyl sulfate or diethylsulfate, a large number of final products are yielded. Softeners can also be developed by alkoxylation and/or quarternization. The intermediate alkoxylated amines may also function as textile softeners. Other textile softeners may also be prepared by the reaction of fatty acids or esters with diethylene triamine. The intermediate diamidoamine can be converted to the alkoxylated tertiary amine, which is a textile softener by itself or can be further reacted with an alkylating reagent. Likewise, the intermediate amidoamine can be converted to an imidazoline and subsequently alkylated to produce a variety of quaternary ammonium compounds. Another class of textile softeners has recently been developed by combining the alkoxylation and quaternization step. The alkylating agent in this case is not limited to halides or sulfates, but can be one of a large variety of anions, some of which are definitely noncorrosive.

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HPLC OF TRIGLYCERIDES CONTINUED. L. Witting, R. Eksteen and N. Pelick, Supelco, Inc., Supelco Park, Bellefonte, PA 16823, and E. Perkins, University of Illinois.

Developments in HPLC separations of triglycerides reported in the literature will be compared to recent developments in our lab. Chromatography separations and identifications of a number of vegetable oil triglycerides will be shown on SUPELCOSIL LC8 and LC18 reversed phase columns. These triglycerides will be compared to animal and human blood triglycerides for the usual characteristic changes found in fats of plant and animal species. Many question who would use this type of analytical information, that is, the identification of the multiplicity of triglycerides in fat. Some suggestions of future uses will be mentioned.

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HPLC AND FAST TLC IN THE ANALYSIS OF OILS. Dennis K. McCreary, Dittmar Wulff and William G. America, Applied Science Division, Milton Roy Co., P.O. Box 440, State College, PA 16801.

Argentation chromatography has been used with great success for the separation of polyunsaturated compounds. This paper describes the use of argentation TLC and argentation HPLC to separate triglyceride oils according to their degree of unsaturation. Using improved chromatographic materials and optimizing the amount of impregnated silver nitrate, a high degree of separation may be obtained. These techniques were applied to corn oil, peanut oil, olive oil, menhaden oil and lard, and the results are presented in this paper. Data concerning the reproducibility of the amount of $AgNo_3$ impregnated on the silicic acid using a silver nitrate in acetonitrile solution are presented. Separations achieved by argentation chromatography will also be compared to adsorption and reversed phase methods.

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QUANTITATION OF ISOMERIC UNSATURATED FATTY ACIDS BY IATROSCAN CHROMARODS COATED WITH SILVER NITRATE. J-L. Sebedio and R.G. Ackman, Fisheries Research and Technology Laboratory, Technical University of Nova Scotia, P.O. Box 1000, Halifax, N.S. B3J 2X4, Canada.

Chromarods-S impregnated with $AgNO_3$, quantitated through the Iatroscan flame ionization detector (FID), were used to study the isomeric unsaturated fatty acids of partially hydrogenated oils. The complex mixture of methyl esters of C_{20} dienoic acids from a partially hydrogenated marine oil was readily fractionated with benzene as the developing solvent into three groups of increasing Rf values; the least mobile group was the *cis,cis*-non-methylene-interrupted dienes (NMID), followed by the *cis,cis*-methylene-interrupted dienes (MID) mixed with the *cis,trans* + *trans,cis*-NMID, whereas the most mobile group included the *cis,trans* and *trans, cis* MID with the *trans,trans* NMID. No *trans,trans* MID (the most mobile group) could be detected. Similarly, the esters of the monoenoic *cis* and *trans* isomers were readily fractionated and quantitated. The FID correction factor was greater for the *cis* than for the *trans* isomers, unexpectedly the opposite of the result usually obtained when calculating the FID correction factor in gas-liquid chromatographic analyses. The Iatroscan is an attractive alternative to other techniques (e.g., IR, HPLC), because no large quantity of solvents is needed, replicate analyses (up to ten) are easily run, and only about 10^{-2} mg of sample is required for an analysis.

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ALUMINA THIN LAYER CHROMATOGRAPHY OF FATTY ACID METHYL ESTERS: SEPARATION BASED ON NUMBER OF DOUBLE BONDS. Robert R. Lowry, Ian J. Tinsley and Barbara A. Jones, Department of Agricultural Chemistry, Oregon State University, Corvallis, OR 97331.

Continuous development thin layer chromatography (TLC) on alumina permits the separation of fatty acid methyl esters on the basis of the number of double bonds present similar to separations obtained previously using silver nitrate TLC. It offers the advantages of using commercially available, stable plates that are quickly prepared for TLC and avoids the use of expensive and corrosive silver nitrate. Various parameters involving tank design, saturation, plate preparation and loading levels were examined to define the optimum conditions for development and separation. Solvents for development, recovery data and the effects of alumina on isomerization of double bonds are defined. (NIEHS Grant #ES 01377.)

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AN HPLC METHOD FOR QUANTITATION OF FREE ACIDS,

MONO-, DI- AND TRIGLYCERIDES USING AN INFRARED DETECTOR. Kathleen L. Payne-Wahl, Gayland F. Spencer, Ronald D. Plattner and Royden O. Butterfield, Northern Regional Research Center, SEA/AR, USDA, 1815 N. University Street, Peoria, IL 61604.

Separation and quantitation of fatty acid, mono-, di- and triglyceride mixtures are often desired in natural products, emulsifier additives and food chemistry. A high performance liquid chromatographic (HPLC) method that separates and quantitates fatty acid methyl ester, triglyceride, 1-2 diglyceride, 1-3 diglyceride, and monoglyceride classes is described. Baseline separations were achieved on an amino-cyano-bonded Partisil column with a gradient of hexane/chloroform (60/65) and hexane/chloroform/acetonitrile (25/65/35). The eluate was monitored by an infrared detector set at 5.72 μ (1750 cm^{-1}). Methyl 9,10 dihydroxystearate was used as an internal standard. This method was used to monitor glyceride lipolysis reactions and to successfully measure monoglycerides present in commercial shortening at the 1% (wt) level to $\pm$0.1% accuracy. Additional examples of applications will be presented, and the separation of other carbonyl-containing compounds with this method will be discussed.

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LIPID AND SURFACTANT ANALYSIS IN CAKE MIXES. Linda G. Sherwin and Sharon L. Melton, University of Tennessee, Food Tech. and Sci., P.O. Box 1071, Knoxville, TN 36901.

Lipid content of different cake mixes that had monoglycerides and propylene glycol monoesters listed as surfactants was determined by two different methods: a chloroform-methanol extraction procedure (CM) and the acid hydrolysis method of the American Cereal Chemist's Association (AACC). Lipid content of six different cake mixes varied from 7.7 to 15.0%. Although analysis of variance showed no significant differences between the two methods for total lipid content at the $P<0.05$ level, the CM method tended to extract more lipid than the AACC method, and the CM method was more precise. Mean lipid content of the cake mixes determined by the CM method was 10.5% with a coefficient of variation (CV) of 3.0%; by the AACC method the mean lipid content was 10.2% with a CV of 5.7%. Separation of the lipids by thin layer chromatography affirmed the presence of MG and PGME and the absence of other surfactants. MG and PGME will be analyzed quantitatively in the lipids extracted from each cake mix by the two methods. PGME will be determined by gas liquid chromatographic analysis of the trimethyl silyl derivatives using monomargarine as an internal standard. Results for MG and PGME will be analyzed by analysis of variance to determine possible significant differences in the two methods of extraction.

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ASPECTS OF STEROL METABOLISM IN YEAST AND PHYTOPHTHORA. Leo W. Parks, Fred R. Taylor, Colleen McLean-Bowen, Cynthia Bottema, Russell Rodriguez and Robert Gonzales, Department of Microbiology, Oregon State University, Corvallis, OR 97331.

Because the synthesis of sterols by an organism represents an expensive investment in carbon intermediates and energy, a strong selective pressure must have existed for their maintenance during evolution, and they must have an essential biological activity. The purpose of our studies is to investigate experimentally the role of sterols in the physiology of the cell. Although wild-type yeast cells can synthesize sterols when molecular oxygen is available, they must accumulate sterols from the medium during anaerobiosis. We have been studying sterol uptake, but have been using mutants under aerobic conditions. Nonsterolic additions to the growth medium can have detrimental effects on sterol transport. Studies with the FY-3 mutant show not only diminished uptake of sterol, but growth reduction as well. Once accumulated, sterols are partitioned either into various membrane structures or into an ester fraction. Rapid movement in and out of the steryl ester pool is observed. The effect of altered sterol structures on mitochondrial membrane preparations will be presented. Although changes in membrane enzyme activities are seen, no dramatic effect is observed on the mitochondrial proton motive force generated by the mutants. There is no apparent major difference in the distribution of sterols between the outer and inner mitochondrial membranes. Cellular materials totally lacking in sterols are needed to test the effect of sterol additions on cellular physiology. Using Phytophthora, we have observed sterol-induced alterations in growth and energy transformations. There is a general lack of specificity in the accumulation of sterols from the medium by these organisms.

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THE USE OF MUTANTS AND AZA STEROLS IN STUDIES OF YEAST STEROL BIOSYNTHESIS. A.C. Oehlschlager, H.D. Pierce, Jr., A.M. Pierce, R. Angus, E. Quantin-Martenot and A.M. Unrau, Department of Chemistry, Simon Fraser University, Burnaby, B.C., Canada V5A 1S6.

When yeast sterol biosynthetic systems are perturbed by genetic mutation or inhibitory substrate, mimics which selectively remove from action a specific sterol-modifying enzyme alternate and often new yeast sterols can be produced. This results from the acceptance by remaining active modifying systems of alternate sterol substrates. This presentation will discuss the design of inhibitory substrate mimics, comparison of yeast sterol biosynthesis in chemically inhibited and mutant yeast, and the simultaneous use of inhibitors and mutation to achieve a designated sterol metabolite.

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THE ROLE OF STEROIDS AND PENTACYCLIC TRITERPENOIDS IN THE GROWTH AND REPRODUCTION OF *Phytophthora cactorum*. W. David Nes, Gary A. Saunders and Erich Heftmann, USDA-SEA, Western Regional Research Center, 800 Buchanan Street, Albany, CA 94706.

Growth and reproduction of *Phytophthora cactorum*, a fungal pathogen unable to epoxidize squalene, are influenced by different combinations and concentrations of β-amyrin, cholesterol and estradiol. Whereas β-amyrin and cholesterol stimulate mycelial growth, estradiol inhibits growth. When β-amyrin and estradiol were added to cholesterol-containing mycelia, growth was inhibited, but cholesterol-induced sexual reproduction was not significantly altered by β-amyrin and estradiol at concentrations inhibitory to growth. Apparently, the mechanisms involved in growth and membrane function are not affected in the same manner as sterol-induced sexual reproduction. Examination of the free sterol, steryl ester, and steryl glucoside fractions of mycelia and media extracts of fungi fed radiolabeled ^{14}C-cholesterol in the presence and absence of β-amyrin and estradiol showed that cholesterol metabolism depends on the nature of the isopentenoids added to the culture medium. The results are interpreted to imply that growth alterations are influenced by the amount of cholesterol and its C-3 metabolites present in the mycelial membranes which, in turn, is influenced by other isopentenoids supplied to the fungus. Reproduction depends on the availability of sterol and on the concentration of other polycyclic isopentenoids. They probably compete for the active sites in the cell, where cholesterol is presumed to be metabolized to steroid hormones responsible for oospore production.

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THE EFFECT OF MEMBRANE STEROL COMPOSITION ON FATTY ACID SYNTHESIS IN *Saccharomyces cerevisiae*. Thomas M. Buttke, Department of Microbiology, University of Mississippi Medical Center, 2500 North State Street, Jackson, MS 39216, Rebecca Reynolds and Susan Jones, Department of Biochemistry, Harvard University.

Saccharomyces cerevisiae strain GL7 is an ideal organism for studying sterol-phospholipid interactions in yeast. Due to two separate mutations, strain GL7 requires exogenous sterol and unsaturated fatty acid for growth, allowing the membrane lipid composition of this organism to be completely modified. Using this approach, we have shown that cells grown with C-24 alkylated sterols incorporate less unsaturated fatty acids into their phospholipids than do cells grown with cholesterol. Additional studies demonstrate that the fatty acid changes are not due to differences in sterol uptake, because membranes isolated from cells grown with ergosterol or 7-dehydrocholesterol have identical sterol-to-phospholipid ratios ($\sim$0.5). To further examine the relationship between sterol structure and phospholipid-fatty acid composition, we have studied the effect of sterol side chains in cells synthesizing both saturated and unsaturated fatty acids, as well as in cells blocked in total fatty acid synthesis. Growth of strain GL7 with hemin in place of unsaturated fatty acids leads to the synthesis of large amounts of short-chain saturated fatty acids (C_{10}-C_{14}) in addition to 16:0, 16:1, 18:0 and 18:1. Phosphatidylethanolamine contains 2-3 times as much unsaturated fatty acid as phosphatidylcholine or phosphatidylserine + phosphatidylinositol, the latter phospholipids being enriched with the short-chain fatty acids. Thus, the mutant can regulate the fatty acid composition of phosphatidylethanolamine independently of the other phospholipids. Phospholipids isolated from cells grown with cholesterol contain higher levels of unsaturated fatty acids ($\sim$2.5 times) than phospholipids isolated from cells grown with C-24 alkylated sterols, demonstrating that strain GL7 can modify the synthesis of fatty acids in response to sterol supplements. In contrast to heme-grown cells, yeast grown with cerulenin are unable to synthesize any fatty acids and are dependent upon exogenously supplied saturated and unsaturated fatty acid supplements for growth. Under these conditions, sterol structure does not affect the phospholipid-fatty acid composition of the mutant. Our results suggest that sterol-induced fatty acid changes in strain GL7 arise at the level of fatty acid synthesis.

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STEROLS IN THE SYSTEMATICS OF *Chlorella*. Marcia J. Holden and Glenn W. Patterson, University of Maryland, Department of Botany, College Park, MD 20742.

Thirty-five isolates representing thirty-two species and varieties of the genus *Chlorella* were analyzed for their sterol content. *Chlorella* is a unicellular member of the division Chlorophyta with few distinguishing morphological characteristics. Sterols were investigated as a potentially valuable biochemical taxonomic tool. Sterols of axenic cultures grown heterotrophically were analyzed by gas chromatography and mass spectroscopy. Seven isolates contain a $\Delta 7$ series of C-28 and C-29 sterols. Seven additional isolates were marked by a similar series of $\Delta 5$ C-28 and C-29 sterols. The largest number of isolates (sixteen) were species that synthesized the $\Delta 5,7,22$ sterol, ergosterol, as the major sterol along with related C-28 sterols. An additional group of four cultures also contained ergosterol along with C-29 sterols not found in the previously mentioned group. One unusual isolate synthesizes ergosterol along with $\Delta 5,8$ sterols in large amounts. Biosynthetic relationships will be discussed. Comparison of the sterol data will be made with fatty acid patterns found in the same cultures plus additional biochemical markers that have been determined for the genus.

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THE DETECTION OF MONOHYDROXYLATED C-22 BILE ACIDS IN HUMAN MECONIUM. Jan St. Pyrek, Roger Lester and Eugene W. Adcock, III, University of Texas at Houston, Medical School Department of Internal Medicine, Division of Gastroenterology, P.O. Box 20708, Houston, TX 77025.

The composition of the monohydroxylated acid fraction isolated from human meconium was studied by means of capillary gas chromatography-computerized mass spectrometry. In addition to C_{24} bile acids and C_{20} steroidal acids, numerous minor steroidal components were detected. Among them, 3α-hydroxy-23,24-bis-nor-5α-cholan-22-oic and 3β-hydroxy-23,24-bis-nor-choi-5 en-22-oic acids were identified by comparison with authentic compounds. C_{22} bile acids are known to be formed from steroidal precursors by the microbial scission of the side chain; however, their presence in the fecal material had not been previously demonstrated. If, in the present case, this is the source of C_{22} acids, their accumulation in the sterile fetal intestine might be explained by the formation in the maternal gut, absorption and placental transfer to fetus.

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REMOVAL OF 1,4 DIOXANE FROM ETHOXYLATES OF PRIMARY AMINES, FATTY ACIDS, AND POLYETHYLENE GLYCOL ESTERS OF FATTY ACIDS. R.S. Shetty, E. Carr, R.S. McDaniel, Jr., and G.D. Lichtenwalter, Armak Co., 8401 West 47th Street, McCook, IL 60525.

Steam stripping was found to be an effective method of removing 1,4 dioxane from the ethoxylated products of primary amines and fatty acids. Various ethoxylates were spiked with 1,4 dioxane at the 500-ppm level and successfully reduced to less than 2 ppm by continuous steam stripping at atmospheric pressure. The 1,4 dioxane removal rate was affected by temperature, pressure, steam flow rate and the ethoxylate's molecular weight. An equation was developed to predict the stripping time to reduce the dioxane content to an acceptable level: $t = k\ (3.32 \log x\text{-}1)/F$, where t = time in minutes, F = steam feed rate, x = initial dioxane content in ppm, and k = constant. Continuous steam stripping was also used to reduce 1,4 dioxane to <2 ppm in polyethylene glycol esters. The rate of 1,4 dioxane removal was affected by temperature and steam feed rate, whereas ester hydrolysis depended mainly upon temperature.

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INTERACTIONS OF PHOSPHOLIPIDS WITH CHARGE-TRANSFER AGENTS. William N. Marmer and Philip E. Pfeffer, USDA, SEA, Eastern Regional Research Center, 600 East Mermaid Lane, Philadelphia, PA 19118.

Scant attention has been given to the interaction of phospholipids with charge-transfer agents. A goal of this research was the utilization of such interactions to effect lipid subclass separations by charge-transfer chromatography. Studies included investigation of the behavior of the charge-transfer electrophile tetracyanoethylene (TCNE) with dimyristoyl phosphatidylcholine (PC) and dilauroyl phosphatidylethanolamine (PE), and with the structurally simpler diethylphosphate (free acid and tetramethylammonium salt) and triethylphosphate. The TCNE/PC complex showed 1:1 stoichiometry and its formation in chloroform was studied by UV/visible spectrophotometry and ^{13}C and ^{31}P NMR spectroscopy. Initial results of ^{31}P NMR relaxation studies indicate that the phospho group is the center of interaction. Although the complex could be isolated from solution, it was easily destroyed during TLC on silica gel, and intact PC was recovered. The interaction of TCNE with PE was more complicated; PE was found to displace a CN group of TCNE to give an isolatable substitution product in 50% yield, analogous to known reactions of TCNE with primary amines. Similar behavior was noted for TCNE/phosphatidylserine. The results of experiments with structurally more complex PC and PE, and with other charge-transfer electrophiles will be discussed.

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ULTRAVIOLET SPECTROPHOTOMETRY OF CRUDE SOYBEAN OILS BEFORE AND AFTER FRACTIONATION ON SILICA GEL COLUMNS. Helen G. Brown and Harry E. Snyder, University of Arkansas, Horticultural Food Science Department, Route 11, Fayetteville, AR 72701.

We investigated the degree of oxidation in crude soybean oils soon after extraction. Both the ultraviolet absorbancy at 233 nm and the absorbancy in the 310–260 nm range (after reduction and dehydration) were used as indicators of oxidation. Also, the crude oils were fractionated on silica gel into oxidized and unoxidized fractions, and these fractions were examined by UV spectrophotometry. The results indicate that freshly extracted soybean oil had easily detectable amounts of oxidized triglycerides.

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PRACTICAL ASPECTS OF HYDROGENATION OF VEGETABLE OILS WITH NICKEL-SULFUR CATALYST. D.V. Okonek and W.R. Alcorn, The Harshaw Chemical Company, 23800 Mercantile Road, P.O. Box 22126, Beachwood, OH 44122.

Hydrogenation of soybean oil with a commercial nickel-sulfur catalyst has been studied at various temperatures and pressures. Although iodine value drop was observed to change with temperature and pressure, *trans* isomer levels did not, in contrast with hydrogenation with conventional nickel catalysts. Conjugated diene formation has been observed in the early stages of soybean oil hydrogenation with nickel-sulfur catalyst. The levels of conjugated diene were observed to vary with reaction temperature and pressure. Free fatty acid formation during hydrogenation of a triglyceride feedstock with nickel-sulfur catalyst has been studied as a function of reaction temperature, pressure, catalyst loading level, time and feedstock moisture level. Solid fat index data on oils hydrogenated with nickel-sulfur and nickel catalysts illustrate the effects of significantly higher *trans* isomer levels made with nickel-sulfur catalyst. Oils studied include soybean oil, palm oil and fish oil.

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INVESTIGATION AND MODELING OF MASS TRANSFER IN HYDROGENATION REACTORS. A.H. Chen and D.D. McIntire, W.L. Clayton Research Center, 3333 N. Central Expressway, Richardson, TX 75080.

The mass transfer of k_La for soybean oil hydrogenation was determined from various sizes of hydrogenators: ½ lb, 100 lb, 1000 lb, 30,000 lb, 40,000 lb and 60,000 lb. A procedure is recommended to standardize production hydrogenators with different k_La values as well as to scale-up or scale-down convertors with various capacities. A mathematic model was constructed for the prediction of k_La when the power per unit volume of oil and the aeration number of hydrogen gas flow were known.

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A NOVEL TRIPHENYLMETHYLFLUOROBORATE OXIDATION OF O^1-HEXADECYL-O^2,O^3-ISOPROPYLIDENEGLYCEROL BY HYDRIDE TRANSFER. Joseph G. Turcotte, Department of Medicinal Chemistry, College of Pharmacy, University of Rhode Island, Kingston, RI 02881, and David A. Marsh, Massachusetts College of Pharmacy.

The synthesis of 1-(hexadecyloxy)-3-hydroxy-2-propanone (*3*) from O^1 hexadecyl-O^2,O^3-isopropylideneglycerol (*1*) was attempted by reaction of *1* with tritylium tetrafluoroborate (TTFB) based on a reported novel synthetic route to hydroxyketones by reaction of ketals with TTFB. Ketal *1* and TTFB in CH_2Cl_2 at room temperature (1 day) gave numerous products with the diol 3-(hexadecyloxy)-1,2-propanediol (*2*) being the major one; no evidence for formation of ketone *3* was found. When the reaction time was increased to 2–6 days, two major lipids (24%, plus 10 minor components, TLC) were isolated by acetone precipitation and column chromatography. ^1H NMR, infrared, and analytical (elemental) data and independent synthesis confirmed the isolated products to be the isomeric 1,2- and 1,3-ether esters O^1-hexadecyl-O^2-palmitoylglycerol (*4*) and O^1-hexadecyl-O^3-palmitoylglycerol (*5*), respectively. Reaction of *1* and *2* with TTFB in CH_2Cl_2 under the same conditions gave identical products, among which were *4* and *5*, indicating that both reactions had a common intermediate (*3*). Mechanisms for the novel formation for *4* and *5* are discussed.

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PREPARATION OF METHYL LINOLEATE-16,16,17,17-d_4. R.O. Adlof and E.A. Emken, Northern Regional Research Center, 1815 North University, Peoria, IL 61604.

Methyl linoleate-16,16,17,17-d_4 was synthesized for use in human metabolism studies. An eight-step synthesis is described that produced 5–25 g of methyl linoleate-d_4 in greater than 30% overall yield. The preparation uses commercially available starting materials. *Tris*(triphenylphosphine)chlororhodium (I) catalyst is used for the incorporation of the deuterium isotopes. The double bond in the 9 position is incorporated by the Wittig coupling of 1-non-3-enyl-d_4-triphenylphosphonium bromide with methyl 8-formyloctanoate obtained by ozonolysis of methyl oleate. The small amount of *trans, cis* isomers of linoleate (~7%) formed during the Wittig reaction was removed by partial argentation resin chromatography. Analysis by mass spectrometry showed the methyl linoleate to be greater than 95%-d_4.

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SYNTHESIS OF METHYL (6-ALKYL-3-CYCLOHEXENYL)ALKENOATES AS MODEL CYCLIC FATTY ACID ESTERS. R.A. Awl and E.N. Frankel, Northern Regional Research Center, 1815 N. University Street, Peoria, IL 61604.

Pure diunsaturated C_{18} cyclic fatty acid methyl esters (CFAME) of known structure were synthesized as models to assess their biological activity in heat-abused oils. The Wittig reaction was used to prepare: methyl 9-(6-propyl-3-cyclohexenyl)-8-nonenoate; methyl 11-(6-methyl-3-cyclohexenyl)-10-undecenoate; and methyl 12-(3-cyclohexenyl)-11-dodecenoate. The appropriate methyl ω-bromo esters and their triphenylphosphonium bromides were made and converted to their reactive ylids with $NaOCH_3$ in DMF. Substituted and unsubstituted 3-cyclohexenals were reacted with the ylids. The desired CFAME products were isolated in crude yields of 30–83% as liquids and fractionally distilled. These model CFAME and their saturated derivatives were characterized by GLC, TLC, IR, NMR and MS.

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INTERESTERIFIED BLENDS OF CORN OIL AND EDIBLE TALLOW FOR USE AS MARGARINE OILS. A. Philip Handel and Oscar Chacon, Department of Food Science and Technology, University of Nebraska, Lincoln, NE 68583.

Interesterified blends of corn oil and edible tallow were produced having physical properties similar to those of tub-type margarines. These blends would be useful as an alternative to hydrogenation for obtaining desirable physical properties. Interesterified blends retain the essential fatty acid content of corn oil without the formation of *trans* isomers. Stability was determined by peroxide value at periodic intervals on samples held at 60 C. Interesterified blends, non-interesterified blends and commercial margarine oils were evaluated. The interesterified products showed a stability comparable to commercial margarine oils. Sensory evaluation was also conducted on the interesterified blends as well as objective analysis of volatiles by gas chromatographic analysis.

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THE LIPID OF SOME LACTIFEROUS PLANTS. J.B.M. Rattray, J.F. Alex and G.W. Anderson, Department of Chemistry, University of Guelph, Guelph, Ontario, Canada N1G 2W1.

Certain plants growing wild in the province of Ontario have been examined for their possible importance in providing compounds that might serve as economically viable petrochemical substitutes. The studies have concentrated on four lactiferous plants—cypress spurge (*Euphorbia cyparissias*), leafy spurge (*Euphorbia esula*), milkweed (*Asclepias syriaca*) and sow thistle (*Sonchus arvensis*). Harvesting of the plants was done on a regular basis during the months June–October and crop yields were determined. Whole plant material was dried at 105 C, powdered and extracted to yield crude resin and rubber fractions. Further fractionation of the resin yielded the lipid and polyphenol components. The largest purified resin fraction was found with cypress spurge; the yield increased gradually over the growing season to a maximum value of 9–10% of the dry matter. The resin yields of the other plants were variable but generally showed maximum values (%) at the beginning of August of 5.4 for leafy spurge, 6.8 for milkweed and 5.5 for sow thistle. The rubber component was greatest at a value of 1.2% with milkweed toward the end of its growing season. Aging of the plants was accompanied by a general decrease in the lipid fraction and a corresponding increase in the polyphenol material. The decrease in lipid (as % of resin) was found to involve a change of 70.7 → 57.4 for cypress spurge, 54.3 → 40.3 for leafy spurge, 59.1 → 38.3 for milkweed, and 72.4 → 43.6 for sow thistle. Examination of the lipid component by thin layer chromatography showed the presence of hydrocarbon, wax, triglyceride, sterol and terpenoids. Several components remain unidentified. Marked compositional differences exist between the plant species. The major fatty acid components were 16:0, 18:1 and a variety of long-chain unsaturated acids.

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NUTRITIONAL SIGNIFICANCE OF PHYTATE AND OXALATE CONTENT IN AMARANTH GRAIN. Joseph P. Senft, Organic Gardening and Farming Research Center, Box 323/RD 1, Kutztown, PA 19530, and Barbara F. Harland, Division of Nutrition, Food and Drug Administration, 200 C Street, SW, Washington, DC 20204.

Amaranth grain was identified as a new potential world food source, particularly for tropical regions, by an advisory panel of the National Academy of Sciences in 1975. Development of this crop since that time suggests it has potential as an economically significant crop in temperate regions as well. The importance of amaranth is that it has a protein content which is of higher quality than that of most of the more common grains, i.e., it contains high levels of lysine and the sulfur-containing amino acids. Animal feeding studies using the raw grain as the sole protein source have given growth rates equivalent to 80% of the growth rates observed for a casein control diet. This paper examines further the nutritional quality of amaranth by presenting data for the phytate and oxalate content of eighteen amaranth grain types. The mean oxalate level was 0.21%, of which approximately 25% was soluble. The mean phytate level was 1.14%. Phytate and oxalate bind mineral micronutrients such as zinc and thus may interfere with optimum mineral metabolism. In addition, phosphate fertilization is known to affect phytate accumulation in pea and bean seeds. A similar relationship is suggested for amaranth. The importance of these observations to the use of amaranth as an important ingredient in human nutrition will be discussed.

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ONTOGENY OF LIPID METABOLISM IN SOYBEANS WITH ALTERED FATTY ACID COMPOSITION. R.F. Wilson, Department of Crop Science, 4124 Williams Hall, North Carolina State University, Raleigh, NC 27650, and B.F. Carver, North Carolina State University.

Recurrent selection methodology has been utilized to develop experimental soybean genotypes that contain a high concentration of oleic acid and low concentrations of polyunsaturated fatty acids. At early stages of seed development, one of the experimental lines developed in this program, N78-2245, contained 64.1% oleic acid, 18.0% linoleic acid, and 3.7% linolenic acid. A typical trend during the development of soybeans is a decrease in linolenic acid concentration. The changes in fatty acid composition and glycerolipid metabolism within phospholipids, diacylglycerol and triacylglycerol were observed at four stages during seed development in N78-2245 and a standard soybean cultivar, the variety Dare. Rates of synthesis and accumulation of each fatty acid in the respective glycerolipid classes were compared between these two genotypes over the developmental period. Correlations between these data coupled with information concerning total oil and protein content of the developing seeds have been used to improve our understanding of lipid biochemistry in soybeans and to develop new methods for screening genetic material for lines with improved oil flavor quality at early stages of seed development.

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FATTY ACID COMPOSITION OF THE METATHORACIC LEG MUSCLE, VENTRAL NERVE CORD AND SPERMATOPHORES OF THE HOUSE CRICKET (*Acheta domesticus*). R.E. Worthington and U.E. Brady, University of Georgia Experiment Station, Experiment, GA 30212.

Linoleic acid is essential for reproduction in the house cricket (*Acheta domesticus*). Analysis of the fatty acids of the reproductive tracts of male house crickets revealed 0.3% eicosa-5,8,11,14-tetraenoic acid (arachidonic acid) and 6% eicosa-5,11,14-trienoic acid. In this study we have examined the metathoracic leg muscle (femur), ventral nerve cord and spermatophores of crickets for total and constituent fatty acids. The muscle, ventral nerve cord and spermatophores contained approximately 5%, 12%, and 0.9% total fatty acids on a dry weight basis. In the muscle tissue, palmitic, stearic, oleic and linoleic accounted for 97% of total fatty acids and were also the major fatty acids of ventral nerve cord and spermatophore tissues. Arachidonic and eicosa-5,11,14-trienoic acids were not detected in the total fatty acid analysis of the muscle tissue, but were present at levels of approximately 0.6% and 0.8% of ventral nerve cord total fatty acids and 0.4% and 5% of spermatophore total fatty acids respectively. Additional unidentified peaks with retention times suggestive of other 20_c unsaturated acids were observed in ventral nerve cord and spermatophore chromatograms. Identifications were based upon retention behavior on Silar 10C, OV225 and OV275 columns.

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MORPHOLOGY AND FATTY ACID COMPOSITION OF IMMATURE RED CELLS IN PHENYLHYDRAZINE TREATED RATS. Steven C. Goheen, Edward C. Larkin, Elaine E. Lahue and G. Ananda Rao, Veterans Administration Medical Center (111H), 150 Muir Road, Martinez, CA 94553.

Reticulocytosis was induced in 400-g rats fed either a chow diet or a fat-free diet for 8 weeks by injecting 6 mg phenylhydrazine/kg body weight each day for 10 days. Red cells from phenylhydrazine-treated rats contained mostly (>80%) reticulocytes, whereas those from control rats had relatively few (<7%) reticulocytes. The hematocrit of blood from control rats was 45.1 ± 2.2, whereas that of the phenylhydrazine-treated rats was 34.7 ± 1.0. Red cells were washed and isolated using centrifugation. Lipids were extracted and fatty acid methyl esters were prepared and analyzed by gas liquid chromatography. Relative levels of 16:0/16:1 and 18:0/18:1 from total lipids were lower in reticulocyte-rich red cells than in controls. The differences described above were observed whether rats were fed a stock diet or a fat-free diet. Increased levels of monounsaturated fatty acids may be related to the presence of endoplasmic reticulum, the site of desaturase enzymes in reticulocytes. The morphology of red cells from the phenylhydrazine-treated rats fed stock diet was studied by scanning electron microscopy. These cells contained 31% discocytes, 4% knizocytes, 11% stomatocytes, 14% echinocytes I and 40% echinocytes II and III. There was no significant difference between the morphology of these cells and those from rats given a fat-free diet with phenylhydrazine treatment. Red cells from control rats fed the stock diet contained 71% discocytes, 1% knizocytes, 2% stomatocytes, 14% echinocytes I and 12% echinocytes II and III. Rats fed a fat-free diet without phehylhydrazine treatment had fewer discocytes than those fed a stock diet. Therefore, the morphology and fatty acid composition of reticulocytes was significantly different from mature erythrocytes of rats fed either a stock diet or a fat free diet. (Supported by the National Aeronautics and Space Administration and the Veterans Administration.)

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A GAS CHROMATOGRAPHIC REACTOR TO MEASURE LIPID OXIDATION. J. Assis F. Faria, UFV-Brazil, and Seymour G. Gilbert, Rutgers University.

A gas chromatographic reactor was developed with the sensitivity to detect the low rates of reactions that occur during the induction period of lipid oxidation. The principle of inverse gas chromatography was used to study properties of the stationary phase (lipid component) of the reactor column. The reaction rates were measured as oxygen uptake by a thermal conductivity detector, and the volatiles formed during the oxidation were quantitatively measured using a flame ionization detector. Conventional methods have failed to monitor the early phases of oxidations; with this method, the oxidations of polyunsaturated fatty acids of some commercial vegetable oils were followed. The gas chromatographic reactor was found to be rapid and accurate for obtaining kinetic and thermodynamic data at a broad range of temperatures and reactant concentrations.

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CHOLESTEROL DISPOSITION IN SWINE FED VARIOUS PROTEINS AND FATS. K.D. Wiggers and L.S. Walsh, Iowa State University, Ames, IA 50011; A.D. Julius, Eppley Institute of Cancer Research; and M.J. Richard, C.E. Glatz and M.A. Hauser, Iowa State University.

In experiment 1, the effects of dietary protein and fat on cholesterol disposition were determined in piglets fed semisynthetic diets containing casein or soy protein isolate (SPI) and beef tallow (T) or soybean oil (SBO). The proteins and fats were designated in a 2x2 factorial fashion. The homogenized slurry diets also contained dextrin, dextrose, water, and were supplemented with vitamins and minerals. Plasma cholesterol concentration (CC) of the T-fed pigs was significantly greater than that of the SBO-pigs. The percentage of total cholesterol carried in the low density lipoprotein (LDL)-fraction was significantly greater in the SBO-fed pigs. Plasma CC response was similar for pigs consuming either protein. SBO-fed pigs had significantly greater adipose tissue CC than T-fed pigs. The SBO-fed pigs tended (p=.07) to have greater whole-body CC than T-fed pigs. In experiment 2, pigs were fed ground beef (21% fat) or SPI-SBO with ground corn plus supplements. Blood CC, lipoprotein cholesterol distribution and liver CC were not significantly different for beef-fed vs soy-fed pigs. The whole-body (excluding central nervous system and blood) cholesterol and fat of the soy-fed pigs was significantly greater than that of the beef-fed pigs. LDL of the soy-fed pigs bound more readily to an in vitro glycosoaminoglycan arterial model than did LDL of beef-fed pigs.

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EFFECTS OF ANIMAL AND VEGETABLE PROTEIN ON SERUM LIPIDS IN ELDERLY WOMEN. George U. Liepa and Sarah Kelleher,* Department of Nutrition and Food Sciences, Texas Woman's University, PO Box 24134, TWU Station, Denton, TX 76204.

The purpose of this study was to compare the effects of animal and vegetable protein on serum lipids. A group of 10 elderly women was fed for a total of 12 weeks in this study. The subjects were non-institutionalized individuals ranging in age from 65 to 93 years. Preliminary analysis indicated that total serum cholesterol levels were normal in all subjects at the start of the study. The subjects were initially fed a control diet (mixed sources of protein) for 3 weeks and were then divided into 2 groups. One group (A) consumed a diet in which 90% of the protein was from defatted beef and the other group (B) consumed a diet in which 90% of the protein was from glandless cottonseed flour. The fat sources in both experimental diets were corn oil and corn oil margarine. After 3 weeks of experimental diets, the subjects were again placed on the control diet for 3 weeks. In the fourth and final 3-week period, the groups were split again, and this time group A received the diet containing protein from cottonseed flour and group B received defatted beef protein in its diet. Blood samples were drawn every 5 days. The serum was separated and stored at -20 C until analysis could be done at the completion of the feeding study. Serum cholesterol was determined enzymatically. High density lipoprotein (HDL) was separated by a heparin-manganese centrifugation method and HDL cholesterol was also analyzed enzymatically. Analysis showed no difference in levels of total serum cholesterol or HDL cholesterol with either of the experimental diets.

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ROLE OF OILSEED PROTEINS IN LIPOPROTEIN METABOLISM. George U. Liepa and Myung Park,* Department of Nutrition and Food Sciences, PO Box 24134, TWU Station, Texas Woman's University, Denton, TX 76204.

This experiment was conducted to study the effects of various dietary proteins and dietary amino acids on serum lipids. Male Sprague-Dawley rats were maintained for 28 days on their particular diets, at which time blood serum samples were obtained to determine the concentrations of cholesterol and of high density lipoprotein (HDL) cholesterol. The concentrations of cholesterol in both the total and HDL fractions were different in 4 dietary groups and were positively correlated with each other. Food consumption was similar in all 4 dietary groups. Diets containing proteins from an animal source (casein) produced more weight gain and less fecal weight than diets from oilseed protein (cottonseed protein) sources, but these changes were not significant. Rats which had been maintained on diets containing animal protein had higher serum cholesterol and HDL cholesterol levels than rats which had been fed oilseed protein. Two other experimental diets were formulated to determine if the amino acid ratios in the proteins played a significant role in the cholesterol altering effect. One diet contained casein plus adequate dietary arginine to make the arginine/lysine ratio similar to that found in cottonseed protein. The other diet contained cottonseed protein plus enough lysine to make it have an identical arginine/lysine ratio to that in casein. After 4 weeks on these dietary regimens, the animals fed the modified casein diet showed a decrease in both serum cholesterol and HDL cholesterol whereas the animals fed the modified cottonseed protein diet showed an increase in the same 2 serum fractions. Also animals on cholesterol-lowering diets (casein plus arginine, cottonseed protein) tended to have higher free cholesterol levels than did animals on cholesterol-elevating diets (casein, cottonseed protein plus lysine). These results suggest that the effect dietary proteins exert on serum lipids may be due to the ratios of arginine and lysine within the diets.

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UTILIZATION OF WHEAT AND GARBANZO BEAN PROTEIN IN RATS AS EVALUATED BY RESPONSE SURFACE METHODOLOGY. Nancy L. Canolty, Department of Foods and Nutrition, Dawson Hall, University of Georgia, Athens, GA 30602.

Twenty diets containing 6, 8, 10 or 12% protein supplied as whole wheat grain, legume (garbanzo bean), or one of 3 mixtures of these 2 protein sources (wheat protein: legume protein, 25:75, 50:50, 75:25) were fed ad libitum to male weanling rats for 3 weeks. At the end of the feeding trial, weight and gross composition of brain, kidneys, liver, spleen, heart, gastrointestinal (GI) tract and remaining carcass were determined. Response surface methodology was used to assess the influence of protein concentration, and percentage protein supplied by wheat, on the weight and composition of rats. The general linear models procedure of the Statistical Analysis Sytem

*Presenting author

(SAS) were used to develop multiple regression equations expressing weights (live wt, fresh wt, fat wt, protein wt) as functions of protein concentration and percentage of protein supplied by wheat. The response surface model of SAS was then used to generate a contour plot for each dependent variable representing weight as a function of protein concentration and percentage protein supplied as wheat. Comparisons of the various contour plots showed that the size and composition of carcasses, organs and GI tracts were differently affected by changes in independent variables. The influence of more than one independent variable on protein utilization can be studied by response surface methodology.

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NUTRITIONAL VALUE OF COTTONSEED PROTEIN IN THE HUMAN DIET: AN OVERVIEW. Alice N. Milner and Betty B. Alford, Department of Nutrition and Food Sciences, Texas Woman's University, PO Box 24134, TWU Station, Denton, TX 76204.

Over the past 10 years, research by faculty and staff of the Human Nutrition Research Laboratory at the Texas Woman's University has demonstrated the feasibility of cottonseed protein as a significant source of protein in the human diet. Feasibility has been explored from the standpoint of nutritional quality for individuals throughout the life cycle, of suitability for product development, and of the acceptability of food items containing cottonseed flour. The biologic value of cottonseed protein and the possible deleterious effect of phytate have been the major nutritional concerns. Parameters such as growth rate and/or maintenance of weight; hematocrit/hemoglobin; total serum protein and A/G ratio; total serum calcium phosphorus and Ca/P ratio remain unchanged whether subjects are maintained on diets in which protein is derived exclusively from casein, synthetic high biologic reference protein, glandless cottonseed flour or of mixtures of the above. Nitrogen balance may be maintained in the young adult female using cottonseed flour at a minimal nitrogen intake of 0.6 g/kg body wt. A consistent finding among individuals from all age groups studied has been the difference in urinary excretion of amino acids (or their derivatives) associated with complex lipids, i.e., serine, phosphoserine and phosphoethanolamine. The 24-hr urinary excretions of these, and the limiting amino acid threonine, were significantly lower when subjects were placed on a diet in which 90% of the protein was derived from cottonseed flour. Corresponding alterations in serum lipoproteins have not been observed either in the young or aged female.

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FOOD ENERGY—A REEVALUATION OF THE FACTORS USED FOR ITS CALCULATION. John L. Weihrauch, USDA, SEA, CNC, and Young-sun Son, University of Maryland.

Energy factors are used for calculating food energy values, the accurate estimation of which is very important for dealing with problems of undernutrition and obesity. Discrepancies between calculated and experimentally determined energy values that were reported in several recent articles necessitate a reevaluation of the existing energy factors. Discussed are some aspects which may contribute to a better evaluation of the general factors 4, 9, 4, and the specific factors for food groups. These include the consideration of the proximate composition of diets or foods, more efficient lipid extraction, heat of combustion of lipid components, and the effect of dietary fiber on the availability of energy. Suggestions will be made for further research.

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THE FATTY ACID CONTENT IN THE FOOD SUPPLY OF SELECTED COUNTRIES WITH DIFFERENT DIETS. John L. Weihrauch, USDA, SEA, CNC, Wanda Polacchi, FAO, ROME, and J. Périssé, FAO, Food Policy and Nutrition Division.

The Food and Agriculture Organization of the United Nations has added to its interlinked computer system the capability to monitor the per capita per day availability of the saturated, monounsaturated, polyunsaturated and linoleic acids in over 300 commodities in the food supply of more than 200 countries and territories. The per capita consumption of these fatty acids in the food supply of selected countries will be compared, and trends since 1962 will be followed. The significance of the data and their usefulness in making certain economic, nutritional or health-related inferences or correlations will be discussed.

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PROSTAGLANDIN AND ZINC INTERACTION IN THE GASTROINTESTINAL TRACT. Simin Nikbin Meydani and Jacqueline Dupont, Harvard Medical School, New England Regional Primate Research Center, 1 Pine Hill Drive, Southborough, MA 01772.

Experiments were conducted to investigate the role of prostaglandins (PG) in zinc absorption and the role of zinc in PG synthesis. PG levels were modified by either changing the concentration of their precursors (essential fatty acids) in the diet or by administering an inhibitor of their synthesis, aspirin or indomethacin. Zinc level was modified by controlling the dietary concentration. Since zinc deficiency causes depression of appetite, a group of rats was pair fed to zinc-deficient rats with the control diet. Weanling rats were fed the assigned diets for one month, after which they were anesthetized with ether. Samples from blood, gut contents and mucosa were collected for zinc measurement, and alkaline phosphatase was measured in serum. PG were measured in serum from clotted blood and from isolated mucosal cells incubated for 10 min at 37 C. Although aspirin and indomethacin treatment slightly decreased zinc concentration in mucosa, this decrease was not reflected in the zinc status of the rats as measured by food intake, weight gain, tissue zinc level and serum alkaline phosphatase activity. Zinc deficiency and food restriction decreased the PG level to the same extent in the gut mucosa. In the gut contents, however, zinc deficiency was more effective in reducing PGE_1, $PGF_{2\alpha}$ and PGI_2 level. The reduction of gut contents PG concentration without concomitant reduction in PG synthesis in mucosa suggests an active process of PG secretion involving zinc.

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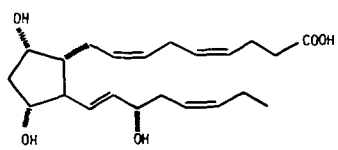
DISCOVERY OF A NEW PROSTAGLANDIN, C22-$PGF_{4\alpha}$ DERIVED FROM DOCOSAHEXAENOIC ACID (C22:6n3) IN THE GILL OF RAINBOW TROUT (*Salmo gairdneri*). Jimbin Mai, Geza Bruckner, Satindra Goswami and John Kinsella, Department of Food Science, Cornell University, Stocking Hall, Ithaca, NY 14853.

A long-term epidemiological study has shown that seafoods rich in docosahexaenoic acid (C22:6n3) are effective in preventing or alleviating coronary heart disease (CHD). Dietary enrichment with n-3 polyunsaturated fatty acids (which occur in fish) has been suggested for the prevention of arterial thrombosis and atherosclerosis. Only recently have certain polyunsaturated fatty acids (PUFA) with n-6 configuration been found to exert their physiological functions through their conversion to prostaglandins (PG) and thromboxanes (Tx). Prostaglandin I_2 (PGI_2) and thromboxane A_2 (TxA_2), both derived from arachidonic acid (C20:4n6) found in animal tissues, are important to platelet function (clotting, thrombosis) and are being intensively studied. However, the synthesis of PG and related derivatives from n-3 fatty acids has not been studied. Since rainbow trout (*Salmo gairdneri*) contain significant amounts of the n-3 fatty acids and PG synthetase is present in the gill of the trout species, we used it to test for the synthesis of prostaglandins from C22:6n3 and C22 PUFA. The PG were extracted from the homogenized fish gill of male rainbow trout by chloroform:methanol (2:1) and purified by silicic column chromatography. The purified PG were derivatized to perfluoro TMS derivatives suitable for gas chromatograph electron capture detection. We identified PGF_3 and PGE_3 prostaglandins. In addition an unknown peak having a chain length equivalence of 22 carbons was found. In vitro studies demonstrated that this unknown compound was derived from C22:6n3. Further GC-MS studies confirmed that this unknown compound was four mass units less than the corresponding homologous dihomo-$PGF_{2\alpha}$. Based on the GC-MS data and the biosynthetic mechansim of PGF, we tentatively identified the structure and labeled it C22-$PGF_{4\alpha}$ as shown.



C22-$PGF_{4\alpha}$

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CONTROL OF PROSTAGLANDIN E_2 SYNTHESIS IN VARIOUS TISSUES BY THE ALTERATION OF THE DIETARY RATIO OF α-LINOLENIC TO LINOLEIC ACID. Lisa A. Marshall and Patricia V. Johnston, 205 Burnsides Research Laboratory, University of Illinois, Urbana, IL 61801.

Unequivocal evidence that α-linolenic acid (18:3ω3) is a dietary essential is lacking. There are, however, indications that its desaturated and elongated metabolites are of functional importance in certain tissues and that one of these, timnodonic acid (20:5ω3), is the precursor of the prostaglandins of the 3-series. A deficiency of the classical essential fatty acid, linoleic (18:2ω6), is known to alter the prostaglandin synthesizing capacity of various tissues. Moreover, earlier studies from this laboratory have shown that changes in the ratio of α-linolenic to linoleic acid in the diet significantly affect prostaglandin E_1 and E_2 synthesis by tissues of the immune system. We have now conducted prolonged feeding trials in which the ratio

α-linolenic to linoleic acid was varied and the prostaglandin E_2 synthesizing capacity of various tissues was examined. Female Lewis rats were fed semipurified diets containing α-linolenic and linoleic acids in ratios of either 0:42 (corn oil), or 1:6 (soybean oil), or 1:1 (linseed and soybean oil mixture) throughout gestation and parturition. After weaning, male and female offspring were continued on the same diet as their mothers. Whole brain, liver and spleen fatty acid composition were analyzed and prostaglandin E_2 synthesis by spleen and liver homogenates, and brain slices was determined by radioimmunoassay. The composition of the dietary fat was reflected in the fatty acid composition of the tissues. Prostaglandin E_2 synthesis by the tissues decreased as the amount of α-linolenic acid in the diet was increased. The level of α-linolenic acid in the diet also altered prostaglandin E_2 synthesis by platelet-rich plasma. It is proposed that the control of prostaglandin synthesis by changes in the ratio of α-linolenic and linoleic acids in the diet reveals one aspect of the function and, therefore, the essentiality of α-linolenic acid. Such a function would not necessarily be expressed in terms of a clinical syndrome commonly associated with the establishment of nutrient essentiality.

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DETERMINATION OF MOLECULAR WEIGHTS OF HUMAN LOW DENSITY LIPOPROTEINS (LDL) BY SEDIMENTATION EQUILIBRIUM. Talwinder Kahlon, Donner Laboratory, University of California, Berkeley, CA 94720; Mason M.S. Shen, Lawrence Livermore Lab, Tjet M. Sun, Frank T. Lindgren and Gerald L. Adamson, Donner Laboratory, University of California at Berkeley.

Sedimentation equilibrium, based on fundamental thermodynamic principles, is a very accurate procedure for determining molecular weight. Meniscus depletion using the Rayleigh interference optical system can be used for such molecular weight determinations. Molecular weight is determined using the equation $MW = (2\ RT\ 1n\ c/r^2)/(1-\bar{v}\rho)w^2$. The only experimental unknown in this equation is $1n\ c/r^2$, which is the slope of the line in a plot of 1n c versus r^2 (c is the concentration of the solute and r is the distance from the axis of rotation). LDL subfractions were collected ranging in density from 1.0270 to 1.0599 g/ml using the Shen et al. procedure. Using meniscus depletion sedimentation equilibrium, molecular weights of fractions 2, 3, 4 and 5 (increasing in density) were determined to be 3.10×10^6, 3.16×10^6, 2.58×10^6 and 3.14×10^6 daltons, respectively. Corresponding partial specific volumes ($\bar{v}$) were 0.9703, 0.9657, 0.9590 and 0.9525 ml/g. There are some discrepancies still to be resolved in the molecular weight determinations obtained by this procedure. Accurate molecular weight determinations are essential to evaluate lipoprotein interconversions and the relative atherogenecity of various LDL subfractions. By comparison, the molecular weights for these fractions as determined by sedimentation velocity were 2.57×10^6, 2.30×10^6, 2.10×10^6 and 1.87×10^6 daltons, respectively, assuming a frictional ratio f/fo of 1.10 and using ηF° versus ρ data. The pronounced discrepancies between these two procedures might be explained by molecular shape changes or a change in $\bar{v}$ as a result of the high centrifugal force, or both. Such molecular distortions may be an important factor in lipoprotein degradation during prolonged ultracentrifugation at high g-forces, such as those commonly used in lipoprotein fractionations.

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A FACILE FLUOROMETRIC METHOD FOR STUDYING THE INTERACTIONS BETWEEN SERUM LIPOPROTEINS AND DETERGENTS OR DENATURANTS. Arthur W. Kruski and Lorraine A. Ghidoni, Department of Pathology, The University of Texas Health Science Center, 7703 Floyd Curl Drive, San Antonio, TX 78284.

The changes in fluorescence intensity of either human or baboon very low density-, low density- or high density-lipoproteins (HDL) were studied after the addition of increasing amounts of either urea or sodium dodecyl sulfate (SDS). The intrinsic fluorescence intensity of the protein and the hydrophobic probe 2-p-toluidinyl-naphthalene-6-sulfonate (TNS) was measured at SDS concentrations from 0–50 mM or at urea concentrations from 0–6.65M. The fluorescent intensity changes of the lipoproteins and delipidated HDL (apo HDL) were markedly different from ten other proteins studied. The lipoproteins, with the exception of HDL, were stable to urea, as evidenced by the lack of change in their fluorescence intensities as well as their elution profiles from a BioGel A-5m column equilibrated with increasing concentrations of urea. At about 6M urea, HDL loses part of its major protein component, apoA-I. Fluorescence intensity changes between 2–3M urea occurred with apoHDL. The TNS fluorescent intensity changes of the lipoproteins were more pronounced with SDS than with urea. The intrinsic fluorescence intensity changes were complementary with the TNS data. Gel filtration of the lipoproteins with different concentrations of SDS indicated extensive lipid removal.

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THE INTERACTION OF CATIONIC SOFTENERS WITH NONIONIC DETERGENTS. Jeannene Williams, Sherex Chemical Company, Inc., P.O. Box 646, Dublin, OH 43065.

The introduction and increasing popularity of nonionic detergents has resulted in renewed interest in adding fabric softeners to detergents. The mutual incompatibility obvious when anionic detergents are combined with cationic softeners is avoided when nonionic surfactants are used. However, interactions do exist that influence performance between nonionic surfactants and cationic softeners. The effects on detergency, soil redeposition and fabric softener adsorption will be discussed.

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CHEMICAL AND PHYSICAL CHARACTERISTICS OF FIBER LUBRICANTS. Hugh T. Patterson, Fiber Surface Research Section, Textile Fibers Department, E.I. du Pont de Nemours & Co., Inc., P.O. Box 800, Kinston, NC 28501.

Review of 20 years of publications on relationships between effectiveness of fiber lubricants and their chemical and physical properties indicates a greater importance of the latter variable in fiber friction control. Reduced low-speed, high-load friction of lubricated polymer surfaces is obtained by increasing chain lengths of liquid organic acids, alcohols and alkanes as well as by reducing lubricant chain branching. Such chemical effects are greatly overshadowed by major friction reductions experienced when changes in liquid lubricants result in solid formation at the testing temperature. Under hydrodynamic conditions, increased sliding speed generally increases fiber friction, as does increased lubricant viscosity. Several polymeric liquids such as polyethers, silicones and polybutenes are exceptions to this generality. For these products, friction initially increases with speed, but at high rates the friction drops. This creates maximum values at velocities inversely related to lubricant molecular weight, and second-order glass transition temperatures. For polymeric lubricants, a straight chain structure is more effective than a branched structure of equal size.

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LINEAR ALKYLBENZENE SULFONATES (LAS) IN THE PREVENTION OF VAGRANT DYE PICKUP ON POLYESTER TEXTILES. K.P. Lannert and M.M. Crutchfield, Monsanto Company, St. Louis, MO 63166.

The unwanted pickup of low levels of vagrant dyes during washing of textile fabrics can be a significant contributor to long-term polyester appearance degradation. Fabric appearance loss from pickup of small quantities of a standard yellow dye are measured on both optically brightened and unbrightened polyester. Linear alkylbenzene sulfonate (LAS) surfactant micelles act as effective dye scavengers, reducing the level of dye pickup by the fabric substantially. The efficacy of LAS as a dye scavenger is quantified as a function of alkyl chain length and use concentration. Dye scavenging ability per unit weight of LAS increases with increasing molecular weight and decreasing critical micelle concentration (CMC). Dye scavenging of up to 80% of the transferable dye is achieved at high LAS concentrations. Results with C_9, C_{11}, C_{13}, and C_{15} single-homolog alkyl chain lengths, and with several mixed chain length blends are presented.

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TYPES OF SURFACTANTS USED IN DYEING NYLON AND ACRYLIC FIBERS. Harry D. Pratt, Jr., P.O. Box 6786, Donaldson Center, Greenville, SC 29606.

Surfactants have long been used commercially to aid in the dyeing process. If one includes preparation as part of the dyeing process, surfactants play a significant role in the entire sphere of textile wet processing. Nylon, being a polyamide, naturally has an affinity for acid dyes because of the amine functionality of the polymer. Anionic and nonionic surfactants are primarily the two types of surfactants commercially used in nylon dyeing. The requirements, benefits and limitations of surfactants in nylon dyeing are discussed. Polyacrylonitrile or acrylic does not possess a natural affinity for dyes. Acrylic fibers are rendered dyeable by modifying the polyacrylonitrile polymer with basic dyesites. The basic dyesites allow acrylic fibers to be dyed by cationic or basic dyes. The majority of commercial acrylic dyebath auxiliaries are cationic in nature. The benefits and limitations of acrylic dyeing auxiliaries are discussed. An area of duplicity in both nylon and acrylic dyeing systems are cationic dyeable nylon and acid dyeable acrylic. The auxiliaries for such systems as well as for cross-dyed blends are discussed.

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USE OF SURFACTANTS IN THE DYEING OF POLYESTER FIBER. John E. Nettles, P.O. Box 16445, Station B, Greenville, SC 29606.

This paper deals with the generic classification of surfactants used in the various stages of dyeing of polyester fiber. Covered in this discussion will be anionic, nonionic, cationic and amphoteric categories. The selection of the proper surfactant is dictated by the end use, and the major function of each classification and the role it plays will be shown in detail. Emphasis will be placed on patent literature, infrared spectra, and a review of current formulations as practiced by commercial dye plants. An effort will be made to review the above technology from a practical standpoint with emphasis on understanding the role which each surfactant class plays in the total dyeing system.

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COMMON SOURCES OF HEXANE LOSS IN AN OIL MILL AND WAYS OF MINIMIZING LOSSES. Glenn D. Brueske, Crown Iron Works Company, P.O. Box 1364, 1229 Tyler St. NE, Minneapolis, MN 55440.

It is important to keep hexane losses to a minimum for reasons of safety, pollution and economics. With hexane costs rising along with fuel costs, economics becomes a very important factor in solvent control. This paper will point out the most common points where solvent is lost, how to recognize these losses, and possible ways to reduce these losses.

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CONTROLLING SOLVENT LOSS THROUGH USE OF MINERAL OIL ABSORPTION. W.M. Barger, French Oil Mill Machinery Co., P.O. Box 920, Piqua, OH 45356.

The presence of noncondensable gases in the extraction plant vent gas stream requires a continuous system for recovering the condensable gas fractions, while continuously venting the noncondensable fractions. Mineral oil absorption columns provide a low cost and continuous means for final recovery of condensable vapors. Parameters such as gas flow rate, absorber pressure drop, packing design and absorber column loading must be examined when designing absorption systems.

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NEW CONCEPT IN ENERGY CONSERVATION AND HEXANE RECOVERY. Roger J. Hansotte, Dravo Engineers and Constructors, Chemical Plants Division, One Oliver Plaza, Pittsburgh, PA 15222.

Current oilseed processing practice includes drying meal after desolventizing, using equipment from which the effluent is usually vented directly to the atmosphere. With this waste stream is the loss of an available and valuable thermal potential, along with traces of solvent stripped in the drying operation. The search for ways to reduce these pollutants to the environment led to a unique approach to the problem wherein the drying operation is directly linked to the desolventizing step. Drying can be performed in conventional equipment modified to permit drying in absence of air. The vapors then being generated are atmospheric steam, which may be compressed for use as direct sparge steam in the desolventizing step. Liberated solvent will be kept within the confines of an enclosed system, thus recovered for reuse.

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LABORATORY PROCEDURES FOR QUANTITATING HEXANE LOSSES IN THE SOLVENT PLANT. G.C. Cavanagh, Ranchers Cotton Oil, P.O. Box 2596, Fresno, CA 93745.

By using quantitative laboratory procedures described in this paper and by others in the literature, between one-fourth and one-third of the total solvent loss in a prepress-solvent plant processing cottonseed can be accounted for. Fugitive losses are difficult to locate and quantitate. Solvent entrained in air and other noncondensable gases in the plant are sources of considerable loss. An increase of 20 F doubles the hexane holding capacity of air. Hexane losses in transit by tank car or truck can amount to as much as 2% of the shipment and should be excluded from plant site losses.

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CORROSION IN SOLVENT PLANTS: CAUSE AND PREVENTION. Leslie R. Watkins, Anderson Clayton & Co., 1100 Louisiana St., Suite 3732, Houston, TX 77002.

Corrosion is encountered in all extraction plants that use mineral oil absorption systems to recover hexane from vent gases. The source originates with the liberation of hydrogen sulfide during the destructive distillation of glutathion in the meal desolventizing process. The corrosion is minimized by neutralizing the by-products of hydrogen sulfide.

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THE USE OF DEUTERIUM LABELED STEROLS AND STEROIDS TO INVESTIGATE STEROID INTERCONVERSIONS IN ANIMALS AND PLANTS. L. John Goad, Michael Breen and Nigel Rendall, Department of Biochemistry, University of Liverpool, P.O. Box 147, Liverpool, L69 3BX U.K.

Most studies on sterol and steroid interconversions in plants and animals have utilized radioactively labeled compounds. However, it is well recognized that co-chromatography and co-crystallization of related steroids can present potential problems to the unambiguous identification of labeled metabolites. An alternative approach is to utilize precursors labeled with deuterium followed by identification of metabolites by gas chromatography-mass spectrometry. This technique has been used for some types of metabolic study, but it has found relatively limited use in steroid bioconversion investigations. A facile synthesis of [6,7,7-$^2H_3$] steroids will be presented and the use of these compounds to examine steroid metabolism by oocytes of the frog, *Zenopus laevis*, ovary tissue of the echinoderm *Asterias rubens*, and a culture of the chrysophyte alga *Ochromonas malhamensis* will be described.

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THE MECHANISM OF CHOLESTEROL TURNOVER IN THE CNS. Harold J. Nicholas, Institute of Medical Education and Research, 1605 S. 14th Street, St. Louis, MO 63104.

Although there is considerable information on factors involved in CNS cholesterol biosynthesis, little is known regarding the disposition of cholesterol in its slow rate of turnover. 24- and 26-Hydroxycholesterol have been reported as trace brain sterols, and these are formed from CNS cholesterol. Using either 4-^{14}C-cholesterol or 2-^{14}C-mevalonic acid injected intracerebrally, it has been found that all three sterols as well as several steroidal acids (currently under structural investigation) are formed within the CNS, become converted to unique metabolites associated with myelin, and are slowly excreted exclusively into the urinary system in these unique forms. Cholesterol is excreted largely as two ionophore-like compounds containing cholesterol, K+ and Na+, or both, and two bases established by high resolution mass spectrometry of their dansyl derivatives as $C_7H_{15}N_4$ and $C_6H_{11}N$. All three sterols and the steroidal acids are converted to steroid-peptide derivatives, all less than 2000 in MW. One of the steroidal acids has been partially identified by chemical means and high resolution mass spectrometry as a C_{24} acid with a ketone group as C-3 and a double bond in ring B. At least 47 steroid-peptide combinations have been indicated by TLC. The ionophore-like compounds and steroid-peptide forms have been detected in rat and human brain myelin, where they are bound in H_2O-insoluble form, probably by protein. Possibly, measuring the metabolites in urine may constitute a method of detecting demyelination in the CNS. For example, rats given triethyl tin chloride in their drinking H_2O (10 mg/ℓ) excrete increased amounts of the unusual urinary metabolites.

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SURFACE PROPERTIES OF STEROL-PHOSPHOLIPID MIXTURES AT THE AIR-WATER INTERFACE. R.W. Evans, J. Tinoco and M.A. Williams, Department of Nutritional Sciences, Morgan Hall, University of California, Berkeley, CA 94720.

Surface areas of sterol-L-α-phosphatidylcholine monolayers were measured at the air-water interface as a function of surface pressure. All the phosphatidylcholines (PC) studied contained palmitic acid at the 1-position and a fatty acid ranging in chain length from 16 to 22 and containing from 0 to 6 double bonds, at the 2-position. Unsaturated PC condensed maximally with cholesterol in approximately equimolar solution, but saturated PC condensed most with cholesterol in mixtures containing about 30 mol % of cholesterol. The extent of condensation varied with surface pressure, and the pressure at which maximum condensation occurred depended upon the structure of the PC. Surface viscosities of lipid monolayers were determined using the oscillating pendulum method. Viscosities are reported as the rate of damping of oscillation of a pendulum by a lipid monolayer relative to the rate of damping produced by a clean water surface. The viscosities of unsaturated PC and sterols were not detected by this method, but the viscosities of saturated phospholipids were high and increased with rising surface pressure. At a surface pressure of 40 dynes/cm all the sterols studied: cholesterol, epicholesterol, coprostanol, lophenol epicholestanol, desmosterol, at a concentration of 2 mol %, substantially lowered the viscosity of dipalmitoylphosphatidylcholine (DPPC) and at 20 mol % virtually eliminated the surface viscosity of DPPC. The effect of cholesterol was studied in more detail with the dipalmitoyl species of phosphatidylethanolamine, phosphatidylmonomethylethanolamine, phosphatidyldimethylethanolamine, phosphatidylcholine and phosphatidylglycerol. The influence of cholesterol on the viscosity of DPPC was detected at a cholesterol concentration of 0.05 mol % and at a cholesterol concentration of 4 mol %, the surface viscosity of DPPC was barely detectable. (This work was supported by USPHS grants AM12024 and AM10166.)

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STRUCTURAL REQUIREMENTS FOR STEROL IN A MOUSE FIBROBLAST STEROL AUXOTROPH. C. Rujanavech and D.F. Silbert*, Washington University School of Medicine, Department of Biological Chemistry, Box 8094, 660 South Euclid Avenue, St. Louis, MO 63110.

Although sterol is an essential component of all eukaryotic cells, interesting differences in structure exist among sterols found in various biological systems. Studies, especially with cholesterol (cholesta-5en-3βol), in model and in some biological systems indicate that the basis for this requirement may be related to the ability of sterol to exert either a condensing or a fluidizing effect on the phosphlipids depending on their initial physical state. Using a sterol auxotroph of the mouse fibroblast (ATCC, CCL1.2), we have examined various naturally occurring sterols for their ability to fully or partially replace cholesterol as a growth factor. Of particular interest are plant sterols which have the same nucleus as cholesterol but differ in their C_{17} side chains. Normal growth is obtained (a) with 24α or β methyl cholesta-5en-3βol alone; (b) with 24α ethyl cholesta-5en-3βol and with 24α ethyl- or 24β methyl cholesta-5,22dien-3βol only when small amounts of cholesterol (alone insufficient for normal growth) are also available. Parinaric (9,11,13, 15-octadecatetraenoic) acid fluorescence polarization has been used to examine the effect of different sterol on the phase behavior of various phospholipids and phospholipid mixtures. Sterols in the second group noted above neither fluidize nor condense phospholipids as well as cholesterol. The deficiency in condensing function is evident only at concentrations of sterol above 30 mol%. These physical studies should provide further clarification of the requirements for sterol in a mammalian cell line. (Supported by ACS grant BC198D).

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THE FITNESS OF STEROLS. William R. Nes, Department of Biological Sciences, Drexel University, Philadelphia, PA 19104.

The suitability, or fitness, of sterols for a given living system has two major parameters. One of these is concerned with the stereochemical and electronic fit of the molecule into a particular receptor site, as in the case of the formation of an enzyme-substrate complex. The other, which is at a higher level of complexity, has to do with the ability of the sterol to function simultaneously in multiple roles, each of which presumably also involves fitness for receptor site(s). One example is the duality in the role of sterols as architectural components of membranes and as precursors to hormones. If more than one role is required in a given organism, then greater strictures in molecular variability would be expected than in an organism that requires the sterol to play a single role. Moreover, even though the sterol may play similar roles in different organisms, the detail may be different, thus imposing different molecular requirements that have now become organismically dependent. Work in this and other laboratories is shedding new light on these concepts and will be reviewed. For instance, with regard to molecular requirements in different roles, we have recently found that removal of C-21 does not seriously impair protozoan metabolism of the sterol, but does prevent the molecule from acting properly as a membranous component in yeast. This work was supported through NIH Grant AM-12172.

Program

AOCS World Conference on

Oilseed and Edible Oil Processing

1,000 expected to attend

More than 1,000 persons are expected to participate in the World Conference on Edible Oil Refining to be held Oct. 3-8, 1982, in The Hague.

General Chairman Frank White and Program Chairman Norm Witte and an International Committee of scores of specialists in edible oils are developing a program that will emphasize the latest development in the industry and a look at what future developments may be anticipated. The meeting basically is a continuation of the 1976 World Conference on Oilseed and Vegetable Oil Processing Technology, held in Amsterdam.

The 1982 World Conference in The Hague's Congress Center will focus more sharply on edible oil processing and refining. The first two days will be devoted to state-of-the-art technology, specifically, the unit processes of the industry. The third day's sessions will be on trading and quality considerations and on economic use and disposition of by-products. The fourth day will include talks on automation, energy, and long-term industry directions. As with all World Conferences, there will be discussion groups each afternoon at which registrants may comment upon what they have heard and ask questions of speakers.

The planning committee hopes to complete its work by November 1981. Program details and registration materials should be available early in 1982.

As of early May, planners had agreed upon the tentative schedule provided above and identified specific topics they wished to have covered each day. Session chairpersons were being selected, to be followed by identification of potential speakers. All papers will be presented in English by invited speakers. Simultaneous translation to French will be available. □

Prince Willem Alexander Hall in The Netherlands Congress Center, The Hague

AOCS Conference on

Dietary Fats and Health

Dietary Fats Meeting to include HDL

A session on high-density lipoproteins (HDL) will be added to the Conference on Dietary Fats and Health to be held Dec. 6-11, 1981, in the Conrad Hilton Hotel in Chicago.

The suggestion to add the session was made during a meeting of the planning/steering committee at the AOCS Annual Meeting in New Orleans. Since that meeting, organizers have approached potential speakers and tentatively have scheduled the session for one afternoon.

In recent years, the presence of HDL has been shown to be inversely related to coronary artery disease. Research on HDL has expanded rapidly in recent years, making HDL one of the most newsworthy topics in the field.

Registration forms and housing reservation materials are available from the American Oil Chemists' Society, 508 S. Sixth St., Champaign, IL 61820. The AOCS and several other groups are organizing the meeting to discuss and review current knowledge on the role of fats in nutrition, health and disease as well as to promote dialog and understanding among all interested persons. The conference is designed to bring together representatives of academia, government, health care professions and industry. A major goal of the conference will be to identify areas where future research, education, and information are needed.

The conference is expected to be of major interest to dietitians and nutritionists, physicians specializing in cardiovascular disease, food technologists, fats and oils researchers, and others who may be involved in those fields.

The major topics for the five days of the program will be: Basic Overview of Fat Chemistry and Technology; Role of Fats in Nutrition; Current Views in Coronary Heart Disease; Current Research on Lipids and Cancer; and Emerging Research on Dietary Fats and Nutrition.

The recently added HDL session would be presented Wednesday, December 9, as a subplenary session during the days devoted to Current Views on Lipids in Coronary Heart Disease.

Plenary presentation will be limited to invited speakers only, but there will be discussion sessions each afternoon or evening during which participants may question speakers or comment upon the topics discussed during the day. □

Toronto

1982 AOCS Toronto meeting to be "domestic"

AOCS' 73rd Annual Meeting to be held May 2-6, 1982, in the Sheraton Centre, in Toronto, Canada, will be a "domestic" meeting for U.S. attendees, as far as tax deductions are concerned.

A new law approved this past winter says meetings and conventions in Canada and Mexico are to be considered the same as "domestic meetings" for U.S. tax purposes. This means U.S. registrants will not need attendance validation forms to justify expense deductions, nor are they limited to per diem amounts set for U.S. federal employees in the meeting city.

That eliminates some red tape that U.S. registrants otherwise would have encountered.

Planners are anticipating more than two dozen symposia sessions and about three dozen poster session papers. The poster sessions provide good opportunity for speakers and audience to converse, certainly more than is available in the traditional lecture-and-slides presentation.

Initial attendance estimates have been about 1,000, but attendance could be higher. Each of the past five AOCS annual meetings has attracted more than 1,000 registrants. The New Orleans meeting attracted more than 1,200 persons, despite rapidly rising travel costs and reduced travel budgets at many institutions and firms.

Toronto is the center of a metropolitan area of more than two million persons. Its international port handles freight bound for and from all over the world. The former capital of what used to be known as Upper Canada, Toronto's modern hotels and buildings are mixed with architecture of earlier eras.

Toronto's attractions include numerous museums, restaurants, and specialized amusement centers, some originally constructed for a world's fair, and several attractions on a redeveloped waterfront.

General chairman for the meeting is Brain L. Walker of the Department of Nutrition at the University of Guelph; program chairman will be J.B.M. Rattray of the Department of Chemistry, also at Guelph. □