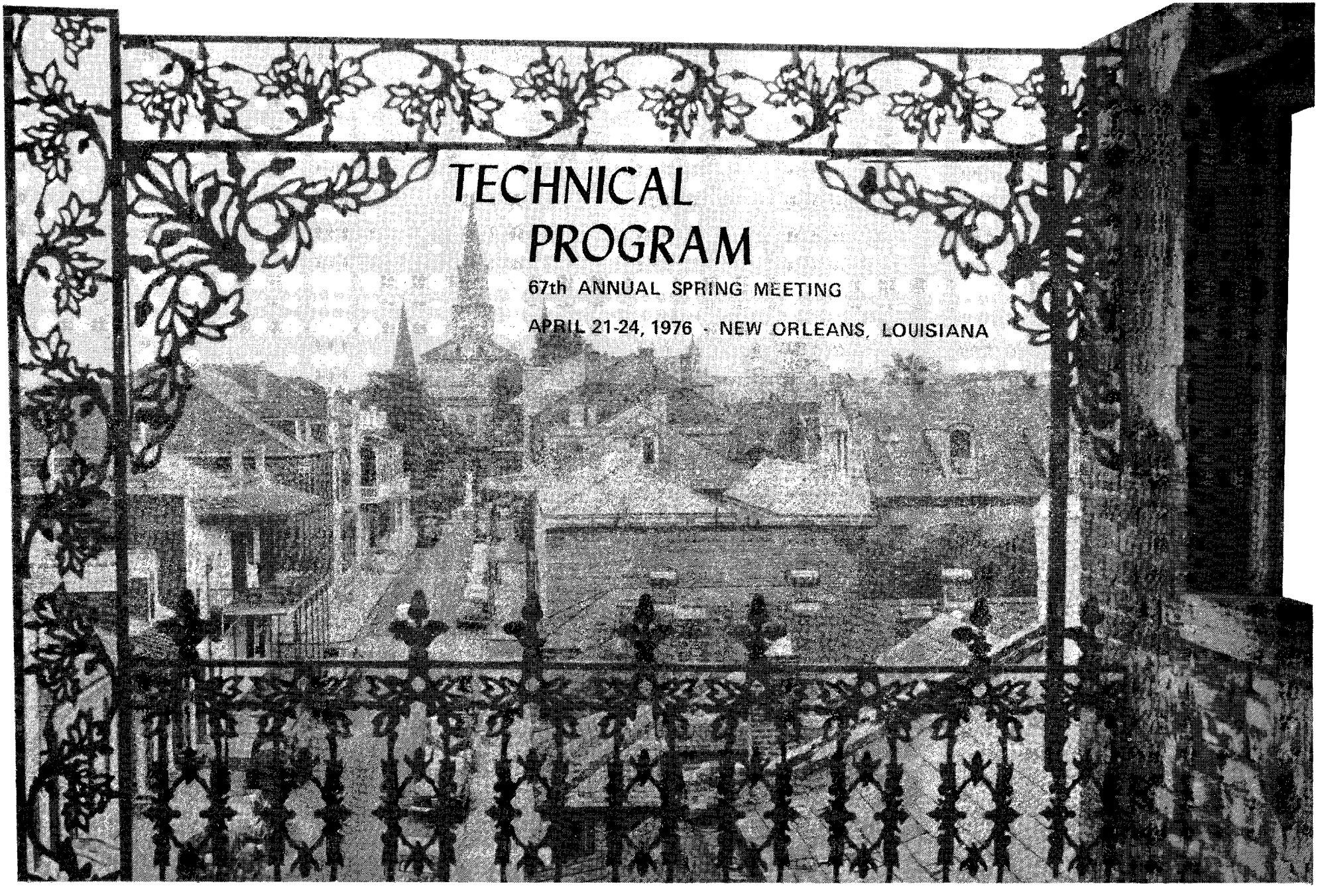
TECHNICAL
PROGRAM
67th ANNUAL SPRING MEETING
APRIL 21-24, 1976 - NEW ORLEANS, LOUISIANA

## THURSDAY MORNING—APRIL 22

10:00 a.m.—Galerie 1

## SESSION A—SYMPOSIUM: I. NEWEST ANALYTICAL METHODS

Chairman: **Leonard H. Ponder,** American Enka Co., Enka, NC 28728

10:00 INTRODUCTORY REMARKS

10:05 1. **HOW TO GET YOUR ANALYTICAL CHEMISTRY PAPER PUBLISHED**
Josephine M. Petruzzi,* Analytical Chemistry, American Chemical Society

10:35 2. **PROGRAMMED MULTIPLE DEVELOPMENT: HIGH PERFORMANCE THIN LAYER CHROMATOGRAPHY IN LIPID SEPARATIONS**
Thomas Jupille,* Regis Chemical Co.

11:00 3. **MAKING USE OF "OUTSIDE" RESEARCH AND ANALYSIS**
Francis B. Coon,* WARF Institute

11:25 4. **FUNCTIONS AND STRUCTURE OF THE ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS**
Fred J. Baur,* Procter & Gamble

## THURSDAY MORNING—APRIL 22

10:00 a.m.—Galerie 4

## SESSION B—SYMPOSIUM: HYPERLIPIDEMIA: AGENTS FOR CONTROL AND CONSEQUENCES TO HEALTH. I. HYPOLIPIDEMIC AGENTS—MECHANISM STUDIES

Chairman: **James G. Hamilton,** Hoffmann-La Roche Inc., Nutley, NJ 07110

10:00 INTRODUCTORY REMARKS

10:05 5. **HYPOLIPIDEMIC ACTIVITY OF (—)-HYDROXYCITRATE**
Ann C. Sullivan* and Joseph Triscari, Hoffmann-La Roche Inc.

10:45 6. **EFFECTS OF COLESTIPOL HYDROCHLORIDE AND NEOMYCIN SULFATE ON CHOLESTEROL TURNOVER IN THE RAT**
William A. Phillips* and Gary L. Elfring, The Upjohn Company

11:30 7. **LINOLEIC ACID AMIDES: EFFECT ON CHOLESTEREMIA AND ATHEROSCLEROSIS**
David Kritchevsky* and Shirley A. Tepper, The Wistar Institute

*** Speaker.**

## THURSDAY MORNING—APRIL 22

10:00 a.m.—Galerie 3

## SESSION C—GENERAL: BIOCHEMISTRY I. TISSUE LIPIDS

Chairman: **Ronald C. Reitz,** Division of Biochemistry, University of Nevada—Reno, Reno, NV 89507

10:00 INTRODUCTORY REMARKS

10:05 8. **EFFECT OF VITAMIN C INTAKE ON LOWERING SERUM AND LIVER CHOLESTEROL CONCENTRATIONS IN GUINEA PIGS**
Herbert K. Naito,* The Cleveland Clinic Foundation

10:25 9. **A COMPARATIVE STUDY OF TISSUE HYDROCARBONS IN THE RABBIT**
Aldo Ferretti* and Vincent P. Flanagan, Lipid Nutrition Laboratory, USDA

10:45 10. **BIOSYNTHESIS OF 13-METHYLPENTACOSANE IN THE COCKROACH PERIPLANETA FULIGINOSA**
George P. Kearney,* Gary J. Blomquist, University of Southern Mississippi, and Larry L. Jackson, Montana State University

11:05 11. **TRANSPORT OF DIACYL-2-ALKYL GLYCEROL BY CHYLOMICRONS AND INTESTINAL VERY LOW DENSITY LIPOPROTEINS OF THE RAT (HONORED STUDENT PRESENTATION)**
Robert E. Pitas* and Robert G. Jensen, University of Connecticut

11:25 12. **COMPARISON OF BRANCHED AND STRAIGHT CHAIN AMINES AND AZASTEROIDS IN REDUCING BLOOD AND LIVER CHOLESTEROL IN THE RAT**
Joel Bitman,* T.R. Wrenn, J.R. Weyant, Nutrient Utilization Laboratory, USDA-ARS-APGI, J.A. Svoboda, and M.J. Thompson, Insect Physiology Laboratory, USDA-ARS-PPI

11:45 13. **ESTROGEN STIMULATED INCORPORATION OF DOCOSAPENTAENOATE INTO PHOSPHATIDYL ETHANOLAMINE AND DOCOSAPENTAENOATE AND STEARATE INTO PHOSPHATIDYL CHOLINE OF LIVER**
James J. Peifer,* S.R. Ahmed, and D. Harden, University of Georgia

## THURSDAY MORNING—APRIL 22

10:00 a.m.—Ballroom F, G, H

## SESSION D—SYMPOSIUM: I. RECENT ADVANCES IN SURFACTANT TECHNOLOGY

Chairman: **Warner M. Linfield,** Eastern Regional Research Center, ARS, USDA, Philadelphia, PA 19118

10:00 INTRODUCTORY REMARKS

10:05 14. **SURFACE-ACTIVE AGENTS DERIVED FROM SUGARS**
R.O. Feuge,* Southern Regional Research Center, ARS, USDA

10:35 15. **SURFACTANTS IN EMULSION POLYMERS TODAY AND TOMORROW**
John W. Calentine,* Alcolac Inc.

11:05 16. **A DETERGENT BUILDER OF THE FUTURE**
R.P. Langguth* and R.L. Liss, Monsanto Company

11:35 17. **A REVIEW OF BLOCK POLYMER SURFACTANTS**
Irving R. Schmolka,* BASF Wyandotte Corporation

## THURSDAY MORNING—APRIL 22

10:00 a.m.—Galerie 6

## SESSION E—SYMPOSIUM: I. OILSEEDS—NEW FOODS FOR TOMORROW

Chairman: **James A. Robertson,** R.B. Russell Research Center, Athens, GA 30604

10:00 INTRODUCTORY REMARKS

10:05 18. **EFFECT OF HEAT AND FRYING ON SUNFLOWER OIL STABILITY**
James A. Robertson* and W.H. Morrison, III, R.B. Russell Research Center

10:35 19. **COTTONSEED OIL: CURRENT TRENDS AND POSSIBLE NEW USES**
N.V. Lovegren,* Southern Regional Research Center, ARS, USDA

11:05 20. **SUCROSE ESTERS: FOOD EMULSIFIERS FOR THE NEAR FUTURE**
H.J. Zeringue, Jr.,* Southern Regional Research Center, ARS, USDA

11:35 21. **VARIABILITY IN FATTY ACID COMPOSITION AMONG ARACHIS GENOTYPES: A POTENTIAL SOURCE OF PRODUCT IMPROVEMENT**
R.E. Worthington,* Georgia Experiment Station, and R.O. Hammons, ARS, USDA

## THURSDAY AFTERNOON—APRIL 22

1:30 p.m.—Galerie 1

## SESSION F—SYMPOSIUM: II. NEWEST ANALYTICAL METHODS

Chairman: **Leonard H. Ponder,** American Enka Co., Enka, NC 28728

1:30 22. **A LIQUID CHROMATOGRAPH-MASS SPECTROMETER-COMPUTER ANALYTICAL SYSTEM BASED ON ATMOSPHERIC PRESSURE IONIZATION MASS SPECTROMETRY**
E.C. Horning,* D.I. Carroll, I. Dzidic, K.D. Haegele, and R.N. Stillwell, Baylor College of Medicine

2:05 23. **EXTENDING THE USE OF DEDICATED DATA SYSTEMS VIA BASIC PROGRAMMING**
Joseph E. Evans,* Finnigan Corporation

2:35 24. **SEPARATION AND IDENTIFICATION FOR ISOMERIC HYDROPEROXIDES, ISOMER RATIO, AND OXO-COMPOUNDS FROM THE PEANUT LIPOXYGENASE-LINOLEIC ACID REACTION**
Harold E. Pattee* and John A. Singleton, ARS, USDA

3:05 25. **COLUMN SELECTION AND METHOD DEVELOPMENT IN LIQUID CHROMATOGRAPHY: PUTTING THE VARIABLES TO WORK**
Michael J. Telepchak,* Instapak Corporation

3:35 26. **OPEN FORUM ON LIQUID CHROMATOGRAPHY (Audience participation invited)**
Michael J. Telepchak and Leonard H. Ponder, Discussion Leaders

## THURSDAY AFTERNOON—APRIL 22

**1:30 p.m.—Galerie 4**

## SESSION G—SYMPOSIUM: HYPERLIPIDEMIA. II. HYPOLIPIDEMIC AGENTS—MECHANISM STUDIES

Chairwoman: **Ann C. Sullivan,** Hoffmann-La Roche Inc., Nutley, NJ 07110

1:30 **INTRODUCTORY REMARKS**

1:35 27. **ALKYLAMINOBENZOIC ACIDS AS HYPOLIPIDEMIC AND ANTIATHEROGENIC AGENTS**
Elwood E. Largis,* Andrew S. Katocs, Lena Will, David K. McClintock, and Sheldon A. Schaffer, Lederle Laboratories

2:20 28. **CHARACTERIZATION OF THE HYPOCHOLESTEROLEMIC ACTIVITY OF N-ARYLISOXAZOLIN-5-ONES**
James E. Miller* and John B. Hill, Searle Laboratories

3:05 29. **PATTERN OF RESPONSE TO THE HYPOBETALIPOPROTEINEMIC AGENT U-41792 IN HYPERLIPEMIC RATS**
Paul E. Schurr* and Charles E. Day, The Upjohn Company

3:30 30. **AN OVERVIEW OF THE BIOCHEMICAL PHARMACOLOGY OF PROBUCOL**
J. Barnhart,* D. Rytter, E. Wagner, J. Johnson, and J. Molello, The Dow Chemical Company

## THURSDAY AFTERNOON—APRIL 22

**1:30 p.m.—Galerie 3**

## SESSION H—SYMPOSIUM: ANTIOXIDANTS AND ANTIOXIDANT APPLICATIONS

Chairman: **Glen A. Jacobson,** Campbell Institute for Food Research, Camden, NJ 08101

1:30 **INTRODUCTORY REMARKS**

1:35 31. **EFFECTIVE RED MEAT ANTIOXIDANTS: PHOSPHATES WITH NATURAL FRUIT JUICE CONCENTRATE**
L.W. Haymon* and P.A. Hammes, Merck & Co., Inc.

2:05 32. **METHIONAL AS AN ANTIOXIDANT FOR VEGETABLE OILS**
Rex J. Sims* and Joseph A. Fioriti, General Foods Technical Center

2:35 33. **ANTIOXIDANTS IN VEGETABLE OILS**
E.R. Sherwin,* Eastman Chemical Products, Inc., Subsidiary of Eastman Kodak Co.

3:05 34. **NATURALLY OCCURRING PLANT POLYPHENOLIC COMPOUNDS AS LIPID ANTIOXIDANTS**
D.E. Pratt,* Purdue University

3:35 35. **ANTIOXIDANT PROPERTIES OF 6-HYDROXY-2, 5,7,8-TETRAMETHYL-CHOMAN-2-CARBOXYLIC ACID**
John W. Scott* and Winifred M. Cort, Hoffmann-La Roche Inc.

4:05 36. **EFFECTS OF SOLVENT AND ATMOSPHERE ON THE STABILITY OF SOME FREE RADICAL NITROXIDES**
H.S. Olcott,* J.S. Lin, and Thea S. Wu, University of California—Davis

4:35 37. **AN IMPROVED OXYGEN BOMB APPARATUS FOR EVALUATION OF ANTIOXIDANT PERFORMANCE**
Anthony R. Cooper,* David P. Matzinger, and Thomas E. Furia, Dynapol

## THURSDAY AFTERNOON—APRIL 22

**1:30 p.m.—Ballroom F, G, H**

## SESSION I—SYMPOSIUM: II. RECENT ADVANCES IN SURFACTANT TECHNOLOGY

Chairman: **Warner M. Linfield,** Eastern Regional Research Center, ARS, USDA, Philadelphia, PA 19118

1:30 38. **PERFORMANCE OF ALPHA OLEFIN SULFONATES IN LIGHT DUTY AND HEAVY DUTY HOUSEHOLD DETERGENTS**
L. Kravetz, D.H. Scharer,* Shell Development Co., and H. Stupel, Shell Chemical Co.

2:00 39. **SUMMARY OF THE TECHNOLOGY FOR THE MANUFACTURE OF HIGHER ALPHA-SULFO FATTY ACID ESTERS**
B.L. Kapur,* J.M. Solomon, and B.R. Bluestein, Witco Chemical Corp.

2:30 40. **SYNTHESIS AND SURFACE ACTIVE PROPERTIES OF ANIONIC AND AMPHOTERIC LIME SOAP DISPERSANTS**
W.M. Linfield,* Eastern Regional Research Center, ARS, USDA

3:00 41. **DETERMINATION OF POLYGLYCOLS IN NONIONIC SURFACTANTS BY HIGH PRESSURE LIQUID CHROMATOGRAPHY**
L.P. Turner* and D. McCullough, Alcolac Inc.

3:30 42. **A REVIEW AND WHAT'S NEW IN LAUNDRY DETERGENCY TESTING**
Ted P. Matson,* Continental Oil Co.

4:00 **5 Minute Break**

## GENERAL: SURFACTANTS

Chairman: **Warner M. Linfield,** Eastern Regional Research Center, ARS, USDA, Philadelphia, PA 19118

4:05 43. **ANTIMICROBIAL/SURFACTANT POTENTIATING SYSTEMS: A REVIEW**
G.G. Corey* and B. Brummer, Airwick Industries, Inc.

4:25 44. **BIODEGRADATION OF ESTERS OF $\alpha$-SULFO FATTY ACIDS**
E.W. Maurer,* J.K. Weil, and W.M. Linfield, Eastern Regional Research Center, ARS, USDA

4:45 45. **SOAP-BASED DETERGENT FORMULATIONS: XXI. AMPHOTERIC DERIVATIVES OF FATTY AMIDES OF AMINOETHYLETHANOLAMINE**
Frank D. Smith* and W.M. Linfield, Eastern Regional Research Center, ARS, USDA

5:05 46. **POLYOLS FOR URETHANE FOAMS FROM EPOXIDIZED TALLOW, TRIMETHYLOLPROPANE, AND PROPYLENE OXIDE**
A. Bilyk,* E.J. Saggese, H.A. Monroe, Jr., and M.P. Zubillaga, Eastern Regional Research Center, ARS, USDA

## THURSDAY AFTERNOON—APRIL 22

**1:30 p.m.—Galerie 6**

## SESSION J—SYMPOSIUM: II. OILSEEDS—NEW FOODS FOR TOMORROW

Chairman: **James A. Robertson,** R.B. Russell Research Center, Athens, GA 30604

1:30 **47. IMPROVING THE NUTRITIONAL PROPERTIES OF PRODUCTS FROM RAPESEED**
S.J. Slinger,* University of Guelph

2:00 **48. NUTRITIONAL POTENTIAL OF SOYBEANS AND OTHER OILSEEDS**
Herbert J. Dutton,* Northern Regional Research Center, ARS, USDA

2:30 **49. OILSEED PROTEINS IN PRUDENT-DIET FOODS**
M.M. Hamdy,* General Foods Corp.

3:00 **50. COTTONSEED PROTEIN FOOD PRODUCTS**
Carl M. Cater,* K.F. Mattil, W.W. Meinke, M.V. Taranto, and K.T. Lawhon, Texas A&M University

3:30 **51. PHYSICAL AND CHEMICAL PROPERTIES OF SOYBEAN PROTEINS**
W.J. Wolf,* Northern Regional Research Center, ARS, USDA

4:00 **52. PEANUT PROTEIN: A VERSATILE FOOD INGREDIENT**
J.L. Ayres,* B.L. Davenport, and K.C. Burgess, Gold Kist Research Center

4:30 **53. PREPARATION AND PROPERTIES OF CHLOROGENIC ACID-FREE SUNFLOWER PROTEIN**
Frank Sosulski,* University of Saskatchewan

5:00 **54. FRACTIONATION OF SUNFLOWER SEED PROTEINS**
J. Baudet and J. Mosse,* Station de Physiologie Vegetale, CNRA, Versailles, France

## THURSDAY AFTERNOON—APRIL 22

**2:00 p.m.—Galerie 2**

## SESSION K—POSTER SESSION: BIOCHEMISTRY

Authors should post materials during the morning, Thursday, April 22, and should be present to discuss their data from 2:00 to 4:00 p.m.

2:00 **55. Paper withdrawn.**

2:00 **56. EFFECTS OF CHRONIC INGESTION OF ETHANOL ON THE MYOCARDIAL METABOLISM OF FATTY ACIDS**
Sharon L. Parker* and Ronald C. Reitz, University of North Carolina

2:00 **57. ENERGY STORAGE IN PLANTS: I. EVIDENCE FOR THE ACCUMULATION OF CYANIDE-SENSITIVE PEROXIDES IN ILLUMINATED TISSUES**
Antony R. Shoaf,* Oscar Hinojosa, Southern Regional Research Center, ARS, USDA, Richard H. Steele, Tulane Medical School, and Jett C. Arthur, Jr., Southern Regional Research Center, ARS, USDA

## FRIDAY MORNING—APRIL 23

**9:00 a.m.—Galerie 1**

## SESSION L—SYMPOSIUM: I. AFLATOXINS IN OILSEEDS—PROBLEMS AND SOLUTIONS

Chairman: **Walter A. Pons, Jr.**, Southern Regional Research Center, ARS, USDA, New Orleans, LA 70179

9:00 INTRODUCTORY REMARKS

9:05 **58. AFLATOXIN IN CORN**
Odette L. Shotwell,* Northern Regional Research Center, ARS, USDA

9:35 **59. AFLATOXIN CONTROL PROGRAM FOR PEANUTS**
J.W. Dickens,* ARS, USDA

10:05 **60. AFLATOXIN IN PECANS: PROBLEMS AND SOLUTIONS**
J.L. Ayres,* Gold Kist Research Center

10:35 **61. SURVEY OF AFLATOXINS IN CALIFORNIA TREE NUTS**
G. Fuller,* W.W. Spooncer, A.D. King, Jr., J. Schade, and B.E. Mackey, Western Regional Research Center, ARS, USDA

11:05 **62. FIELD CONTAMINATION OF COTTONSEED BY ASPERGILLUS FLAVUS: OCCURRENCE AND CONTROL**
T.E. Russell* and G.F. Ryan, University of Arizona

## FRIDAY MORNING—APRIL 23

**9:00 a.m.—Galerie 4**

## SESSION M—SYMPOSIUM: HYPERLIPIDEMIA. III. HYPOLIPIDEMIC AGENTS—CLINICAL STUDIES

Chairmen: **Ann C. Sullivan**, Hoffmann-La Roche Inc., Nutley, NJ 07110, and **David Kritchevsky**, The Wistar Institute, Philadelphia, PA 19104

9:00 **63. STUDIES ON THE MECHANISM OF ACTION OF HALOFENATE**
Lewis Mandel,* Merck Institute for Therapeutic Research

9:45 **64. HYPOLIPIDEMIC EFFECT OF ADDITION OF EITHER NIACIN, CHOLESTYRAMINE, OR ATROMID-S ON SUBJECTS RECEIVING PROBUCOL**
Frank Canosa* and Edwin Boyle, Jr., et al., The Dow Chemical Co.

10:30 **65. PROBUCOL IN LONG TERM MANAGEMENT OF HYPERLIPIDEMIAS**
Donald McCaughan,* Harvard Medical School

11:15 **66. CLINICAL EXPERIENCE WITH CI-720, A NEW HYPOLIPIDEMIC AGENT**
H.P. Blumenthal,* J.R. Ryan, and F.G. McMahon, Tulane University School of Medicine

## FRIDAY MORNING—APRIL 23

**9:00 a.m.—Galerie 3**

## SESSION N—SYMPOSIUM: I. FLAVOR AND FLAVOR STABILITY OF FATS AND FATTY FOODS

Chairman: **Stephen S. Chang**, Rutgers University, New Brunswick, NJ 08903

Co-Chairman: **Thomas H. Smouse**, Anderson Clayton Foods, Richardson, TX 75080

9:00 INTRODUCTORY REMARKS
(Thomas H. Smouse)

9:05 **67. RECENT DEVELOPMENTS IN THE FLAVOR OF MEAT**
Stephen S. Chang,* Rutgers University

9:35 **68. LIPID-DERIVED FLAVORS OF LEGUMES**
David J. Sessa* and Joseph J. Rackis, Northern Regional Research Center, ARS, USDA

10:05 **69. CHEMISTRY OF PEANUT FLAVOR**
B.R. Johnson,* North Carolina State University

10:35 **70. FLAVOR OF OLIVE OIL**
Enzo Fedeli and Giovanni Jacini,* Oil and Fat Industries Experiment Station, Milan, Italy

11:05 **71. 25 YEARS OF FLAVOR RESEARCH IN A FOOD INDUSTRY**
J.G. Keppler,* Unilever Research, Vlaardingen, The Netherlands

11:35 **72. ROLE OF FATS IN IRRADIATION-INDUCED FLAVORS**
W.W. Nawar,* University of Massachusetts

(The following companies have contributed funds to defray speakers' expenses: Felton International, Inc.; Fritzsche—D & O; Grindsted Produ., Inc.; International Flavor & Fragrances; Polak's Frutal Works, Inc.; The Edlong Chemical Company; and an unidentified contributor.)

## FRIDAY MORNING—APRIL 23

**9:00 a.m.—Ballroom F, G, H**

## SESSION O—SYMPOSIUM: OSHA AND EPA RELATED TO OILSEED PROCESSING PLANTS

Chairman: **C. Louis Kingsbaker**, Dravo Corporation, Pittsburgh, PA 15222

9:00 INTRODUCTORY REMARKS

9:05 **73. EPA REFINERY ASPECTS**
Giles Farmer,* Anderson Clayton Foods

9:50 **74. EPA SOYBEAN PROCESSING PLANTS AND DESIGN**
W.A. Coombes,* Dravo Corporation

10:35 **75. OSHA GOOD MANUFACTURING PRACTICES FOR OILSEED PROCESSING**
Richard Fentem,* Lauhoff Grain Company

11:20 **76. OSHA REFINERY ASPECTS**
(Speaker to be designated)

## FRIDAY MORNING—APRIL 23

**9:00 a.m.—Galerie 6**

## SESSION P—GENERAL: LIPASES AND FATTY ACIDS METABOLISM

Chairman: **Robert G. Jensen,** University of Connecticut, Storrs, CT 06268

9:00 **INTRODUCTORY REMARKS**

9:05 **77. COMPARISON OF METHODS FOR SCREENING LIPASE ACTIVITY IN RICE-BORNE MICROORGANISMS**
Anthony J. De Lucca, II,* and Robert L. Ory, Southern Regional Research Center, ARS, USDA

9:25 **78. LIPOLYTIC ACTIVITY IN DENTAL TISSUES**
Kathleen E. McMahon,* Robert E. Pitas, and Robert G. Jensen, Department of Nutritional Sciences, University of Connecticut

9:45 **79. INFLUENCE OF DIET ON CONVERSION OF $^{14}C_1$-LINOLENIC ACID TO DOCOSAHEXAENOIC ACID IN THE RAT**
B.P. Poovaiah, J. Tinoco,* and R.L. Lyman, University of California—Berkeley

10:05 **80. SOME DETAILS OF ISOMERIC MONOETHYLENIC FATTY ACIDS IN MONKEY FECES AND DEPOT FATS**
R.G. Ackman,* C.A. Eaton, and J.S. Sipos, Canadian Fisheries and Marine Sciences Laboratory, Halifax, Nova Scotia, Canada

10:25 **81. SPECIFIC CONTROL OF HEPATIC LIPOGENESIS EXERTED BY DIETARY LINOLEATE AND LINOLENATE (HONORED STUDENT PRESENTATION)**
S.D. Clarke,* D.R. Romsos, and G.A. Leveille, Michigan State University

10:45 **82. LIPID COMPOSITION OF BOVINE MILK FAT GLOBULES WITH INCREASED POLYUNSATURATED FATTY ACIDS**
L.M. Smith,* D.H. Bianco, and W.L. Dunckley, University of California—Davis

11:05 **83. FEEDING OR ABOMASAL ADMINISTRATION OF POLYUNSATURATED VEGETABLE OILS TO LACTATING COWS**
T.R. Wrenn,* H.K. Goering, L.F. Edmondson, J.R. Weyant, D.L. Wood, and Joel Bitman, ARS, USDA

11:25 **84. CHARACTERIZATION OF SUBFRACTIONS DERIVED FROM PURIFIED MYELIN ISOLATED FROM MOUSE BRAIN**
Linda D. Sheads,* Michael J. Eby, and Joseph Sampugna, University of Maryland

11:45 **85. SYNTHESIS AND STUDY OF LARGE RING CYCLOALKENE-1-CARBOXYLIC ACIDS**
A. Silveira, Jr.,* State University of New York, College at Oswego, Y.R. Mehra, University of Denver, and W. Atwell, State University of New York, College at Oswego

## FRIDAY AFTERNOON—APRIL 23

**1:30 p.m.—Galerie 1**

## SESSION Q—SYMPOSIUM: II. AFLATOXINS IN OILSEEDS—PROBLEMS AND SOLUTIONS

Chairman: **Walter A. Pons, Jr.,** Southern Regional Research Center, ARS, USDA, New Orleans, LA 70179

1:30 **86. CHEMISTRY OF AFLATOXIN INACTIVATION**
F.G. Dollear,* E.T. Rayner, and L.P. Codifer, Jr., Southern Regional Research Center, ARS, USDA

2:00 **87. SEPARATION OF AFLATOXIN-CONTAMINATED COTTONSEED BY PHYSICAL CHARACTERISTICS OF THE GINNED SEED**
Louise S. Lee,* Alva F. Cucullu, and Walter A. Pons, Jr., Southern Regional Research Center, ARS, USDA

2:30 **88. PROCESSING EDIBLE PEANUT PROTEIN CONCENTRATES AND ISOLATES TO INACTIVATE AFLATOXINS**
Khee-Choon Rhee, K.R. Natarajan, Carl M. Cater,* and Karl F. Mattil, Texas A&M University

3:00 **89. PROCESSING CONDITIONS FOR INACTIVATING AFLATOXINS IN COTTONSEED MEAL BY AMMONIATION**
Stanley P. Koltun,* Eric T. Rayner, and James I. Wadsworth, Southern Regional Research Center, ARS, USDA

3:30 **90. SOLVENT EXTRACTION OF AFLATOXINS FROM CONTAMINATED AGRICULTURAL PRODUCTS**
Eric T. Rayner* and Stanley P. Koltun, Southern Regional Research Center, ARS, USDA

4:00 **10 Minute Break**

## GENERAL: AFLATOXINS RESEARCH

Chairman: **Walter A. Pons, Jr.,** Southern Regional Research Center, ARS, USDA, New Orleans, LA 70179

4:10 **91. A RAPID SCREENING METHOD FOR THE AFLATOXINS AND OCHRATOXIN A**
Charles E. Holaday,* National Peanut Research Laboratory

4:30 **92. TYPE AND LEVEL OF DIETARY FAT, VITAMIN E DEFICIENCY, AND CHRONIC AFLATOXIN TOXICITY**
R.B. Alfin-Slater, L. Aftergood, A. Alexander, and P. Wells,* UCLA School of Public Health

## FRIDAY AFTERNOON—APRIL 23

**1:30 p.m.—Galerie 4**

## SESSION R—SYMPOSIUM: HYPERLIPIDEMIA. IV. ROUND TABLE DISCUSSION OF INTERVENTION STUDIES

Chairman: **David Kritchevsky,** The Wistar Institute, Philadelphia, PA 19104

1:30 **93. DIETARY INTERVENTION**
David Kritchevsky,* The Wistar Institute

1:50 **94. INTERVENTION STUDIES**
W. Friedewald,* NIH Heart Institute

2:10 **95. CORONARY DRUG PROJECT**
Kenneth Berge,* Mayo Clinic

2:30 **96. SURGICAL INTERVENTION**
Henry Buchwald,* University of Minnesota

2:50 **97. FDA CONSIDERATIONS REGARDING NEW HYPOLIPIDEMIC AGENTS**
Marian J. Finkel,* Food and Drug Administration

3:10–4:30 **OPEN DISCUSSION BY ALL PANELISTS**

## FRIDAY AFTERNOON—APRIL 23

**1:30 p.m.—Galerie 3**

## SESSION S—SYMPOSIUM: II. FLAVOR AND FLAVOR STABILITY OF FATS AND FATTY FOODS

Chairman: **Stephen S. Chang,** Rutgers University, New Brunswick, NJ 08903

1:30 **INTRODUCTORY REMARKS**

1:35 **98. ANALYSIS OF VEGETABLE OILS FOR FLAVOR QUALITY BY DIRECT GAS CHROMATOGRAPHY**
H.P. Dupuy,* E.T. Rayner, and J.I. Wadsworth, Southern Regional Research Center, ARS, USDA

2:05 **99. MEASURING FLAVOR DETERIORATION OF FATS, OILS, DRIED EMULSIONS, AND FOODS**
Joseph A. Fioriti,* General Foods Technical Center

**2:35 100. A QUALITY CONTROL PROCEDURE FOR THE GAS LIQUID CHROMATOGRAPHIC EVALUATION OF THE FLAVOR QUALITY OF VEGETABLE OILS**
Helen Zmachinski and Arthur E. Waltking,* CPC International Inc.

**3:05 101. ROUND TABLE DISCUSSION: INSTRUMENTAL ANALYSIS OF FLAVOR AND FLAVOR STABILITY OF FATS AND OILS**
T.H. Applewhite,* Kraftco Corporation

**3:35 102. EVALUATION OF FAT AND OIL FLAVOR QUALITY BY GAS LIQUID CHROMATOGRAPHY USING A SELECTIVE ADSORPTION-DESORPTION TECHNIQUE**
J.A. Kirkpatrick and G.A. Jacobson,* Campbell Institute for Food Research

**4:05 103. DETERMINATION OF FLAVOR SCORES OF FATS AND OILS BY INSTRUMENTAL METHODS**
Thomas H. Smouse,* James K. Maines, and John W. Boddie, Anderson Clayton Foods

(The following companies have contributed funds to defray speakers' expenses: Felton International, Inc.; Fritzsche—D & O; Grindsted Produ., Inc.; International Flavor & Fragrances; Polak's Frutal Works, Inc.; The Edlong Chemical Company; and an unidentified contributor.)

## FRIDAY AFTERNOON—APRIL 23

**1:30 p.m.—Ballroom F, G, H**

## SESSION T—GENERAL: ATHEROSCLEROSIS AND TUMOR LIPIDS

Chairman: **Nome Baker,** Tumor-Lipid Research Laboratory, Veterans Administration Hospital Center, Los Angeles, CA 90073

**1:30 INTRODUCTORY REMARKS**

**1:35 104. ESSENTIAL FATTY ACID DEFICIENCY IN EXPERIMENTAL CANINE ATHEROSCLEROSIS**
Allen Ehrhart,* Antanas Butkus, and Keith McCullagh, Research Division, The Cleveland Clinic Foundation

**1:55 105. TISSUE LIPIDS IN EXPERIMENTAL CANINE ATHEROSCLEROSIS**
Antanas Butkus* and Allen Ehrhart, The Cleveland Clinic Foundation

**2:15 106. CHOLESTEROL STIMULATION OF LIPID ABSORPTION IN RABBITS**
Joel Bitman,* J.R. Weyant, D.L. Wood, and T.R. Wrenn, Nutrient Utilization Laboratory, USDA-ARS-APGI

**2:35 107. LIPIDS OF CULTURED HEPATOMA CELLS: VIII. UTILIZATION OF 1-$^{14}$C-GLUCOSE IN CELLULAR AND MEDIA LIPID SYNTHESIS (HONORED STUDENT PRESENTATION)**
Charles L. Welch* and Randall Wood, University of Missouri

**2:55 108. STRAIN DIFFERENCES IN DEGREES OF HYPERLIPIDEMIA IN MICE BEARING EHRLICH ASCITES TUMOR**
Ramaswamy Kannan* and Nome Baker, UCLA School of Medicine

**3:15 109. FATTY CHAIN ELONGATION AND SHORTENING IN HUMAN HEART MITOCHONDRIA**
William J. Ferrell,* University of Michigan, and Kuo-Ching Yao, Mayo Clinic

**3:35 110. OPERATION OF THE ACYL DIHYDROXYACETONE PHOSPHATE PATHWAY FOR TRIGLYCERIDE BIOSYNTHESIS IN MAMMARY GLANDS OF LACTATING MICE**
G. Ananda Rao* and S. Abraham, Veterans Administration Hospital

**3:55 111. A REDUCTION IN THE SIZE OF MOUSE MAMMARY ADENOCARCINOMAS INDUCED BY FEEDING INHIBITORS OF PROSTAGLANDIN SYNTHESIS**
G. Ananda Rao* and S. Abraham, Veterans Administration Hospital

**4:15 112. EFFECT OF CYCLOPROPENE FATTY ACIDS ON THE DISTRIBUTION OF ISOMERIC OCTADECENOATES IN INDIVIDUAL LIPID CLASSES OF LIVER AND HEPATOMA**
Rex D. Wiegand,* Fred Chumbler, and Randall Wood, University of Missouri and Veterans Administration Hospital

**4:35 113. DISTRIBUTION OF GEOMETRICAL AND POSITIONAL ISOMERS OF OCTADECENOATE DERIVED FROM INDIVIDUAL LIPID CLASSES OF LIVER AND HEPATOMA**
Randall Wood,* Fred Chumbler, and Rex D. Wiegand, University of Missouri and Veterans Administration Hospital

## FRIDAY AFTERNOON—APRIL 23

**1:30 p.m.—Galerie 6**

## SESSION U—SYMPOSIUM: INDUSTRIAL USES FOR FATS AND OILS

Chairman: **Gerhard Maerker,** Eastern Regional Research Center, ARS, USDA, Philadelphia, PA 19118

**1:30 INTRODUCTORY REMARKS**

**1:35 114. HISTORICAL AND MARKETING TRENDS OF NATURAL/SYNTHETIC FATTY ACIDS**
Arnold G. Johanson,* Ashland Chemical Co.

**2:05 115. INDUSTRIAL IMPORTANCE OF VEGETABLE OILS AS RAW MATERIALS IN A PETROLEUM-DEFICIENT WORLD**
Colin G. Hull,* PVO International Inc.

**2:35 116. FATS AND OILS IN AGRICULTURE**
Walter W. Abramitis,* Armak Company

**3:05 117. A CONTINUOUS PROCESS FOR ISOPROPENYL STEARATE**
M.F. Kozempel,* J.C. Craig, Jr., H.I. Sinnamon, and N.C. Aceto, Eastern Regional Research Center, ARS, USDA

**3:35 118. OXIDATION OF FATTY ACIDS BY USE OF PHASE TRANSFER CATALYSIS**
T.A. Foglia* and P.A. Barr, Eastern Regional Research Center, ARS, USDA

**4:05 119. CATALYTIC HYDROFORMYLATION AND HYDROCARBOXYLATION OF UNSATURATED FATTY COMPOUNDS**
E.N. Frankel and E.H. Pryde,* Northern Regional Research Center, ARS, USDA

**4:35 120. GERMINAL HYDROXYMETHYL COMPOUNDS FROM 9(10)-FORMYLSTEARIC ACID**
W.R. Miller* and E.H. Pryde, Northern Regional Research Center, ARS, USDA

**5:05 121. HEPTANOIC ACID FROM 2-OCTANOL BY CAUSTIC FUSION**
Nelson E. Lawson* and Thomas E. Farina, Union Camp Corp.

## SATURDAY MORNING—APRIL 24

**9:15 a.m.—Galerie 1**

## SESSION V—SYMPOSIUM: OUR CHANGING DIET

Chairman: **David Firestone,** Food and Drug Administration, HEW, Washington, DC 20204

**9:15 INTRODUCTORY REMARKS**

**9:20 122. CONSUMERS' FOOD SHOPPING BEHAVIOR AND RELATED FACTORS**
Alice E. Fusillo* and Arletta M. Beloian, Food and Drug Administration

**9:50 123. DIETARY PATTERNS OF MEN BY PERCENTAGE OF FOOD ENERGY FROM FAT**
Eleanor M. Pao,* ARS, USDA

**10:20 124. NUTRIENT DATA BANK: COMPUTER-BASED MANAGEMENT OF NUTRIENT VALUES IN FOODS**
Ritva R. Butrum,* ARS, USDA

**10:50 125. FOOD SAFETY AND THE CONSUMER**
Arthur F. Novak,* Louisiana State University

## SATURDAY MORNING—APRIL 24

**9:15 a.m.—Galerie 4**

## SESSION W—GENERAL: OILSEEDS—PROCESSING AND PROTEINS

Chairwoman: **Edith J. Conkerton,** Southern Regional Research Center, ARS, USDA, New Orleans, LA 70179

**9:15** INTRODUCTORY REMARKS

**9:20 126. STEAM REFINING COMBINED WITH DEODORIZATION: AN EDIBLE OIL PROCESSING INNOVATION**
Stanley Loft,* Sullivan Corporation

**9:40 127. A COMPUTERIZED OIL REFINERY MONITORING SYSTEM**
Peter Elliott,* Elliott Automation Co.

**10:00 128. EVALUATION OF PROCESSING ALTERNATIVES TO SAW DELINTERING OF COTTONSEED**
S.P. Clark,* Texas A&M University

**10:20 129. AN OIL FRACTION FROM EDIBLE BEEF TALLOW AS A CONSTITUENT OF A CHEESE WHEY—SOY FLOUR BEVERAGE BASE**
V.H. Holsinger, F.E. Luddy,* C.A. Sutton, H.E. Vettel, C. Allen, F.B. Talley, and H.L. Rothbart, Eastern Regional Research Center, ARS, USDA

**10:40 130. RAPID METHOD FOR PARTIAL HYDROLYSIS OF OILSEED PROTEINS FOR FOOD USES**
Antonio A. Sekul* and Robert L. Ory, Southern Regional Research Center, ARS, USDA

**11:00 131. SOME PHYSICOCHEMICAL AND FUNCTIONAL PROPERTIES OF PROCESSED PEANUT SEED HIGH PROTEIN DERIVATIVES: A COMPARATIVE SURVEY**
John P. Cherry,* Kay H. McWatters, and Linda P. Garrison, University of Georgia

**11:20 132. EFFECT OF ENDOGENOUS REDUCING SUGARS ON STORAGE STABILITY OF PEANUT MEAL**
Jaime Amaya-F.* and Clyde T. Young, University of Georgia

**11:40 133. NUTRIENTS AND ANTI-NUTRIENTS IN POTENTIAL EDIBLE PROTEIN PRODUCTS FROM COTTONSEED**
Leah C. Berardi,* Southern Regional Research Center, ARS, USDA

## SATURDAY MORNING—APRIL 24

**9:15 a.m.—Galerie 3**

## SESSION X—GENERAL: BIOCHEMISTRY II. LIPID OXIDATION AND MEMBRANES

Chairman: **Allen J. St. Angelo,** Southern Regional Research Center, ARS, USDA, New Orleans, LA 70179

**9:15** INTRODUCTORY REMARKS

**9:20 134. AN AUTOMATED SYSTEM FOR MICRODENSITOMETRY OF LIPOPROTEINS USING AGAROSE GEL ELECTROPHORESIS**
R.A. Wong, P.G. Banchero, L.C. Jensen, S. Pan, G.L. Adamson, and F.T. Lindgren,* University of California-Berkeley

**9:40 135. EVIDENCE FOR HYDROPEROXIDE LYASE ACTIVITY IN SUNFLOWER, FLAX, AND SOYBEAN SEEDLINGS**
Don C. Zimmerman* and Carol A. Olson, ARS, USDA

**10:00 136. AN IMPROVED PURIFICATION PROCEDURE FOR ISOLATION OF ALL COMPONENTS OF MICROSOMAL ELECTRON TRANSPORT SYSTEMS (HONORED STUDENT PRESENTATION)**
Rhea Craig* and Wayne R. Bidlack, USC School of Medicine

**10:20 137. AUTOXIDATION OF LINOLEIC ACID MONOLAYERS**
Guey-Shuang Wu,* Robert A. Stein, and James F. Mead, University of California—Los Angeles

**10:40 138. SYNTHESIS AND TESTING OF ANTIOXIDANTS DESIGNED FOR MEMBRANE PROTECTION**
William L. Porter,* Rose Colgan, Armand Paradis, and Gary Porfert, U.S. Army Natick Development Center

**11:00 139. FLUORESENCE ENHANCEMENT AS A MEANS OF DETECTION OF MIXING OF MEMBRANE MOLECULES**
Paul Keller and Stanley Person,* The Pennsylvania State University

**11:20 140. SPIN LABEL STUDIES ON MEMBRANE SURFACES**
Alec D. Keith* and Wallace Snipes, The Pennsylvania State University

**11:40 141. ANTIVIRAL ACTIVITY OF MEMBRANE-PERTURBING MOLECULES**
Wallace Snipes* and Alec D. Keith, The Pennsylvania State University

## SATURDAY MORNING—APRIL 24

**9:15 a.m.—Ballroom F, G, H**

## SESSION Y—GENERAL: CHROMATOGRAPHIC ANALYSES OF ANTIOXIDANTS AND OIL DERIVATIVES

Chairman: **L.D. Metcalfe,** Armak Company, McCook, IL 60525

**9:15** INTRODUCTORY REMARKS

**9:20 142. GAS CHROMATOGRAPHIC SEPARATION OF CIS AND TRANS UNSATURATED LONG CHAIN AMINES**
L.D. Metcalfe,* R.J. Jakubiec, and C.N. Wang, Armak Company

**9:40 143. ARGENTATION GAS CHROMATOGRAPHY OF CIS AND TRANS FATTY ACID METHYL ESTERS**
P. Magidman,* R.A. Barford, and H.L. Rothbart, Eastern Regional Research Center, ARS, USDA

**10:00 144. GAS LIQUID CHROMATOGRAPHIC ANALYSIS OF CIS-TRANS FATTY ACIDS OF STORE PURCHASED MARGARINES**
D.M. Ottenstein, G. Walker, D. Bartley, V. Mahadevan, and N. Pelick,* Supelco, Inc.

**10:20 145. A STUDY OF COLOR STABILITY OF COMMERCIAL OLEIC ACID (HONORED STUDENT PRESENTATION, AOCS NORTHEAST SECTION)**
Sherman S. Lin, An-Li Hsieh,* David B.S. Min, and Stephen S. Chang, Department of Food Science, Rutgers University

**10:40 146. QUANTITATIVE DETERMINATION OF ALPHA-, BETA-, GAMMA-, AND DELTA-TOCOPHEROLS IN VEGETABLE OILS AND IN MARGARINES BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY**
H.E. Woziwodzki,* Lever Brothers Co.

**11:00 147. A SIMPLIFIED GAS LIQUID CHROMATOGRAPHIC DETERMINATION FOR VITAMIN E IN VEGETABLE OILS**
Kenneth T. Hartman,* Frito-Lay, Inc.

**11:20 148. CORRELATION OF THE FLAVOR SCORE OF VEGETABLE OILS WITH VOLATILES PROFILE DATA**
Joseph L. Williams* and Thomas H. Applewhite, Kraftco Corporation

**11:40 149. VOLATILES AND OIL QUALITY**
Harold W. Jackson* and David J. Giacherio, Kraftco Corporation

# ABSTRACTS OF PAPERS

**1**

HOW TO GET YOUR ANALYTICAL CHEMISTRY PAPER PUBLISHED. JOSEPHINE M. PETRUZZI, *Analytical Chemistry*, 1155 Sixteenth St., NW, Washington, DC 20036.

A good analytical chemistry paper may be defined as one that passes the critical review of one's peers for publication in a recognized journal. Factors to consider in publishing an analytical paper include careful selection of the right journal, clear concise presentation that emphasizes the research contribution and its significance to the field, and careful revision if called for to account for the reviewers' and editors' criticisms. Rather special requirements apply to "methods" papers as opposed to other types of analytical papers. Data should be included to establish the accuracy and precision of the method by the use of standard reference materials, standard addition studies, interference studies, and comparison with established methods. Day to day and run precision studies of the proposed method in a real setting help validate the method. Common problems with analytical papers will be discussed. Specific suggestions will be given for improving the likelihood of publication. Some data will be given on the ultimate disposition of papers submitted to *Analytical Chemistry*.

**2**

PROGRAMMED MULTIPLE DEVELOPMENT: HIGH PERFORMANCE THIN LAYER CHROMATOGRAPHY IN LIPID SEPARATIONS. THOMAS JUPILLE, Regis Chemical Co., 8210 Austin Ave., Morton Grove, IL 60053.

Any form of chromatography provides a complementary relation between efficiency and selectivity: if one is high, the other can be very low and still provide effective separation. Much effort in thin layer chromatography has been and is devoted to finding systems that are highly selective. By and large, however, efficiencies in thin layer chromatography do not exceed 2,000 or so theoretical plates. Programmed Multiple Development is the repeated development of a thin layer chromatographic plate with the same solvent in the same direction. Each development is longer than its predecessor. Between developments the plate is dried by a process of controlled evaporation while it remains in contact with the solvent. As a result of spot reconcentration twice during each development, efficiencies upwards of 30,000 theoretical plates are readily obtained. This high efficiency relaxes the requirements on the selectivity of the system and allows separation in many cases where high selectivity is unattainable. Examples of the application of Programmed Multiple Development can be given for such samples as steroids, edible oils, and naturally occurring terpenoid compounds.

**3**

MAKING USE OF "OUTSIDE" RESEARCH AND ANALYSIS. FRANCIS B. COON, WARF Institute, PO Box 2599, Madison, WI 53701.

Utilizing the services offered by commercial research and analysis laboratories is discussed with emphasis on what a user may expect. Suggestions are given on what to look for in an "outside" laboratory and what should be done in cases of dissatisfaction or uncertainty. Problems a service laboratory may have with users and ways to resolve such problems are given. Typical examples illustrate the usefulness of "outside" research and analysis.

**4**

FUNCTIONS AND STRUCTURE OF THE ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS. FRED J. BAUR, Procter & Gamble, 6090 Center Hill Rd., Cincinnati, OH 45224.

The analytical methods adopted by the Association of Official Analytical Chemists are used by government agencies to regulate the food and drug industries and commodities and substances affecting the public health and welfare and by industries to check compliance of their products. The American Oil Chemists' Society and the Association of Official Analytical Chemists have cooperated in the past toward common methodology such as in fatty acid analyses, hydrocarbons and mineral oil, and monoglycerides. Present cooperative efforts center primarily in the mycotoxin area. The various methods adopted by the Association appear in their book, *Official Methods of Analysis*, which issues every 4–5 years and most recently last year—the 12th edition. Industrial scientists cannot be full or active members but they can be associate members of the Association, inasmuch as the active membership is limited to governmental scientists. Industry can and should, however, participate in the activities of this organization, and particularly in the key task of developing, testing, and validating methods. Uniform methodology should be the goal of all societies. The purpose of this presentation is twofold: (1) to explain the structure, functions, and goals of the Association; and (2) to inform industrial representatives on how they can participate in the Association's activities.

**5**

HYPOLIPIDEMIC ACTIVITY OF (—)-HYDROXYCITRATE. ANN C. SULLIVAN and JOSEPH TRISCARI, Department of Biochemical Nutrition, Hoffmann-La Roche Inc., Nutley, NJ 07110.

(—)-Hydroxycitrate was utilized to explore the relationship between hypertriglyceridemia and hyperlipogenesis and to determine the feasibility of treating hypertriglyceridemia through a reduction of fatty acid synthesis. Previous investigations demonstrated (—)-hydroxycitrate to be an effective inhibitor of triglyceride and cholesterol synthesis in vivo, due to its action as a potent competitive inhibitor of adenosine triphosphate citrate lyase, the extramitochondrial enzyme which supplies the acetyl CoA pool through cleavage of citrate to acetyl CoA and oxaloacetate. Three animal models of hypertriglyceridemia were employed: the genetically obese Zucker rat, the fructose fed rat and the Triton treated rat. Zucker obese rats demonstrated significantly increased rates of fatty acid synthesis and levels of serum triglycerides compared to their lean litter mates; lipogenic rates and circulating triglycerides were reduced markedly by the oral administration of (—)-hydroxycitrate. Fructose administered in the diet or drinking water induced a hypertriglyceridemia which was associated with a marked increase in hepatic lipogenesis, and (—)-hydroxycitrate reduced significantly both parameters. In contrast to the significant role that increased rates of lipogenesis apparently played in the development of hypertriglyceridemia in the Zucker rat and the fructose fed rat, Triton given intravenously produced a marked rise in serum triglycerides which could not be accounted for, to an appreciable extent, by increased rates of fatty acid synthesis. (—)-Hydroxycitrate reduced serum triglyceride levels and hepatic lipogenic rates equivalently in the Triton treated and nontreated rats.

**6**

EFFECTS OF COLESTIPOL HYDROCHLORIDE AND NEOMYCIN SULFATE ON CHOLESTEROL TURNOVER IN THE RAT. WILLIAM A. PHILLIPS and GARY L. ELFRING, The Upjohn Company, Kalamazoo, MI 49001.

Three groups of male rats were fed diets containing the bile acid sequestrant colestipol hydrochloride (1%), neomycin sulfate (0.25%), or basic diet during the test. After 15 days, each rat was injected intravenously with 3.9 $\mu$Ci cholesterol-1,2-$^3$H complexed with serum lipoproteins; specific radioactivity of the total serum cholesterol was measured at several time intervals for a period of 7 weeks. Computer analysis of the data indicated that the turnover of cholesterol could best be fitted by a three pool model. In pool A colestipol HCl caused a significant increase in production rate (10.09–15.96 mg/day) and the excretion rate constant (0.53–0.79 day$^{-1}$) of cholesterol without significantly altering the size of the pool or serum cholesterol concentrations. These results are compatible with an agent capable of binding bile acids in the rat but does not cause a decrease of the sterol pool because of an adequate compensatory increase in cholesterol biosynthesis. Neomycin $SO_4$ produced a significant reduction in serum cholesterol (9%) without altering turnover parameters and apparently exerts its hypocholesteremia by some mechanism other than bile acid sequestration.

**7**

LINOLEIC ACID AMIDES: EFFECT ON CHOLESTEREMIA AND ATHEROSCLEROSIS. DAVID KRITCHEVSKY and SHIRLEY A. TEPPER, The Wistar Institute, 36th & Spruce Sts., Philadelphia, PA 19104.

Toki and Nakatani first reported that the N-cyclohexylamine amide of linoleic acid (linolexamide) inhibited cholesterol induced atherosclerosis in rabbits. Our investigations with this compound confirmed that linolexamide, in doses of 600–900 mg/day, reduced serum and liver cholesterol levels and atherosclerosis in cholesterol fed rabbits. This compound did not affect cholesterol biosynthesis in the rat. Two other amides of linoleic acid have been found to reduce atherosclerosis in rabbits. The two compounds are the amides of $\alpha$-methylbenzylamine (AC-223) and $\alpha$-phenyl-$\beta$-($\rho$-tolyl) ethylamine (AC-485). AC-223 is hepatomegalic in rats, but does not significantly affect serum or liver cholesterol levels or cholesterol biosynthesis. The mechanism of action of the linoleic acid amides, as derived from studies in rats, seems to involve inhibition of cholesterol absorption.

**8**

EFFECT OF VITAMIN C INTAKE ON LOWERING SERUM AND LIVER CHOLESTEROL CONCENTRATIONS IN GUINEA PIGS. HERBERT K. NAITO, The Cleveland Clinic Foundation, 9500 Euclid Ave., Cleveland, OH 44106.

The aim of this study was to evaluate the effects of vitamin C (ascorbate) on serum and liver cholesterol concentrations. A 2 × 3 factorial analysis of variance experiment was designed to determine the effects of three levels of ascorbate intake in guinea pigs fed a diet with and a diet without cholesterol supplementation. English Short Hair guinea pigs weighing 503 ± 88 g ($\bar{x}$ ± SD) were randomly divided into six groups. Three groups of guinea pigs were maintained on a Reid-Briggs, low fat, low cholesterol Scorbutogenic diet and another three groups on a Scorbutogenic diet supplemented with 2% cholesterol. In each of the two dietary groups, vitamin C was given orally for 6 weeks at the following dosages: 0.5, 5.0, and 50.0 mg ascorbate/animal/day. The data showed that (1) in contrast to serum ascorbate levels, liver ascorbate levels correlated well with the amount of oral intake of vitamin C; (2) the different amounts of ascorbate ingested had no effect on liver cholesterol concentrations; (3) cholesterol feeding caused the liver cholesterol concentration to increase 10-fold, but the different amounts of ascorbate intake had no influence on the concentration; (4) in both dietary groups, the 0.5 mg groups had significantly higher serum cholesterol levels than the respective 50 mg groups; and (5) there is some indication that there was increased vascular (thoracic aorta) permeability to Evans-Blue dye, primarily in the cholesterol fed guinea pigs, regardless of the amount of ascorbate intake. The study suggests that the varying amount of vitamin C intake does not affect the cholesterol level in the liver but does affect the serum cholesterol levels in both the noncholesterol and cholesterol fed groups. It further suggests that vitamin C may not be a major factor in the change in vascular wall permeability during cholesterol feeding.

**9**

A COMPARATIVE STUDY OF TISSUE HYDROCARBONS IN THE RABBIT. ALDO FERRETTI and VINCENT P. FLANAGAN, Lipid Nutrition Laboratory, Room 122, Bldg. 308, BARC-East, USDA, Beltsville, MD 20705.

With the purpose of casting light on the question of the biological significance of the hydrocarbons in mammalian tissues, a comparative study of seven representative rabbit tissues from a single animal was conducted. Three general distribution patterns were recognized: (a) one where odd numbered hydrocarbons predominate over even numbered ones (adipose); (b) one where the pattern is bell shaped with the apex at $C_{22}$ (kidneys, brain, and spleen), $C_{23}$ (liver), or $C_{24}$ (skeletal muscle); and (c) one where the distribution of hydrocarbons is quite uniform (blood serum). With the exception of squalene, the overwhelming majority of the identified components were normal, saturated, nonterpenoid hydrocarbons in the $C_{16}$–$C_{33}$ range. Squalene, phytene, phytadiene, and pristane were the only terpenoids identified; they were quite unevenly distributed. Nonterpenoid branched (iso and anteiso) hydrocarbons were detected in significant amounts in the skeletal muscle only. The adipose was the only tissue which was relatively rich in mono-

alkenes. Its overall hydrocarbon composition was virtually identical with that of the feed. The analytical methodology involved solvent extraction, saponification (in the adipose), elution chromatography on hydrated alumina followed by combined gas chromatography-mass spectrometry. This study establishes for the first time that the qualitative and quantitative distribution of the hydrocarbons within a single animal varies considerably from organ to organ. The results suggest that such variance might reflect the complex function and metabolic activities of the various organs in a way yet to be elucidated. The question of dietary versus endogenous origin cannot be fully answered with the data presently available.

## 10

BIOSYNTHESIS OF 13-METHYLPENTACOSANE IN THE COCKROACH *PERIPLANETA FULIGINOSA*. GEORGE P. KEARNEY, GARY J. BLOMQUIST, Chemistry Department, University of Southern Mississippi, Southern Station, Box 5347, Hattiesburg, MS 39401, and LARRY L. JACKSON, Chemistry Department, Montana State University, Bozeman, MT 59715.

The internally branched monomethylalkanes in insects are formed by a different biosynthetic pathway than that reported in the algae (Fehler and Light, *Biochemistry* 9: 418, 1970), where the methyl of methionine serves as the branching methyl group donor. Studies in the cockroach *Periplaneta fuliginosa* indicate that a different biosynthetic pathway is involved. Sodium (1-$^{14}$C) acetate, sodium (1-$^{14}$C) propionate, sodium (2-$^{14}$C) propionate, sodium (3-$^{14}$C) propionate, and sodium (methyl-$^{14}$C) methylmalonate were readily incorporated into the cuticular hydrocarbons of nymphal stages of this insect, both in vivo and in vitro, whereas no incorporation of (methyl-$^{14}$C) methionine was observed. n-Alkanes comprise 25% of the alkanes of the nymphal stages of this insect, with 14% 3-methylalkanes, and 59+% internally branched monomethylalkanes, principally 13-methylpentacosane. Sodium (1-$^{14}$C) acetate was incorporated into each class of alkane at about its percent composition. In contrast, labeled sodium propionate and sodium methylmalonate were preferentially incorporated into the branched fractions. Detailed radio-gas liquid chromatography showed that sodium (1-$^{14}$C) propionate was incorporated almost exclusively into 3-methyltricosane and 13-methylpentacosane, whereas sodium (1-$^{14}$C) acetate was incorporated into each gas liquid chromatographic peak at about its percent composition. This data suggests that propionate, incorporated during chain elongation, serves as the branching methyl group donor for both the 3-methyl and the internally branched monomethylalkanes in insects. Excised cuticle slices, with adhering fat body tissue removed, gave good incorporation of labeled substrates into the hydrocarbon fraction. No hydrocarbon synthesis was observed in the fat body preparations. This suggests that cells associated with epidermal cells are involved in hydrocarbon synthesis.

## 11

TRANSPORT OF DIACYL-2-ALKYL GLYCEROL BY CHYLOMICRONS AND INTESTINAL VERY LOW DENSITY LIPOPROTEINS OF THE RAT. ROBERT E. PITAS and ROBERT G. JENSEN, Department of Nutritional Science, U-17, The University of Connecticut, Storrs, CT 06268.

The diacylalkyl glycerol *rac*, 1,3-dioctadecenoyl-2-hexadecanyl glycerol was administered to three rats, via stomach cannula, 7 hr after cannulating the intestinal lymphatics and stomachs of the fasted animals. Chylomicrons and very low density lipoproteins were isolated from the lymph by preparative ultracentrifugation lipids extracted and triacylglycerols separated from diacyl alkyl glycerols by preparative thin layer chromatography. The relative moles of triacylglycerol and diacylalkyl glycerol in each fraction were determined by gas liquid chromatographic analysis of their respective methyl esters, using methyl heptadecanoate as an internal standard. The ratio of diacylalkyl glycerol to triacylglycerol in the chylomicrons was 0.39, 0.30, and 0.21, with corresponding ratios for very low density lipoprotein of 0.11, 0.10, and 0.09. One rat was tested a second time after clearing the initial sample of glyceryl ether. The resultant values for the ratio of chylomicrons was 1.04 and for very low density lipoprotein, 0.35. The fatty acid composition of the diacylalkyl glycerols and triacylglycerol were similar in the chylomicrons and very low density lipoprotein except that the glyceryl ether always contained less 16:0 and more 18:1 than the corresponding triacylglycerol. Analysis of the isolated lipoproteins by agarose gel electrophoresis indicated some cross contamination of fractions; nevertheless, it is apparent that very low density lipoproteins transport less diacylalkyl glycerol relative to triacylglycerol than chylomicrons. The possibility exists that the glyceryl ether seen in the very low density lipoprotein fraction was due to contamination by chylomicrons.

## 12

COMPARISON OF BRANCHED AND STRAIGHT CHAIN AMINES AND AZASTEROIDS IN REDUCING BLOOD AND LIVER CHOLESTEROL IN THE RAT. JOEL BITMAN, T.R. WRENN, J.R. WEYANT, USDA-ARS-APGI, Nutrient Utilization Laboratory, Bldg. 161, ARC-East, Beltsville, MD 20705, J.A. SVOBODA, and M.J. THOMPSON, Insect Physiology Laboratory, USDA-ARS-PPI, Bldg. 467, Beltsville, MD 20705.

The activity of several straight and branched chain alkyl amines, containing a chain length of 12–18 carbons, and one azasteroid, 25-aza-5$\alpha$-cholestane, was compared with 20,25-diazacholesterol (SC-12937), an azasterol known to be a potent hypocholesterolemic agent in the rat. These amines have recently been shown to inhibit the $\Delta^{24}$-sterol reductase system in the tobacco hornworm at the last step in the conversion of $C_{28}$ and $C_{29}$ plant sterols to cholesterol, resulting in an accumulation of desmosterol. Nine groups of 12 male Sprague Dawley rats (190–260 g) were fed the amines at 1,000 ppm and the two azasteroids at 12.5 ppm of the diet for 3 weeks. Body wt gain, cholesterol, desmosterol, vitamin E, and lipid composition of blood, feces, liver, and epididymal fat pad wt were measured. The azasteroids and the $C_{12}$ branched chain amine, N,N-dimethyl-3,7,11-trimethyldodecanamine, were the most effective, reducing plasma sterols to one-half the control level. Plasma and liver desmosterol were concomitantly increased to 76, 46, and 23% of the total sterol by azacholestane, diazacholesterol, and the branched dodecanamine, respectively. All of the other amines increased desmosterol in liver and plasma from trace amounts to 1–6% of total sterol. Azacholestane, diazacholesterol, and the branched dodecanamine decreased total plasma lipids by 50, 39, and 43%. The branched dodecanamine caused a 25% reduction in feed consumption and restricted body wt gain to 38% of controls. The branched and straight chain dodecanamines severely reduced epididymal fat pad wt. Our results demonstrated that the relatively simple steroid, 5$\alpha$-azacholestane, was a more potent inhibitor of cholesterol biosynthesis than 20,25-diazacholesterol. This study also demonstrates that the $\Delta^{24}$-sterol reductase system can be inhibited in a mammalian system by a simple nonsteroidal acyclic amine.

## 13

ESTROGEN STIMULATED INCORPORATION OF DOCOSAPENTAENOATE INTO PHOSPHATIDYL ETHANOLAMINE AND DOCOSAPENTAENOATE AND STEARATE INTO PHOSPHATIDYL CHOLINE OF LIVER. JAMES J. PEIFER, S.R. AHMED, and D. HARDEN, Department of Foods and Nutrition, Dawson Hall, University of Georgia, Athens, GA 30602.

Sexual maturity of female, but not male, Sprague Dawley rats promotes greater accumulation of docosapentaenoate (22:5n–6) into both phosphatidyl ethanolamine and phosphatidyl choline of the liver. Estradiol treatment of castrate males and intact females also promotes increases of 22:5n–6 into both phosphatidyl ethanolamine and phosphatidyl choline. However, castration, per se, progesterone, and low dose treatments with testerone propionate had little or no influence on the 22:5 levels of these phospholipids. Hepatic phosphatidyl choline of sexually mature females had 89% more 22:5n–6 than males, and even greater differences were noted in estradiol treated intact females. Mature females also have ca. two times more stearate than palmitate in their liver phosphatidyl choline, whereas males have 18:0/16:0 ratios in the range of 1.0. Both sexes retained ca. the same amounts of arachidonate (20:4n–6) in their phosphatidyl ethanolamine and phosphatidyl choline. In these studies, linoleate was the only source of polyunsaturated fatty acids, i.e., 3.5% 18:2n–6 in the diet, and docosahexaenoate (22:6n–3) of the phospholipids was not influenced by either sexual maturity or estrogen activity in the rats. These and related studies suggest that estrogens stimulate the biosynthesis of phosphatidyl ethanolamine rich in 22:5n–6 and its conversion to phosphatidyl choline rich in both 22:5n–6 and stearate. The data also suggest that the biosynthetic pathway for phosphatidyl choline in the male is distinctly different from that of the female. (Supported in part by CSRS S-87 research funds.)

## 14

SURFACE-ACTIVE AGENTS DERIVED FROM SUGARS. R.O. FEUGE, Southern Regional Research Center, ARS, USDA, PO Box 19687, New Orleans, LA 70179.

The sucrose esters of fatty acids are probably the best known of the sugar based compounds exhibiting surface activity. Among other sugar based compounds of potential importance are the fatty acid esters of sugars other than sucrose, the fatty acid esters of glycosides, including the polyol glycosides, and the ethers of fatty alcohols and polyglucosides. Economically feasible processes for making a number of such products have been or are being developed. The better methods of preparation are reviewed in a critical manner. The physical and chemical properties of individual compounds and products are presented, and the extent to which the properties can be tailored is discussed. The performance of various products in different uses is described, and other possible uses are suggeted.

## 15

SURFACTANTS IN EMULSION POLYMERS TODAY AND TOMORROW. JOHN W. CALENTINE, Alcolac Inc., 3440 Fairfield Rd., Baltimore, MD 21226.

Surfactants presently used in emulsion polymer systems are mostly those that have been available for decades. The list of surfactants, although very long in number, is fairly short for the majority of practical emulsion applications. A case for these points and a review of surfactants are presented. Further, events occurring presently, such as (a) the changing raw materials situation, (b) increasing government related regulations, (c) the energy shortage and rising costs, and (d) the rapidly expanding list of demanding applications, are shown to be catalyzing the development of surfactants to meet the needs of tomorrow. A few of the surfactants that will be used in emulsion polymers tomorrow, being developed today, are discussed. The apparent trend toward more specific surfactants for emulsion polymers is explored.

## 16

A DETERGENT BUILDER OF THE FUTURE. R.P. LANGGUTH and R.L. LISS, Monsanto Company—N1A, 800 N. Lindbergh Blvd., St. Louis, MO 63166.

This presentation will consist of a very brief overview of detergent builders, showing the historical development and use of materials to the present time. The search and screening of alternate materials as a result of ecological and legislative pressures will also be briefly reviewed. Described will be an intensive program of screening and evaluating builder candidates culminating in a product meeting the requisites of a sequestering builder for detergent systems. This builder candidate will be identified and characterized. Detailed properties and performance characteristics will be presented to justify its choice as a future detergent builder candidate.

## 17

A REVIEW OF BLOCK POLYMER SURFACTANTS. IRVING R. SCHMOLKA, BASF Wyandotte Corporation, 1609 Biddle Ave., Wyandotte, MI 48192.

A brief historical review of four series of commercially available block polymer surface-active agents—the Pluronic®, Tetronic®, Pluradot®, and Pluronic R® polyols—is presented. A comparison is made of the physical properties within each series, in the form of trend lines. These parameters encompass solubility, rate of solubility, wetting, foaming, defoaming, emulsification, thickening, cleansing, and toxicity. The physical property relationships which depend on variation in the hydrophobe mol wt and variation in the hydrophile hydrophobe balance are shown to be similar in each series of surfactants. Differences among the four series of polymers, where they exist, are seen to vary from little to significant. The many controversial articles on the micellar nature of the block polymers and their critical micelle concentrations are examined. Consideration of the important physical properties which lead to practical applications are discussed. Some of the more important newly developed potential uses of these polymeric surfactants are then described in various application areas, including the cosmetic, medical, paper, pharmaceutical, and textile industries.

## 18

EFFECT OF HEAT AND FRYING ON SUNFLOWER OIL STABILITY. J.A. ROBERTSON and W.H. MORRISON, III, Richard B. Russell Research Center, ARS, USDA, PO Box 5677, Athens, GA 30604.

Sunflowers are one of the most important sources of vegetable oils in the world, second only to soybeans. Although in use throughout many parts of the world, sunflower seeds are just now beginning to attract attention and use in the U.S. Composition of the oil appears to be dependent on where the plants are grown. Sunflower oil from seed grown in the northern U.S. typically contains 70% linoleic acid. In contrast, oil from seed produced in the South generally contains 40–50% linoleic acid and is higher in monounsaturated fats. For most of the edible oil market, sunflower oil appears to have an advantage over most other vegetable oils. A study was made comparing a lightly hydrogenated sunflower oil with a cottonseed–corn oil mixture for frying potato chips. Organoleptic evaluation of the chips indicated no significant difference in chips fried in either oil. Studies were made to evaluate the useful life of various sunflower seed oils for deep fat frying. Hydrogenated and unhydrogenated sunflower oils and a commercial shortening were used to deep fry raw potatoes. A plot of the log of the active oxygen method values of the oils versus time gave a straight line, the slope of which reflects the oxidizability of the oil. Data indicated that lightly hydrogenated northern sunflower oil was much less prone to oxidation after abuse than the commercial shortening and has a longer useful lifetime. The southern oil used in this study deteriorated faster than the northern sunflower oil; however, the two oils were processed differently. Thus, in recent work, care was taken to process both northern and southern grown sunflower seed under identical conditions. Frying studies indicated that the southern oil was more stable than the northern oil, as would be expected from its fatty acid composition.

## 19

COTTONSEED OIL: CURRENT TRENDS AND POSSIBLE NEW USES. N.V. LOVEGREN, Southern Regional Research Center, ARS, USDA, PO Box 19687, New Orleans, LA 70179.

Cottonseed oil has a significant place in both the U.S. and world fats and oils market. In the U.S., nearly all of the cottonseed oil is used for salad and cooking oils, or partially hydrogenated to make baking or frying fats, with a lesser amount used to make margarine. In recent years, over one-third of the oil has been exported. Improvements in analytical techniques have given very good values for the composition of cottonseed oil, and from this its advantages and disadvantages over competitive oils may be examined. A water white sharp melting fat can be made by a simple solvent fractionation of cottonseed oil winterization stearine. Good confectionery fats can be prepared from hydrogenated cottonseed oil, or better, from hydrogenated winterization stearine or by interesterification of completely hydrogenated cottonseed oil with an oleic rich oil. Methods for preparing these products and some of their properties will be described.

## 20

SUCROSE ESTERS: FOOD EMULSIFIERS FOR THE NEAR FUTURE. H.J. ZERINGUE, JR., Southern Regional Research Center, ARS, USDA, PO Box 19687, New Orleans, LA 70179.

The long chain fatty acid esters of sucrose possess properties which make them very attractive for food uses. Being nonionic, biodegradable, surface-active agents, stable in neutral or slightly acidic media, they can serve as emulsifiers and stabilizers. All evidence suggests that sucrose esters of low degree of acylation, ingested within the body, revert back by hydrolyses into sucrose and fatty acid and are utilized by the body. Specialty uses of sucrose esters in foods will be discussed, including the application of these esters in formulating low calorie foods and improving the quality of high protein breads. Better methods of preparation, the more recent methods of purification, and some physical properties of pure sucrose esters with reference to the degree of esterification will also be discussed.

## 21

VARIABILITY IN FATTY ACID COMPOSITION AMONG *ARACHIS* GENOTYPES: A POTENTIAL SOURCE OF PRODUCT IMPROVEMENT. R.E. WORTHINGTON, Department of Food Science, Georgia Experiment Station, Experiment, GA 30212, and R.O. HAMMONS, ARS, USDA, Tifton, GA 31794.

Research on peanut (*Arachis hypogaea* L.) genotypes has shown a high degree of genetic variability in fatty acid composition. The two major oil fatty acids, oleic and linoleic, range between 36–69% and 14–40%, respectively, and together make up 75–85% of total fatty acids. The very long chain ($C_{20}$–$C_{24}$) fatty acids make up 4–9%, palmitic acid 7–13%, and stearic acid 2–5% of total fatty acids. Stability of oil samples as measured by wt gain at 60 C shows variable but statistically significant correlations with levels of linoleic acid; peanut butter samples show similar patterns of wt gain. Some genotypes show consistent differences in oil stability patterns that are not related to linoleic acid content. Examination of entries from 13 wild *Arachis* species revealed levels of linoleic acid higher than those found in *A. hypogaea*. One species, *A. villosulicarpa*, contained 50% linoleic acid and 22% very long chain acids. These data will be coordinated with previously published data.

## 22

A LIQUID CHROMATOGRAPH-MASS SPECTROMETER-COMPUTER ANALYTICAL SYSTEM BASED ON ATMOSPHERIC PRESSURE IONIZATION MASS SPECTROMETRY. E.C. HORNING, D.I. CARROLL, I. DZIDIC, K.D. HAEGELE, and R.N. STILLWELL, Baylor College of Medicine, Texas Medical Center, Houston, TX 77025.

The principles of operation have been demonstrated for a liquid chromatograph-mass spectrometer-computer analytical system based on atmospheric pressure ionization mass spectrometry. A corona discharge ionization source was used, and ionzation of samples was based on solvent mediated reactions. Suitable solvents were isooctane, benzene, methylene chloride, and chloroform (with 0.5–1% ethanol). In most instances the product ions were $MH^+$. A high pressure liquid chromatograph was employed. Comparisons of detection sensitivity were made with an ultraviolet absorption detector. Band overlap, which may occur for ultraviolet detectors, is less likely to occur for detection based on $MH^+$ ions.

## 23

EXTENDING THE USE OF DEDICATED DATA SYSTEMS VIA BASIC PROGRAMMING. JOSEPH E. EVANS, Finnigan Corporation, Washington Science Center, 6110 Executive Blvd., Rockville, MD 20852.

The use of dedicated data systems to further process and reformat general laboratory data will be discussed. Examples of user-written programs which illustrate the power and versatility of BASIC will be presented. Particular emphasis will be placed on further processing of gas chromatographic-mass spectrometric data via dedicated data systems.

## 24

SEPARATION AND IDENTIFICATION FOR ISOMERIC HYDROPEROXIDES, ISOMER RATIO, AND OXO-COMPOUNDS FROM THE PEANUT LIPOXYGENASE-LINOLEIC ACID REACTION. HAROLD E. PATTEE and JOHN A. SINGLETON, ARS, USDA, PO Box 5906, Raleigh, NC 27607.

The peanut lipoxygenase-linoleic acid reaction produces positional and geometric isomers of linoleic acid hydroperoxides as well as oxo-compounds. These reaction products were separated by high performance liquid chromatography and identified by adsorption characteristics and mass spectrometry. The oxo-compounds eluted first from the 2.2 × 250 mm SI-10 MicroPak column, using 0.25% ethanol in hexane as solvent, followed by the geometric isomers of 13-hydroperoxy-9,11-octadecadienoic acid and then the positional isomer 9-hydroperoxy-10,12-octadecadienoic acid. Changes in the geometrical isomer ratio with time will be discussed.

## 25

COLUMN SELECTION AND METHOD DEVELOPMENT IN LIQUID CHROMATOGRAPHY: PUTTING THE VARIABLES TO WORK. MICHAEL J. TELEPCHAK, Instapak Corporation, Old Sherman Turnpike, Danbury, CT 06810.

The past several years have seen a great deal of advancement in the area of high speed liquid chromatography. Instrumentation has been developed which will allow the chromatographer to manipulate most of the variables involved in performing qualitative and quantitative analysis. Significant advances have been made in the area of column technology and design. With all the recent developments in high speed liquid chromatography, it has become increasingly complicated to sort through the variables in developing a method to obtain the optimum analysis. The four basic modes of liquid chromatography overlap to some degree in their ability to solve a given problem, and some problems can be solved by several approaches. The optimum solution lies in the ability to achieve maximum sensitivity and resolution in a minimum alloted time. The purpose of this paper is to familiarize the chemist with the various possibilities available to him as well as the most recent developments made in this area of analytical chemistry. Various approaches to liquid chromatography problem solving will be discussed, column selection criteria will be shown, and examples of separations will be shown. Applications of liquid chromatography to various areas of oil chemistry will be shown and related to the various approaches to problem solving. Separations of triglycerides, fatty acid amides, spearmint oil, lime oil, waxy alcohols, and preservatives in lotions will be included.

## 26

OPEN FORUM ON LIQUID CHROMATOGRAPHY. MICHAEL J. TELEPCHAK, Instapak Corporation, Old Sherman Turnpike, Danbury, CT 06810, and LEONARD H. PONDER, American Enka Co., Research Center–ATR, Enka, NC 28728.

Brief presentations are invited from the audience for this forum, which will focus principally on three topics: (1) application of liquid chromatography to specific problems, (2) liquid chromatographic packings—what is available and what is needed, and (3) liquid chromatographic instrumentation and accessories—specifications. Chromatographers are invited to present their own application problems (structures and chemical-physical data helpful) and their opinions on these topics, and to comment on applications and opinions presented. Manufacturers of liquid chromatographic equipment, supplies, and accessories are invited to make known their products and potential products in relation to the discussion. Presentations of 3–5 min are in order, as are shorter questions. Longer presentations require advance permission of the symposium chairman.

## 27

ALKYLAMINOBENZOIC ACIDS AS HYPOLIPIDEMIC AND ANTIATHEROGENIC AGENTS. ELWOOD E. LARGIS, ANDREW S. KATOCS, JR., LENA WILL, DAVID K. MCCLINTOCK, and SHELDON A. SCHAFFER, Lederle Laboratories, A Division of American Cyanamid Co., Pearl River, NY 10965.

The alkylaminobenzoic acids ($HO_2C$–$C_6H_4$–$NHC_nH_{2n+1}$) have been found to be potent hypolipidemic agents in rats and to have antiatherogenic effects in rabbits. p-Hexadecylaminobenzoic acid (n = 16), the most potent of the series, lowered serum sterol in normal rats by 30% when fed at 0.05% of the diet. Increasing or decreasing the alkyl chain length diminished the efficacy of the compounds as hypocholesterolemics. However, all members of the series were equipotent in decreasing serum triglycerides, giving decreases which ranged from 30 to 40%. The n = 16 compound also proved to be the most effective of the series in inhibiting both glycerol and acetate incorporation into liver and serum triglycerides and phospholipids. p-Hexadecylaminobenzoic acid was also found to inhibit cholesterogenesis from $^{14}$C-acetate in liver homogenates from drug fed rats. This result was paralleled by inhibition of liver β-hydroxy-β-methyl glutaryl CoA reductase. When added in vitro to liver homogenates, the compound was capable of inhibiting cholesterogenesis from $^{14}$C-acetate but did not inhibit β-hydroxy-β-methyl glutaryl CoA reductase or cholesterogenesis from $^{14}$C-mevalonate. The inhibitory effect of the compound on cholesterogenesis could be reversed by adding Coenzyme A ($10^{-4}$M) to the liver homogenate, suggesting inhibition of an early activation step in sterol synthesis. p-Hexadecylaminobenzoic acid, when fed to hypercholesteremic rabbits (110 mg/kg/day), also proved effective in decreasing lesion involvement and sterol deposition in aortas of rabbits that underwent endothelial cell denudation by the balloon catherization technique.

## 28

CHARACTERIZATION OF THE HYPOCHOLESTEROLEMIC ACTIVITY OF N-ARYLISOXAZOLIN-5-ONES. JAMES E. MILLER and JOHN B. HILL, Department of Biological Research, Searle Laboratories, PO Box 5110, Chicago, Il 60680.

In the course of evaluating compounds which can or might reduce the circulating levels of serum total cholesterol, the

observation was made that 2-(o-chlorophenyl)-3,4-diphenyl-isoxazolin-5-one (SC-27504) exhibited oral activity in the rat. Hypocholesterolemic activity was dose dependent with a minimal effective dose of ca. 1 mg/kg of body wt per day when administered for 4 or 6 days. Information about structural components of SC-27504 required for activity was obtained from a structural series prepared and evaluated for hypocholesterolemic activity. While serum total cholesterol was reduced, serum triglyceride remained unchanged or was reduced in a manner independent of dosage. Measurements of fatty acid and triglyceride biosynthesis in vitro indicate a lack of inhibition. Cholesterol biosynthesis is inhibited prior to mevalonic acid only when measured in vitro at concentrations >5 x $10^{-4}M$. While serum total cholesterol is decreasing, an increase in liver cholesterol is observed. An interpretation of the results is that SC-27504 induces an increased rate of cholesterol uptake by liver from serum.

## 29

PATTERN OF RESPONSE TO THE HYPOBETALIPOPROTEINEMIC AGENT U-41792 IN HYPERLIPEMIC RATS. PAUL E. SCHURR and CHARLES E. DAY, The Upjohn Company, Kalamazoo, MI 49001.

The hypobetalipoproteinemic activity of U-41792 (1-[p-(1-adamantyloxy) phenyl]-piperidine) is a marked and selective reduction of heparin precipitating lipoproteins (low density plus very low density lipoproteins) in cholesterol-cholic acid induced hypercholesterolemic rats. This activity consists of both a reduction in heparin precipitating lipoproteins and an increase in high density lipoproteins that are not precipitated by heparin. The increase in high density lipoproteins is routinely noted by decreases in the ratios of heparin precipitating lipoproteins to cholesterol. The pattern of response following single 100 mg/kg doses of U-41792 was determined. After an intravenous dose was administered in a cottonseed oil emulsion, serum cholesterol levels were reduced. The reduction began at 8 hr after administration and persisted for 96 hr. Activity was accompanied by increases in wt and cholesterol content of livers. Increases of high density lipoproteins in serum were first noted at 16 hr and persisted for 72 hr. Similar results, though delayed somewhat, were obtained after a single oral dose. After multiple daily oral doses, liver cholesterol was reduced. Hypobetalipoproteinemic activity was enhanced by prolonged treatments, as demonstrated by analyses of serum obtained weekly throughout 7 weeks.

## 30

AN OVERVIEW OF THE BIOCHEMICAL PHARMACOLOGY OF PROBUCOL. J. BARNHART, D. RYTTER, E. WAGNER, J. JOHNSON, and J. MOLELLO, The Dow Chemical Company, PO Box 68511, Indianapolis, IN 46268.

Probucol, 4,4'-(isopropylidenedithio)bis(2,6-di-tert-butylphenol), was identified as a hypocholesterolemic agent in mice over 10 years ago. Activity has since been demonstrated in several other animal species and in man. Minor structural modifications of the molecule have resulted in other active compounds. Probucol was not shown to affect cholesterol biosynthesis because no significant inhibition of acetate-$^{14}$C into cholesterol was observed in rats. Cholesterol absorption, estimated using a dual isotope technique, was reduced slightly in probucol treated rats. A 50% reduction of serum total cholesterol was effected by probucol treatment in cholesterol fed monkeys. Fecal neutral steroids were not increased during drug treatment in this study. Fecal bile acids were increased compared to control values, but this apparent increase was not statistically significant. Of 18 different tissues analyzed for total cholesterol, only liver (< control) and spleen (> control) were different from control values. A gas chromatographic method for the determination of probucol in biological material has been devised. After chronic 1 g/day dosing in humans, plasma probucol levels were usually in the 10–60 $\mu$g/ml range.

## 31

EFFECTIVE RED MEAT ANTIOXIDANTS: PHOSPHATES WITH NATURAL FRUIT JUICE CONCENTRATE. L.W. HAYMON and P.A. HAMMES, Product Development and Service Laboratories, Merck Chemical Division, Merck & Co., Inc., Rahway, NJ 07065.

Sodium tripolyphosphate and blends of phosphates with sodium tripolyphosphate exhibit good antioxidant properties in pork, seafood, poultry, and beef products. Enhanced antioxidant action was observed for the combination of sodium tripolyphosphate with lemon juice concentrate in frozen meat products. The natural fruit juice and sodium tripolyphosphate were evaluated alone and in combination by thiobarbituric acid values. Storage trials for the evaluations were conducted at −18 C with unrestricted oxygen. The combination products of sodium tripolyphosphate plus fruit juice concentrate were statistically compared to the components of the combination. Moisture losses after thawing and cooking the frozen meat products were also compared. Applications data for the phosphate commercial products of Kena®, Curafos®, Curavis®, and Freez-Gard® will also be reviewed.

## 32

METHIONAL AS AN ANTIOXIDANT FOR VEGETABLE OILS. REX J. SIMS and JOSEPH A. FIORITI, General Foods Technical Center, 250 North St., White Plains, NY 10625.

Heating of polyunsaturated vegetable oils with small quantities of methionine stabilizes them from oxidative rancidity. The mechanism of this effect involves decomposition of this amino acid to methional. Methional, or its dimer and trimer, is ca. as effective as tertiary butylhydroquinone in preventing oxygen absorption and in minimizing accumulation of hydroperoxides. Previously, it was shown that N-substituted amides are the principal products resulting when amino acids are heated in the presence of fats. These amides have a slight prooxidant effect; but in the case of methionine, the small quantity of methional that is generated provides protection from oxidation. Other sulfur-containing amino acids such as cystine were less effective. Elemental sulfur functioned quite well. The data confirm that hydroperoxide accumulation alone is an unreliable index of oxidation rate. After the oils have been heated with amino acids, hydroperoxides do not accumulate during storage at 60 C, but in some cases oxygen absorption rates may be quite rapid.

## 33

ANTIOXIDANTS IN VEGETABLE OILS. E.R. SHERWIN, Eastman Chemical Products, Inc., Subsidiary of Eastman Kodak Co., PO Box 431, Kingsport, TN 37662.

Various chemical compounds having antioxidant efficacy in food fats and oils and cleared for food use by governmental regulatory agencies are available for such use by vegetable oil processors in many nations. These antioxidants are reviewed with regard to major benefits and possible shortcomings they may afford when added commercially to vegetable oils. Some guidelines in selecting antioxidants for specific applications are offered. Also discussed are techniques that may be used and precautions that must be observed to achieve optimum results when antioxidants are added to fats and oils.

## 34

NATURALLY OCCURRING PLANT POLYPHENOLIC COMPOUNDS AS LIPID ANTIOXIDANTS. D.E. PRATT, Department of Foods and Nutrition, School of Home Economics, Purdue University, West Lafayette, IN 47907.

Many naturally occurring polyphenolic compounds possess strong antioxidant activity in lipid-aqueous and lipid food systems. Certain flavones, flavonols, flavonones, flavononols, cinnamic acids, and some of their derivatives suspended in the aqueous phase of a lipid-aqueous system offer appreciable protection to lipid oxidation. The action of some polyphenolic compounds, particularly the flavonoids, is bi-modal. Flavonols form complexes with metals, chelating at the 3-hydroxy, 4-keto-grouping and/or the 5-hydroxy, 4-keto group when the A ring is hydroxylated in the 5-position. An o-quinol grouping on the B-ring also possesses metal complexing activity. However, the major value of polyphenolic antioxidants is in their primary antioxidant activity. The position and degree of hydroxylation of polyphenols are of primary importance to antioxidant activity. All flavonoids with the 3',4'-dehydroxylation configuration possess antioxidant activity; an additional hydroxyl group at the 5' position increases the antioxidant activity. O-dehydroxy substituted cinnamic acids and their derivatives also possess appreciable antioxidant activity. Most compounds considered occur in plant tissues as water soluble esters. The three glycosides of flavonoids possess ca. the same antioxidant activity as the corresponding aglycone when the glycosyl substitution is a monosaccharide. However, higher level substitution reduces the activity. Esters of caffeic acid, such as chlorogenic acid and caffeoylquinic acid, possess ca. the same activity as caffeic acid.

## 35

ANTIOXIDANT PROPERTIES OF 6-HYDROXY-2,5,7,8-TETRAMETHYL-CHOMAN-2-CARBOXYLIC ACID. JOHN W. SCOTT and WINIFRED M. CORT, Hoffmann-La Roche Inc., Nutley, NJ 07110.

Abstract not available at press time.

## 36

EFFECTS OF SOLVENT AND ATMOSPHERE ON THE STABILITY OF SOME FREE RADICAL NITROXIDES. H.S. OLCOTT, J.S. LIN, and THEA S. WU, Institute of Marine Resources, University of California, Davis, CA 95616.

We recently showed that the electron paramagnetic resonance spectrum of the free radical, ethoxyquin nitroxide, was stable in methyl laurate but decreased in methyl linoleate. When air was present, active oxidation of the methyl linoleate began when the signal was no longer detectable. However, the signal also diminished in nitrogen, and, as we will describe in this paper, even more quickly in a high vacuum. In methyl linoleate, ethoxyquin nitroxide, and tempol free radical signals disappear in vacuo but return when air is reintroduced into the vessel. In methyl laurate, only the ethoxyquin nitroxide signal is reduced in vacuo, but it does not return when air is readmitted. The nature of the reactions involved will be discussed.

## 37

AN IMPROVED OXYGEN BOMB APPARATUS FOR EVALUATION OF ANTIOXIDANT PERFORMANCE. ANTHONY R. COOPER, DAVID P. MATZINGER, and THOMAS E. FURIA, Dynapol, 1454 Page Mill Rd., Palo Alto, CA 94304.

An improved oxygen bomb apparatus has been developed for evaluation of antioxidant performance under accelerated conditions. The currently available commercial apparatus employs an external mechanical pressure gauge maintained at ambient temperature, and this is connected to the hot oxygen bomb by a hollow tube. The tube provides a relatively cool region into which volatile materials, possibly including the antioxidant, can condense and thus be removed from the test mixture. Another limitation of the conventional apparatus is the poor resolution of the mechanical pressure gauge; the read-out reliability is ca. 0.5 psi. The improved oxygen bomb apparatus described in this study is a completely closed system in which all components are maintained at uniform temperature in a circulating air oven. This allows a wide choice of test temperature in the range room temperature to 150 C. The oxygen pressure is monitored using a strain gauge transducer having a range 0–100 psi, and pressure changes are recorded electronically on a strip chart recorder. The system stability and sensitivity is such that pressures may be read to 0.1 psi. Several variables have been examined, including sample wt, oxygen pressure, and test temperature using vegetable oil as the test material. The performances of conventional food grade and other antioxidants have been compared using this improved apparatus and the commercially available oxygen bomb units.

## 38

PERFORMANCE OF ALPHA OLEFIN SULFONATES IN LIGHT DUTY AND HEAVY DUTY HOUSEHOLD DETERGENTS. L. KRAVETZ, D.H. SCHARER, Shell Development Co., Westhollow Research Center, PO Box 1380, Houston, TX 77001, and H. STUPEL, Shell Chemical Co., 1 Shell Plaza, PO Box 2563, Houston, TX 77001.

The increased supplies of high quality linear alpha olefins shortly to become available on the U.S. market make alpha olefin sulfonates a realistic alternative for many anionic surfactant applications. A review will be given of recent applications research carried out in our laboratories on the properties and use of alpha olefin sulfonates in light duty and heavy duty detergents. Based on a laboratory dishwashing test using fat/protein soil, $C_{14-16}$ alpha olefin sulfonate was found to give superior foam stability to linear alkylbenzene sulfonate. Fabric detergency was evaluated using radiolabeled sebum and clay soils. $C_{16}$ and $C_{18}$ alpha olefin sulfonates looked attractive as workhorse anionics for heavy duty applications and showed advantages over linear alkylbenzene sulfonate.

## 39

SUMMARY OF THE TECHNOLOGY FOR THE MANUFACTURE OF HIGHER ALPHA-SULFO FATTY ACID ESTERS. B.L. KAPUR, J.M. SOLOMON, and B.R. BLUESTEIN, Witco Chemical Corp., 100 Bauer Dr., Oakland, NJ 07436.

A summary of the technology for the manufacture of sodium alpha-sulfo methyl tallowate with its excellent detergent and lime soap dispersing properties, high levels of biodegradability, and low toxicity is of current interest because of the recent construction of a new plant for the manufacture of these products in Japan. Although the sulfonation of fatty acids generally has been carried out over a period of several decades, it is only in the last 10–15 years that advances, i.e., availability of stabilized liquid $SO_3$, high purity tallow fatty acid esters, and continuous thin-film equipment, have been made in sulfonating long chain fatty acid esters culminating with the recent construction of a plant for the production of alpha-sulfo tallow esters. Earlier background laboratory work before this recent commercialization was done in the U.S. at the Eastern Regional Research Center of the USDA and in West Germany at Henkel and Cie. It is important to note that a serious attempt at commercialization was made in the mid–1960s by Stepan Chemical Co. This survey also includes our unpublished work on the continuous direct sulfonation of saturated fatty acid esters with sulfur trioxide in a turbulent falling film reactor. The chemistry of the preparation of alpha-sulfo fatty acid esters includes the reaction mechanism of alpha-sulfonation of the higher fatty acid esters as well as procedures for the neutralization and bleaching of the sulfonated fatty acid ester. A process development study covers process modules or unit operations and use of available industrial sulfonation equipment. Finally, the properties of the alpha-sulfo tallow esters, which include biodegradability, hydrolytic stability, and biological compatibility, generally are examined in detail. Because these products have a unique combination of desirable properties, their use in detergent powders, liquid formulations, and detergent bars should see a many-fold increase in the near future.

## 40

SYNTHESIS AND SURFACE ACTIVE PROPERTIES OF ANIONIC AND AMPHOTERIC LIME SOAP DISPERSANTS. W.M. LINFIELD, Eastern Regional Research Center, ARS, USDA, 600 E. Mermaid Lane, Philadelphia, PA 19118.

A review is given of recent studies on the subject. Different classes of anionic and amphoteric lime soap dispersants were synthesized in an effort to correlate chemical structure with surface activity, particularly with lime soap dispersing ability and with the detergency of soap-based detergent formulations containing the lime soap dispersants. Although good correlation between chemical structure and lime soap dispersing ability was established, no clear cut relationship could be derived between structure and detergency. Detergency and lime soap dispersing ability appear to be independent of each other. In anionic surfactants, the lime soap dispersing ability is increased by the addition of bulk to the polar end of the molecule. Thus, the introduction of amido, ester, or ether groups near the polar end has a marked beneficial effect on lime soap dispersing ability. Among the numerous classes of anionic dispersants investigated, three types are most promising with respect to ease of synthesis and cost, the α-sulfonated esters of fatty acids, the sulfated alkanolamides of fatty acids, and the sulfated alkylbenzenesulfonamides. Amphoterics in general are better lime soap dispersants and their formulations with soap give better detergency than those prepared from anionic dispersants. Optimum surface active properties are obtained when the cationic site is a quaternary ammonium nitrogen and when the anionic site is a sulfate or sulfonate group. Secondary or tertiary amino compounds are less satisfactory with respect to detergency than the analogous quaternary ammonium compounds. A carboxylate group is much poorer with respect to detergency and lime soap dispersing ability than a sulfate or sulfonate group. It is mandatory for good surface active properties that the anionic site is in the terminal position with the cationic site closer to the hydrophobic long alkyl chain. Introduction of an amido group into the polar end of the amphoteric molecule enhances lime soap dispersing ability and water solubility. Introduction of a second amido group, however, does not result in an additional enhancement of properties.

## 41

DETERMINATION OF POLYGLYCOLS IN NONIONIC SURFACTANTS BY HIGH PRESSURE LIQUID CHROMATOGRAPHY. L.P. TURNER and D. MCCULLOUGH, Alcolac Inc., 3440 Fairfield Rd., Baltimore, MD 21226.

The presence of glycols and polyglycols in nonionic surfactants is widely recognized. The level and nature of these components exert a significant influence upon the physicochemical and performance characteristics of the overall product mixture. A large number of analytical methods have been reported for the determination of polyglycols in these products. The primary problems often encountered with these methods are long analysis times, lack of specificity, difficulty of quantitation, limited application, and poor precision and accuracy. The use of high pressure liquid chromatography overcomes some of these limitations. The methodology of the high pressure liquid chromatographic determination of polyglycols in nonionic surfactants will be presented. Application of this technique to a wide variety of specific products will be discussed, along with the precision and accuracy attainable. The scope of the technique and current efforts to improve and expand the information derived from high pressure liquid chromatography will also be presented.

## 42

A REVIEW AND WHAT'S NEW IN LAUNDRY DETERGENCY TESTING. TED P. MATSON, Continental Oil Co., PO Drawer 1267, Ponca City, OK 74601.

A brief review is given of detergency test procedures. Newer developments in cloth soiling are presented, and some of the shortcomings of laundry detergency testing methods are discussed.

## 43

ANTIMICROBIAL/SURFACTANT POTENTIATING SYSTEMS: A REVIEW. G.G. COREY and B. BRUMMER, Airwick Industries, Inc., 380 North St., Teterboro, NJ 07608.

Synergistic effects combining antimicrobial agents and various classes of surfactants and related systems are discussed. Literature review, coupled with supplier data and original work, will be presented encompassing both phenolic and quaternary ammonium halide antimicrobial systems. Evaluation screening work is dependent on final parameters, including antimicrobial and cleaning effects, economics, and the substrate being utilized. Often as not, a compromise situation is reached, with the end product meeting some of the basic parameters satisfactorily but not all of them. The potential synergistic possibilities indicate that the least amount of original exploration and experimentation has been carried out in this area. Furthermore, "hard fast" rules based on limited knowledge of surfactants and antimicrobial agents indicate that a tunnel vision approach has been taken in the past by both the formulating chemist and the microbiologist.

## 44

BIODEGRADATION OF ESTERS OF α-SULFO FATTY ACIDS. E.W. MAURER, J.K. WEIL, and W.M. LINFIELD, Eastern Regional Research Center, ARS, USDA, 600 E. Mermaid Lane, Philadelphia, PA 19118.

Methyl and aminoalkyl esters of α-sulfonated fatty acids in the $C_{12}$-$C_{18}$ range were subjected to aerobic biodegradation in a controlled nutrient medium in which sewage microorganisms were used as the sole source of carbon, and biodegradability was determined by the loss of carbon. The extent of biodegradation varied with the alkyl chain length of the α-sulfo acid. Thus, the methyl ester of α-sulfostearic acid was most biodegradable whereas that of α-sulfolauric acid was least degradable. The extent of biodegradation of various aminoalkyl esters of α-sulfolauric acid was compared with that of the methyl ester. It was found that all of the aminoalkyl esters were less degradable than the corresponding methyl esters. The decreasing order of biodegradability of the esters was as follows: α-sulfolaurate of ethanolamine > α-sulfolaurate of N-methylethanolamine > α-sulfolaurate of N,N-dimethylethanolamine > α-sulfolaurate of diethanolamine > α-sulfolaurate of diglycolamine. Similarly, sodium methyl α-sulfopalmitate degraded to a much greater extent than the corresponding esters of diglycolamine or N,N,N-trimethylammonioethanol. It thus appears that increasing substitution on the amino nitrogen results in decreasing biodegradation.

## 45

SOAP-BASED DETERGENT FORMULATIONS: XXI. AMPHOTERIC DERIVATIVES OF FATTY AMIDES OF AMINOETHYLETHANOLAMINE. FRANK D. SMITH and W.M. LINFIELD, Eastern Regional Research Center, ARS, USDA, 600 E. Mermaid Lane, Philadelphia, PA 19118.

Amides and N-(2-hydroxyethyl)imidazolines were prepared from various fatty acids or their methyl esters and N-(2-hydroxyethyl) ethylene diamine. The diamine reacted exclusively at the primary amine function. Amphoteric surfactants were obtained by reaction of the fatty primary monoamide with 1 or 2 moles of 1,3-propanesultone or by reaction with 1 mole of propylene oxide followed by quaternization with 1,3-propanesultone. Cyclization of the primary monoamides gave N-(2-hydroxyethyl)imidazoline derivatives which were converted to amphoteric surfactants either by addition of 1,3-propanesultone or by quaternization with dimethyl sulfate. The resulting quaternary N-(2-hydroxyethyl)imidazolinium compounds were either sulfated directly with chlorosulfonic acid or treated with 1 mole of propylene oxide first and then sulfated. Most of the amphoteric compounds of this study were quite water soluble and, with the exception of the sulfated N-(2-hydroxyethyl) imidazolinium compounds, all were stable to alkaline hydrolysis. Even though virtually all amphoteric compounds of this study were good lime soap dispersants, with lime soap dispersant requirements of < 10, they were somewhat inferior in dispersing ability to simpler sultobetaines reported previously. Although a few compounds of this series were good detergents by themselves, particularly on cotton-polyester blends, formulations of those amphoterics with soap or with soap and silicate builders were generally inferior to analogous formulations with simpler sulfobetaines.

## 46

POLYOLS FOR URETHANE FOAMS FROM EPOXIDIZED TALLOW, TRIMETHYLOLPROPANE, AND PROPYLENE OXIDE. A. BILYK, E.J. SAGGESE, H.A. MONROE, JR., and M.P. ZUBILLAGA, Eastern Regional Research Center, ARS, USDA, 600 E. Mermaid Lane, Philadelphia, PA 19118.

In the previously described preparation of polyols from epoxidized tallow and trimethylolpropane, water washing was necessary to remove solid, unchanged trimethylolpropane. The present three stage reaction provides a convenient alternative to this purification step. In the first stage the epoxidized tallow was heated with trimethylolpropane under catalysis by $BF_3$. Reactant proportions were chosen in terms of functional ratio, or the ratio of hydroxyl function provided by trimethylolpropane to oxirane plus ester function provided by epoxidized tallow. Under the acidic catalysis the oxirane was rapidly consumed. After 1 hr the $BF_3$ was eliminated and KOH catalyst introduced. The second stage (4 hr) favored reaction of the trimethylolpropane with glyceride links to confer OH functionality even on nonepoxidized fatty species. In the third stage (2 hr), unchanged trimethylolpropane and other hydroxylic components were brought into reaction with propylene oxide to give, without need of a washing step, a homogeneous mixed polyol suitable for use in making urethane foams. Such polyols were prepared using epoxidized fancy beef tallow, also from an experimental liquid tallow fraction which had been epoxidized. The polyols, all liquid at room temperature, were adjusted to equivalent wts of 100 and 120 with added triisopropanolamine and treated with a polymeric isocyanate to give low density rigid foams. Densities ranged from 1.6 to 1.8 lb/ft³ and compressive strengths from 21 to 30 lb/ft³. These formulations were also modified to give higher density rigid cellular products. At densities between 11.1–12.5 lb/ft³, compressive strengths ranged between 318–467 psi; at densities between 19.6–20.2 lb/ft³, compressive strengths ranged between 880–1265 psi.

## 47

IMPROVING THE NUTRITIONAL PROPERTIES OF PRODUCTS FROM RAPESEED. S.J. SLINGER, Department of Nutrition, University of Guelph, Guelph, Ontario, Canada.

Canadian plant breeders have recently succeeded in producing rapeseed with < 1% erucic acid in the oil and with a very low level of glucosinolates in the meal. One such *Brassica napus* cultivar, "Tower," is now licensed. The meal from Tower seed has been subjected to extensive chemical and biological testing and has proven to be a markedly superior product as compared with conventional rapeseed meals. This new cultivar is less goitrogenic, more palatable, and gives satisfactory productive performance in animals at use levels well in excess of older varieties. The presence of high levels of erucic acid in older varieties made the oils undesirable, particularly because this compound is not well metabolized by cardiac and certain other tissues and results in pathological changes in a number of experimental animals. Tower oil is less cardiotoxic than high erucic oils and appears to be no more detrimental when used at the 20% level in animal diets than a number of other oils used in human foods. Work is underway to determine whether the cardiopathogenic factor of fats

is in the triglyceride or in the non-glyceride fraction and whether linolenic acid or the ratio between this and linoleic acid are causal. Hydrogenation of Tower oil significantly reduces cardiotoxicity. Rapeseed varieties with a yellow seed coat are now being developed in Canada because this is associated with a thinner hull which results in higher oil and protein and lower fiber than in dark coated varieties. One advantage of rapeseed over the soybean is that the former contains 40% or more of oil as compared with ca. 18% for the latter. Plant breeders are working towards lowering the level of linolenic acid from 8 to 9% of the present Tower oil to a considerably lower level. It is also believed feasible to increase the linoleic acid at the expense of oleic and linolenic acids, thus increasing the market potential.

## 48

NUTRITIONAL POTENTIAL OF SOYBEANS AND OTHER OILSEEDS. HERBERT J. DUTTON, Northern Regional Research Center, ARS, USDA, 1815 N. University, Peoria, IL 61604.

In considering oilseeds as new foods for tomorrow, one of our purposes is to look at them from the point of view of the end product user and to assess characteristics that (1) are desirable or (2) limit utilization, or (3) are needed for new and expanded outlets of oilseeds. Although not a purpose, an undercurrent and recurrent theme concerns how we shall achieve these desired characteristics. "Shall we attempt to breed them?" or "Shall we try to effect them by processing treatments?" In addition, there is a basic issue that needs to be resolved, if possible, with regard to nutritional potentials: "How long can *Homo sapiens* afford to compete with farm animals for protein supplies?" Frequently, oilseed proteins can be made available both for animal and for direct human consumption. In surveying plant seeds worldwide as a source of protein, soybeans rank well, both among major economic crops and among those of the survey. Although it is generally agreed that soybeans are raised for their meal to meet protein requirements of the U.S. animal feeding economy, the by-product oil may at times be more valuable. Due largely to research by government and academic groups, on the one hand, and corresponding implementation of research by industry on the other, soybean oil today performs satisfactorily in margarines, shortenings, and salad oils; as a high temperature cooking oil, more research is required and is underway.

## 49

OILSEED PROTEINS IN PRUDENT-DIET FOODS. M.M. HAMDY (Technical Center, General Foods Corp.), White Plains, NY 10625.

Animal proteins such as meat, milk, and eggs cost more each year because of the poor conversion efficiency from plant to animal proteins and the increasing production costs of plant proteins. Animal fats associated with animal proteins have a role in cardiovascular diseases. These factors combined indicated an opportunity to the food technologists and food manufacturers to develop imitations of animal proteins and foods that eliminate or reduce significantly the disadvantages of natural animal proteins. Logically the substitutes have tried to duplicate the quality of food the consumer is familiar with and likes. Therefore, we find the bacon, ham, chicken, fish, etc., analogs which are direct substitutes that can be prepared in finished foods by simple recipes. Oilseed proteins, particularly soybeans, peanut, and cottonseed, are the most important from the cost/value aspect. Their nutritional and functional value will be discussed in relation to animal proteins. The problems of antimetabolites and flavors inherent in oilseed proteins have been overcome in the former and managed to a limited success in the latter. The impact of imitation protein foods on the environment and the threats to consumer's health and welfare are considered bright.

## 50

COTTONSEED PROTEIN FOOD PRODUCTS. C.M. CATER, K.F. MATTIL, W.W. MEINKE, M.V. TARANTO, and J.T. LAWHON, Food Protein Research and Development Center, Texas A&M University, College Station, TX 77843.

Upward trending world population and increasing costs for traditional food proteins provide many incentives for utilization of oilseed proteins directly in human diets. Cotton, as one of the world's major oilseed crops, represents a potential source of food proteins. Acceptability of oilseed protein products in terms of functional properties in food systems and nutritional value will largely determine the extent of their utilization by the food industry. Cottonseed protein products, including liquid cyclone process cottonseed flour and defatted glandless cottonseed flour as well as others, have been evaluated by various functionality tests and in a number of food systems and have also been subjected to processing by extrusion texturization. Human feeding studies have also been conducted. Results indicate a good potential for use of cottonseed protein products in a variety of food systems.

## 51

PHYSICAL AND CHEMICAL PROPERTIES OF SOYBEAN PROTEINS. W.J. WOLF, Northern Regional Research Center, ARS, USDA, 1815 N. University, Peoria, IL 61604.

Soybean proteins continue to intrigue researchers by their diversity and complexity. Primary structures of two soybean trypsin inhibitors are now known. Bowman-Birk inhibitor consists of 71 amino acid residues (mol wt 8,000) tightly crosslinked by seven disulfide bridges that confer stability to heat, acid, and proteolytic digestion. Kunitz inhibitor contains 181 amino acid residues (mol wt 21,500) crosslinked by two disulfide bonds. The crystalline complex of Kunitz inhibitor with trypsin has been analyzed by X-ray crystallography to reveal its structure at 2.6 Å resolution. Only ca. 12 of the amino acid residues in the inhibitor interact with trypsin to form the stable crystalline complex. Soybean agglutinin, now believed to be free of antinutritional effects, consists of four identical subunits (mol wt 30,000) each containing a carbohydrate side chain. The 7S globulin fraction is more heterogeneous than previously suspected; fractionation by ion exchange chromatography yielded five electrophoretically distinct proteins, but all reversibly dimerized at 0.1 ionic strength. Physical properties of purified 11S protein have been redetermined, and genetic polymorphism is suggested to account for four acidic subunits instead of three reported earlier. A fraction sensitive to acid (pH 4.5) was isolated by ammonium sulfate precipitation and found to bind color and flavor compounds preferentially; it likely contributes to turbidity of isolate dispersions. Crude 7S and 11S fractions differ in their gelation behavior in the presence of calcium ion in preparing tofu-like gels. Crude 11S protein forms firmer and more cohesive gels than crude 7S protein. Fractionation may be a method for changing functional properties of soybean proteins without resorting to chemical or enzymatic methods.

## 52

PEANUT PROTEIN: A VERSATILE FOOD INGREDIENT. J.L. AYRES, B.L. DAVENPORT, and K.C. BURGESS, Gold Kist Research Center, 2230 Industrial Blvd., Lithonia, GA 30058.

Peanut flour has been evaluated for use in a variety of food products as a replacement for animal source proteins. In breakfast cereals and snack foods, peanut flour blends well with cereal flours to yield products with excellent flavor, texture, and color. Peanut flour can be used in both emulsion and ground meats to provide good moisture and fat binding characteristics. In bakery products, peanut flour can be used at levels up to 20% to provide protein supplementation without astringent flavor of other oilseed flours. Unique flavor can be obtained by using peanut flavor in hydrolyzed vegetable protein.

## 53

PREPARATION AND PROPERTIES OF CHLOROGENIC ACID-FREE SUNFLOWER PROTEIN. FRANK SOSULSKI, Crop Science Department, University of Saskatchewan, Saskatoon, Saskatchewan, Canada S7N 0W0.

Sunflower flours, protein concentrates, and isolates have potential food uses because of their high protein content, white color, bland flavor, and absence of antinutritive factors. Procedures have been developed for removal of chlorogenic acid, which forms green and brown colors under alkalin pH, and selection for low chlorogenic acid lines is under way in sunflower plant breeding programs. Nutritional studies have demonstrated that sunflower proteins have an excellent amino acid balance except for lysine and show high protein efficiency ratios in blends with meat or legume proteins. Sunflower flour and concentrates show excellent fat and water absorption and exceed soybean products in oil emulsification and whipping properties. Wieners supplemented with sunflower flours and concentrates are comparable to soy wieners in most chemical, physical, and organoleptic properties, and research is under way with sunflower supplemented milk and bread products.

## 54

FRACTIONATION OF SUNFLOWER SEED PROTEINS. J. BAUDET and J. MOSSE, Station de Physiologie Vegetale, CNRA, Versailles, France.

Abstract not available at press time.

## 55

Paper withdrawn.

## 56

EFFECTS OF CHRONIC INGESTION OF ETHANOL ON MYOCARDIAL METABOLISM OF FATTY ACIDS. SHARON L. PARKER and RONALD C. REITZ, Department of Biochemistry, University of Nevada, Reno, NV 89507.

The chronic ingestion of ethanol altered the esterification/oxidation ratio in favor of esterification. This ratio for palmitate was increased by 26.4%, and that for linoleate was increased by 32.9%. The oxidation rates for palmitate, stearate, oleate, and linoleate were determined to be decreased significantly by the chronic ingestion of ethanol, and the percent decrease was shown to be related to both chain length and degree of unsaturation. When the kinetics of the total oxidation process were studied, it was determined that the decrease in oxidation was a rate phenomenon rather than a substrate binding effect. An attempt was then made to determine the mechanism by which the rate of oxidation was decreased by ethanol ingestion. To test the functioning of the trichloroacetic acid cycle, the kinetic parameters for the oxidation of acetate were determined. In addition, the activities of three enzymes of the trichloroacetic acid cycle were assayed, and without exception, no effect was observed on any of these parameters. Thus, it was concluded that the trichloroacetic acid cycle was not involved in the ethanol induced decrease in fatty acid oxidation. Next, the $\beta$-oxidation sequence per se was tested by using $1^{14}$-C-octanoate, a carnitine independent substrate. Again, no effect of ethanol ingestion was observed, ruling out any influence on the $\beta$-oxidation enzymes. Finally, the transport of fatty acids via the acyl-CoA:carnitine acyltransferase (CAT) was determined. The data thus obtained indicated a significant effect on this enzyme. The total activity of mitochondrial CAT activity was decreased 25.6% by the chronic ingestion of ethanol. Further, digitonen was used to fractionate this enzyme into a soluble and a membrane bound fraction. The inhibitory effects of ethanol were observed only in the solubilized fraction. These data suggest that CAT plays a significant role in the decreased myocardial oxidation of fatty acids in chronic ethanol treated animals. They also suggest that this decreased CAT activity may be related to the "outer" form of acyl-CoA: carnitine acyltransferase. (This work was supported in part by Grant No. AA00204 from the National Institute of Alcohol Abuse and Alcoholism.)

## 57

ENERGY STORAGE IN PLANTS: I. EVIDENCE FOR THE ACCUMULATION OF CYANIDE-SENSITIVE PEROXIDES IN ILLUMINATED TISSUES. ANTONY R. SHOAF, OSCAR HINOJOSA, Southern Regional Research Center, ARS, USDA, 1100 Robert E. Lee Blvd., PO Box 19687, New Orleans, LA 70179, RICHARD H. STEELE, Tulane Medical School, New Orleans, LA 70112, and JETT C. ARTHUR, JR., Southern Regional Research Center, ARS, USDA, PO Box 19687, New Orleans, LA 70179.

Whole leaves, aqueous leaf extracts, and chloroform-methanol extracts of whole leaves of *Ligustrum* contain an extremely cyanide-sensitive factor(s) (CSF) which is demonstrated by monitoring (1) chemiluminescence, (2) nitroblue tetrazolium reduction, (3) hydroxylamine oxidation, (4) development of an intense fluorescent pigment (excitation max:365 nm; emission max:467 nm), and (5) development of strong electron paramagnetic resonance signals (at 21 C), all immediately following KCN addition to either whole leaves or extracts. The identity of CSF as a peroxide is supported by its capacity to oxidize ferrous ion in the iron thiocyanate test for peroxides. Thin layer chromatography of isolates of CSF is accomplished only on cellulose plates, because silica gel and alumina destroy CSF. The location of CSF on the thin layer chromatography plates is accomplished by performing any and all of the above CN⁻-elicited assays, as well as the $Fe(SCN)_3$ assay for peroxides. A possible relationship of CSF to photosynthesis is suggested by the fact that (a) all CN⁻-elicited effects require a history of illumination, even though CSF is demonstrated in darkness, (b) the intensity of the effects is proportionate to

the extent of illumination following a 30 hr dark period of the unharvested leaves, (c) the CN--elicited electron paramagnetic resonance signal is identical with "EPR Signal II" known to occur in photosynthesis, (d) CN- causes a disappearance of the $Mn^{++}$ electron paramagnetic resonance signal, and (e) CSF may be identical to the factors responsible for the photoinduced light emissions first reported by Strehler and Arnold (*J. Gen. Physiol.* 34:809, 1951). Recently, cyanide-sensitive peroxides were isolated from liver microsomes and were found to resemble the cyanide-sensitive 1-hydroxyalkyl peroxides, $H_2COH\text{-}OO\text{-}HOH_2C$, and $H_2COH\text{-}OOH$ (Shoaf and Steele, *Biochem. Biophys. Res. Commun.* 61:1363, 1974).

## 58

AFLATOXIN IN CORN. ODETTE L. SHOTWELL, Northern Regional Research Laboratory, ARS, USDA, 1815 N. University, Peoria, IL 61604.

Low incidence and levels of aflatoxin were identified in corn of all grades grown in the Midwest in 1964, 1965, and 1967. Later surveys indicate that corn grown in southern regions is subject to invasion by *Aspergillus flavus* and subsequent aflatoxin formation. This mycotoxin is formed either in the field or in storage. In the field, such factors as insect damage and weather conditions are probably associated with aflatoxin formation. In storage, temperatures must be above 25 C and moisture levels above 18% if toxin is to form. Aflatoxin formed in a hot spot in stored corn in the Midwest where temperatures rose early in the summer and where the grain became wet because of leaks in the storage building. Analytical methods to detect and determine aflatoxin fall into three categories: presumptive tests indicating the presence of *Aspergillus flavus* and the possible occurrence of aflatoxin, rapid screening tests establishing the presence or absence of the toxin, and quantitative procedures determining toxin levels. Detoxification methods being studied include ammoniation and roasting. A process has been developed for ammoniating corn, which is being fed to domestic animals to determine whether it has adverse effects and whether toxic compounds are transmitted in animal tissues.

## 59

AFLATOXIN CONTROL PROGRAM FOR PEANUTS. J.W. DICKENS, ARS, USDA, PO Box 5906, Raleigh, NC, 27607.

Under provisions of USDA Marketing Agreement No. 104, an aflatoxin control program for U.S. peanuts is administered by the Peanut Administrative Committee composed of grower and sheller representatives and financially supported by sheller assessments based on the volume of peanuts purchased. Regulations contain provisions about the quality of peanuts acquired from farmers, storage of unshelled (farmers' stock) peanuts, aflatoxin testing, quality and disposition of processed lots, and indemnification of shellers for eligible lots that test over 25 parts per billion aflatoxin. Lots of farmers' stock peanuts found to contain kernels with visible *Aspergillus flavus* mold, $>$ 2% kernels with external damage, or $>$ 1% kernels with internal damage cannot be used for edible purposes. Moisture content must not exceed 10% and only approved storage facilities may be used. Small kernels and discolored kernels (pickouts) cannot be used for edible purposes, and meal from them must test $<$ 25 parts per billion if used for animal feed. All processed lots of edible peanuts must meet requirements about foreign material, moisture content, kernel size, and damaged kernels. They must be tested for aflatoxin by prescribed procedures, and test results are available to the Food and Drug Administration. Peanuts failing to pass aflatoxin tests may be cleaned, sized, and color sorted in an attempt to remove aflatoxin contamination. Some are blanched (removal of red skin) followed by removal of discolored kernels and those that fail to blanch. Peanuts that continue to fail aflatoxin tests are crushed for oil and the meal is restricted from animal feed. Shellers are indemnified for most losses caused by positive aflatoxin tests. Effects of the various procedures on aflatoxin concentrations in finished lots are discussed.

## 60

AFLATOXIN IN PECANS: PROBLEMS AND SOLUTIONS. J.L. AYRES, Gold Kist Research Center, 2230 Industrial Blvd., Lithonia, GA 30058.

The potential for aflatoxin contamination in pecans has been demonstrated in the literature. However, the incidence and level of contamination has not been extensively surveyed. The pecan industry is currently evaluating cultural practices to prevent mold growth in the orchard, during harvest, or in-shell storage. Removal of moldy pecans by careful procurement, grading, and sizing as well as during shelling is being evaluated. Detection of aflatoxin contamination is complicated by the high cost of pecans, large sample required, low incidence of contamination, and great variety of pecan sizes and grades currently marketed.

## 61

SURVEY OF AFLATOXIN IN CALIFORNIA TREE NUTS. G. FULLER, W.W. SPOONCER, A.D. KING, JR., J. SCHADE, and B.E. MACKEY, Western Regional Research Center, ARS, USDA, Berkeley, CA 94710.

Because of concern regarding the possible presence of aflatoxin in almonds and walnuts, independent cooperative surveys were made by the Western Regional Research Center in cooperation with the respective industry control boards in California. In-shell and processed samples of both almonds and walnuts from the 1972–73 crop were sampled and analyzed, followed by less extensive sampling of the almond crop during subsequent years. As received, both crops had many samples containing aflatoxin, usually at concentrations of $<$ 20 parts per billion. Procedures already in effect, consisting of combinations of electronic and hand sorting to remove physically damaged product, were effective in concentrating the aflatoxin into reject material or inedible oil stock. Statistical analysis of the data allowed estimates of aflatoxin incidence in the total crop as well as in sorted products.

## 62

FIELD CONTAMINATION OF COTTONSEED BY *ASPERGILLUS FLAVUS*: OCCURRENCE AND CONTROL. T.E. RUSSELL and G.F. RYAN, University of Arizona, Mesa Experiment Station, PO Box 1308, Mesa, AZ 85201.

Significant contamination of cottonseed by aflatoxins occurs in three main geographical areas in the United States: southern California, central and southwestern Arizona, and southwestern Texas. In Arizona, seed contamination by aflatoxin, as well as the presence of *Aspergillus flavus* propagules in soils and on bolls, is closely related to elevation and temperature. The degree of aflatoxin contamination within these areas is directly related to the amount of boll damage by the pink bollworm and populations of other insects. Insect control reduces potential for aflatoxin contamination. Applications of commercially available fungicides have resulted in little benefit. Some variations in the ability of certain varieties to support aflatoxin production have been noted. A growth chamber procedure, using detached bolls, has been developed for standardized production of aflatoxin under environmental conditions approximating those found in the field.

## 63

STUDIES OF THE MECHANISM OF ACTION OF HALOFENATE. LEWIS MANDEL, Merck Institute for Therapeutic Research, Bldg. 80M, Merck & Co., Inc., Rahway, NJ 07065.

Halofenate, 2-acetamidoethyl (p-chlorophenyl) (m-trifluoromethylphenoxy) acetate, is an agent with hypolipidemic and hypouricemic activity in man. The results of preclinical research projects of several investigators on the mechanism of its hypolipidemic action will be presented. Studies in *Saccharomyces cerevisiae* and isolated rat adipocytes suggest that halofenate inhibits lipid synthesis at or near pyruvate dehydrogenase. Although this enzyme was inhibited in vitro, halofenate also inhibited the activity of a variety of other enzymes in vitro. In rats maintained on dietary 0.05–0.15% halofenate for 7–14 days, a 30–40% decrease in plasma cholesterol, triglycerides, phospholipids, and free fatty acids resulted. Inhibition of the activity of liver HMG-CoA reductase does not solely account for the hypocholesterolemic effect, and activation of mitochondrial $\alpha$-glycerophosphate dehydrogenase does not explain the hypotriglyceridemic action. Kinetic measurements of the serum appearance and disappearance of $^3$H-triglyceride in drug treated rats given $^3$H-glycerol showed a 75% reduction in the formation of serum triglycerides. Because halofenate did not accelerate clearance of serum triglycerides, its hypotriglyceridemic action appears due to net inhibition of hepatic triglyceride synthesis. In sucrose induced hyperlipidemic rats 0.05% halofenate reduced serum cholesterol to normal values, triglycerides decreased 60%, very low density lipoprotein concentrations were normalized, but the very low density lipoprotein triglyceride:protein ratio remained doubled. The sucrose induced increase in the C-111 apolipoprotein, and the altered distribution of apoprotein B between the very low density lipoprotein and low density lipoprotein fractions was also prevented by halofenate. In the Zucker obese hyperlipidemic rat, the plasma lipid lowering effect of halofenate was associated with a marked decrease in insulin:glucagon molar ratio, both in the basal state and after arginine challenge. Recent studies have shown that halofenate reduces blood glucose in patients with pretreatment values $>$ 140 mg %. Preliminary experiments in rats on the mechanism of the hypoglycemic action indicate halofenate acts differently than sulfonylureas or phenformin. Some, but not all, of the effects of halofenate associated with its hypolipidemic action were observed with clofibrate at 2–10 times higher concentration.

## 64

HYPOLIPIDEMIC EFFECT OF ADDITION OF EITHER NIACIN, CHOLESTYRAMINE, OR ATROMID-S ON SUBJECTS RECEIVING PROBUCOL. FRANK CANOSA, EDWIN BOYLE, JR., et al., The Dow Chemical Co., PO Box 68511, Indianapolis, IN 46268.

This study, begun on January 9, 1974, is designed to establish the effect of a specific diet and a combined drug therapy according to the subject's phenotype. A total of 30 subjects with type II-A phenotype and 30 subjects with type II-B phenotype are to be enrolled in this study. At present, we have 16 subjects with Phenotype II-A and 20 subjects with Phenotype II-B. The medications that are being used in this study are Probucol (The Dow Chemical Co.), Cholestyramine, Atromid-S, and Niacin. On entering the study, each subject is asked to follow a diet (recommended by the National Heart and Lung Institute) specifically designed for his phenotype for 2 months. At the end of these 2 months, the subject is assigned Probucol (2 tablets b.i.d.) for the next 4 months, at which time the subject is randomly assigned either to Probucol with Niacin, Probucol with Atromid-S, or Probucol with Cholestyramine, which is then continued for the next 5 months. At the end of this 5-month combined therapy (11 months from program start), the subject is given only Probucol. This allows the subject a washout period of 1 month. At the end of this month, the patient is assigned either to Probucol with Niacin, Probucol with Atromid-S, or Probucol with Cholestyramine, so as to be different from those used previously. Again, at the end of the next 5 months, subject is given only Probucol for a second washout period of 1 month. Then, the subject is assigned to the remaining combination for 5 months. At the end of this period, the subject is again assigned to Probucol for the last 2 months of medication for washout. Then he is assigned to placebo for the last month of the study for total washout. Results to date show that 5 weeks of Probucol alone produced a significant reduction in serum cholesterol from 315 to 273 mg% ($P < 0.001$), serum beta lipoproteins by the K-Agar Delta Method ($P < 0.005$). Addition of the second hypolipidemic drug induced additional decreases in serum lipids. Most of these subjects studied thus far have already demonstrated a highly significant reduction in their lipid values. The results of the total subjects studied shall be reported in the presentation.

## 65

PROBUCOL IN LONG TERM MANAGEMENT OF HYPERLIPIDEMIAS. DONALD MCCAUGHAN, Harvard Medical School, Boston, MA 02115.

Probucol has been administered to 60 patients for a period of 58–60 months for the control of hypercholesterolemia. Initiation of therapy was based on pretreatment levels of cholesterol $>$ 250 mg % (average of three values). Cholesterol and triglyceride determinations were made at two monthly intervals during the period of treatment. The average of the final three values was compared with the pretreatment average. All cases showed a decline in serum cholesterol, with a mean of −29% (standard deviation 9). The range of declines was −45 to −8. No significant differences were observed in the declines in the various types (type IV, 16 cases; type II, 28 cases; type VI, 13 cases) (type I, 1 case; type III, 1 case; type V, 1 case). Fifty-seven cases showed a decline in pretreatment triglycerides and three showed an elevation. The percentage declines in triglyceride levels were much more scattered than the decline in cholesterol levels. Red and white cell counts, hemoglobin, hematocrit, urinalysis, serum glutamic pyruvic transaminase, blood urea nitrogen, and complete physical examination were carried out at each visit. No significant deviation from control values was observed. Electrocardiograms were performed at baseline and annually. No significant differences were observed in rhythm and intervals (P-R, QRS, Q-T). Slit lamp examinations were performed at baseline and annually and showed no change. Side effects were minimal

and limited to several cases with occasional loose bowel motions, never of sufficient degree to discontinue therapy.

## 66

CLINICAL EXPERIENCE WITH CI-720, A NEW HYPOLIPIDEMIC AGENT. H.P. BLUMENTHAL, J.R. RYAN, and F.G. MCMAHON, Tulane University School of Medicine, New Orleans, LA 70112.

Abstract not available at press time.

## 67

RECENT DEVELOPMENTS IN THE FLAVOR OF MEAT. STEPHEN S. CHANG, Department of Food Science, Rutgers University, New Brunswick, NJ 08903.

The flavor of meat is of great academic as well as practical importance. The current trend of using vegetable protein as a substitute for meat caused an urgent need to understand the chemical composition of meat flavor. With the advancement of modern instruments, a giant step forward has been made during the last 15 years in identifying the volatile compounds responsible for meat flavor. However, the knowledge is still far from complete. The volatile compounds which have been reported as components of meat flavor will be reviewed. Patented processes of producing meat flavor by reacting proper components will be summarized. The methodology developed in the author's laboratory for the isolation and identification of components of meat flavor will be presented.

## 68

LIPID-DERIVED FLAVORS OF LEGUMES. DAVID J. SESSA and JOSEPH J. RACKIS, Northern Regional Research Center, ARS, USDA, 1815 N. University, Peoria, IL 61604.

Off-flavors in legumes are produced in various ways. Inherent flavors arise from normal metabolism of a growing plant. The green-beaniness of raw soybeans and the green pea flavor of peas are combinations of volatile compounds within a matrix of protein and carbohydrate unique to those vegetables. Vegetables contain two lipid systems: nonpolar, represented by the triglycerides; polar, represented principally by phospholipids and sterols. With intact raw vegetables, polar lipids are stable, apparently protected by enzymes that maintain a reducing state. The flavor of raw vegetables changes after harvesting and during processing and storage. These changes can arise from action of enzymes on flavor precursors, autocatalytic reactions, chemical interactions, and fermentation. Processing that inactivates enzymes renders polar lipids vulnerable to oxidative attack. Generally, fatty acid constituents of these lipids form hydroperoxides that are decomposed by the catalysts present to give volatile and nonvolatile constituents which either possess flavors themselves or interact with other food components to produce flavors. Identifying the numerous volatile carbonyl compounds, coupled with organoleptic evaluation, will only partially solve the complex flavor problem. By this approach, major contributors to the green-beaniness of soybeans were found to be *cis*-hexenal, *n*-pentyl furan, and ethyl vinyl ketone. Oxidized phosphatidylcholines cause some of the bitter taste. The flavor problem will be solved by either effective removal of the flavor compounds from the matrix to which they are bound or by inhibition of their formation. Solvent systems based on alcohol have been used to extract flavor principles, and methodology involving alcohol treatment of the intact seed or blanching effectively inhibits formation of off-flavors.

## 69

CHEMISTRY OF PEANUT FLAVOR. B.R. JOHNSON, Department of Food Science, North Carolina State University, Raleigh, NC 27607.

The characteristic aroma of roasted peanuts is essentially due to volatile flavor compounds produced by nonenzymatic browning reactions. In excess of 180 volatile components have been reported. The flavor precursors have been shown to be free amino acids and reducing sugars. Factors influencing the levels of the precursors have been determined to be type of peanut, size, growing location, and time of harvest. The relatively high levels of sucrose which are responsible for peanuts' natural sweet taste varied significantly with peanut type and yearly seasonal effects. Roasting procedures affect both the destruction of sugars and free amino acids and flavor acceptability of the peantus. A system was designed whereby a gas chromatographic volatile profile could be obtained from roasted peanuts. Volatile profile differences were observed for processing, storage, and varietal changes. Corresponding flavor profile evaluations related volatile profile differences to flavor and the other variables. The potential of using these approaches to objective peanut flavor evaluation is examined.

## 70

FLAVOR OF OLIVE OIL. ENZO FEDELI and GIOVANNI JACINI, Stazione Sperimentale per le Industrie degli Olii e dei Grassi (Oil and Fat Industries Experiment Station), 79, Via Giuseppe Colombo, 20133 Milan, Italy.

Among edible oils, a peculiar position is held by olive oil as one of the few that can be consumed as such, requiring no refining processes whatever. The so called "virgin" oil has a peculiar flavor of its own which varies noticeably from one cultivar to another to the point that professional tasters can determine an oil's origin from its flavor. The Milan (Italy) Oil and Fat Industries Experiment Station has been engaged for several years now in a research program on flavoring components of olive oil, i.e., such compounds which are volatile under certain conditions. Very little is known, instead, of the oil's taste affecting components. The Oil and Fat Industries Experiment Station's research results in this specific field are summarized and discussed, together with its future scope and the applications of such findings.

## 71

25 YEARS OF FLAVOR RESEARCH IN A FOOD INDUSTRY. J.G. KEPPLER, Unilever Research, PO Box 114, Vlaardingen, The Netherlands.

In the last few decades, flavor research has developed along different main routes. The first step was the discovery of the complex mixtures of volatile components that together build the particular flavors. Apart from this, interest became focused on the taste substances which, through interaction with the flavor carriers, impart aroma to a food. The third main route was investigation of the deterioration in odor and taste due to oxydative or microbial spoilage. As these investigations progressed, it became clear that these flavor areas show considerable interaction and that, in addition, other sensory impressions of a product as regards shape, texture, color, etc., play a role in the ultimate subjective perception by the consumer. In this way, flavor research has widened into a complex branch of science, and it is becoming more and more apparent that consumer testing that encompasses all the elements mentioned above will have to indicate the real preferences of the public.

## 72

ROLE OF FATS IN IRRADIATION-INDUCED FLAVORS. W.W. NAWAR, Department of Food Science and Nutrition, University of Massachusetts, Amherst, MA 01002.

When fat-containing foods are exposed to high energy radiation, lipid oxidation is enhanced. The decomposition compounds produced from the lipids and the off-flavors which develop are not very different from those arising from nonoxidative rancidity of nonirradiated foods. Ionizing radiation, however, induces a unique nonoxidative breakdown in the lipid fraction of food, resulting in numerous decomposition products. Although a typical irradiation off-flavor is developed, no definite correlation has been established between specific compounds and the off-flavor. The formation of certain compounds which may contribute to the irradiation flavor will be discussed.

## 73

EPA REFINERY ASPECTS. GILES FARMER, Anderson Clayton Foods, PO Box 6165, Dallas, TX 75222.

Abstract not available at press time.

## 74

EPA SOYBEAN PROCESSING PLANTS AND DESIGN. W.A. COOMBES, Blaw Knox Chemical Plants Division, Dravo Corporation, No. 1 Oliver Plaza, Pittsburgh, PA 15222.

Abstract not available at press time.

## 75

OSHA GOOD MANUFACTURING PRACTICES FOR OILSEED PROCESSING. RICHARD FENTEM, Lauhoff Grain Company, Danville, IL 61832.

Abstract not available at press time.

## 76

OSHA REFINERY ASPECTS. (*Speaker to be designated.*)

Abstract not available at press time.

## 77

COMPARISON OF METHODS FOR SCREENING LIPASE ACTIVITY IN RICE-BORNE MICROORGANISMS. ANTHONY J. DE LUCCA, II, and ROBERT L. ORY, Southern Regional Research Center, ARS, USDA, PO Box 19687, New Orleans, LA 70179.

Brown (unmilled) rice is known to have better nutritional value than white (milled) rice, but shelf life problems have limited its wider use as a food. One of these problems concerns the formation of free fatty acids and lipid derived off-flavors. As part of an investigation into the effects of growing areas, environment, and variety on lipid composition of commerical rices, the lipolytic systems that might be implicated in free fatty acid formation in rice are being examined. This report will describe two methods being used to screen microorganisms adhering to rough rice and to identify those with high lipase activity: (1) a screening method for differentiating lipolytic and nonlipolytic bacteria from rough rice in petri plates containing tributyrin-based agar as a substrate, and (2) a clinical method used to identify members of the family Enterobacteriaceae, adapted to identify high lipase producing bacteria from rice. A comparison of two media used to differentiate between lipolytic and nonlipolytic bacteria, as well as results obtained on different rice samples, will be presented.

## 78

LIPOLYTIC ACTIVITY IN DENTAL TISSUES. KATHLEEN E. MCMAHON, ROBERT E. PITAS, and ROBERT G. JENSEN, Department of Nutritional Sciences, U-17, University of Connecticut, Storrs, CT 06268.

The endogenous pulp from unerupted calves' teeth was found to contain low levels of glycerol ester hydrolase activity. Dispersions in tris(hydroxymethyl)aminomethane buffer cleared tributyryl glycerol agar and hydrolyzed emulsified olive oil, producing diacylglycerol and free fatty acids. Specific activities (m kat/kg protein) obtained from the latter assays ranged from 0.109 to 0.407. It is hypothesized that the released acids could be oxidized to provide energy for collagen biosynthesis.

## 79

INFLUENCE OF DIET ON CONVERSION OF $^{14}C_1$-LINOLENIC ACID TO DOCOSAHEXAENOIC ACID IN THE RAT. B.P. POOVAIAH, J. TINOCO, and R.L. LYMAN, Department of Nutritional Sciences, University of California, Berkeley, CA 94720.

$^{14}C_1$-linolenic acid was incorporated into lipids of hearts, livers, and carcasses of male rats. We studied the influence of diet composition on extent and distribution of radioactivity. A CHOW diet; a purified essential fatty acid-deficient diet; a purified control diet; and essential fatty acid-deficient diets with four fatty acid supplements were used. Supplements of 18:2n6, 20:4n6, 18:3n3, and 22:6n3 were given as single doses. Radioactivities in liver phosphatidylethanolamines, phosphatidylcholines, and neutral lipids were measured. The distribution of radioactivity among the fatty acids in liver phospholipids was determined. Rats on CHOW diet incorporated far less radioactivity than any other group into lipids of hearts and livers. Most of the activity in livers was recovered as 20:5n3 and 22:6n3, in all rats. In essential fatty acid-deficient rats, the radioactivity in 22:6n3 of liver phosphatidylethanolamine was still increasing 36 hr after $^{14}C_1$-linolenic acid had been administered. The n-6 supplements (18:2n6 and 20:4n6) seemed to reduce the conversion of 20:4n3 to 20:5n3 (desaturation), while the n-3 supplements (18:3n3 and 22:6n3) reduced the conversion of 20:5n3 to 22:5n3 (elongation). The formation of 22:6n3 may be controlled by 22:6n3 itself at the elongation of 20:5n3 to 22:5n3.

## 80

SOME DETAILS OF ISOMERIC MONOETHYLENIC FATTY ACIDS IN MONKEY FECES AND DEPOT FATS. R.G. ACKMAN, C.A. EATON, and J.S. SIPOS, Environment Canadian Fisheries and Marine Sciences Laboratory, Halifax, Nova Scotia, Canada B3J 2R3.

The feces of a primate (*Macaca fascilaris*) on a high fat diet show C-22 monoethylenic fatty acids of both exogenous and endogenous origins. These may be studied in lesser or greater detail by open tubular gas liquid and other chromatographic techniques. The distribution of the unusual monoethylenic acids in some primate lipids and organs will be discussed.

## 81

SPECIFIC CONTROL OF HEPATIC LIPOGENESIS EXERTED BY DIETARY LINOLEATE AND LINOLENATE. S.D. CLARKE, D.R. ROMSOS, and G.A. LEVEILLE, Food Science and Human Nutrition Department, Michigan State University, East Lansing, MI 48824.

These experiments were designed to examine the contention that polyunsaturated fatty acids specifically inhibit hepatic and adipose lipogenesis in rats under essential fatty acid-deficient and essential fatty acid-adequate conditions. Differences in digestibility ($C_{18:0}$, 40; $C_{18:0}$, 35; $C_{18:1}$, 88; $C_{18:2}$, 87; $C_{18:3}$, 89%) among fatty acid methyl esters often are overlooked as factors. After compensation for digestibility differences and in the presence of constant intake of fat free diet, the addition of 3% $C_{18:2}$ or $C_{18:3}$ esters to fat free diet for eight meals (3 hr per day) precipitated a 50% reduction in the in vivo rate of $^3H_2O$ incorporation into rat liver fatty acid and in fatty acid synthetase, glucose-6-phosphate dehydrogenase, and malic enzyme activities; 7% $C_{16:0}$ was without effect. The inclusion of 3% fatty acid esters in a constant daily allotment of an essential fatty acid-adequate diet (1% safflower oil) resulted in in vivo rates of fatty acid synthesis of 4207, 3105, 2455, and 1990 $dpm^3H\ g^{-1}$ liver $10\ min^{-1}$; hepatic fatty acid synthetase and glucose-6-phosphate dehydrogenase activities (nmoles reduced nicotinamide adenine dinucleotide phosphate or reduced nicotinamide adenine dinucleotide $mg^{-1}\ min^{-1}$) of 12, 110; 11, 82; 8, 47; and 8, 50 for basal, $+C_{18:1}$, $+C_{18:2}$ and $+C_{18:3}$, respectively. In all experiments, adipose tissue lipogenesis remained unchanged. These data demonstrate that $C_{18:2}$ and $C_{18:3}$ specifically control hepatic lipogenesis and the effect is not a product of essential fatty acid-deficient diets. Such an effect requires three meals of fatty acid supplementation. When fat free diet was supplemented with either 7% $C_{16:0}$, 8% $C_{18:0}$, 3% $C_{18:2}$, or 3% $C_{18:3}$ for one or two meals, in vivo incorporation of $^3H_2O$ and/or $1\text{-}^{14}C$-acetate into rat liver fatty acid remained essentially unaltered. After three meals, rats fed fat free diet plus 3% $C_{18:2}$ or $C_{18:3}$ had incorporated 6634, 6125 $dpm^3H$ and 7033, 6359 $dpm^{14}C\ g^{-1}$ liver $15\ min^{-1}$, respectively; while fat free and +8% $C_{18:0}$ groups incorporated 9846, 8129 $dpm^3H$ and 8371, 9157 $dpm^{14}C\ g^{-1}$ liver. Hepatic fatty acid synthetase was also significantly depressed after three meals of $C_{18:2}$ or $C_{18:3}$, but glucokinase activity was unchanged among treatments. In contrast to cell culture data ($C_{18:0}$ most potent lipogenic inhibitor), dietary $C_{18:2}$ or $C_{18:3}$, in the presence of an equivalent quantity of absorbed CHO and fatty acid esters among treatments, specifically depresses in vivo hepatic lipogenesis in meal fed rats. (This work was supported in part by NIH HL 14677 and K04 AM 00112.)

## 82

LIPID COMPOSITION OF BOVINE MILK FAT GLOBULES WITH INCREASED POLYUNSATURATED FATTY ACIDS. L.M. SMITH, D.H. BIANCO, and W.L. DUNKLEY, Department of Food Science and Technology, 3450 Chemistry Addition, University of California, Davis, CA 95616.

By feeding "protected lipid" supplements to dairy cows, the percentage of linoleic acid in milk fat can be readily increased from ca. 2% to 20–30%. In this study, comparisons were made of the composition and distribution of the lipids in fat globules from conventional and polyunsaturated milks. Washed creams were prepared from the milks of three individual cows fed a protected sunflower-soybean supplement and from three fed a conventional ration, and were fractionated by treatment with sodium deoxycholate and centrifugation. Each washed cream and four fractions (designated as outer fat globule membrane, inner membrane, pellet, and globule core) were analyzed for protein, lipid, phospholipid, cholesterol, tocopherols, carotenoids, and fatty acid composition. The outer and inner fractions were further fractionated into neutral and polar (phospholipids) classes by thin layer chromatography. For both types of washed cream, the approximate wt distribution was outer membrane, 1%; inner membrane, 2%; pellet, 0.1%; and core, 96%. The percentages of protein, phospholipid, cholesterol, and carotenoids were all lower in the polyunsaturated creams. Also, the concentration of phosphatidyl cholines was less in the outer membrane of the polyunsaturated globules than in the corresponding fraction of the conventional globules. In the saturated and unsaturated fatty acids of the various fractions from the polyunsaturated creams, the percentages of $C_{18}$ acids increased, with compensating decreases in $C_{16}$ and acids of shorter chain length. A greater increase (+19%) in linoleic acid occurred in the core fraction of the polyunsaturated creams than in the total lipids of the outer (+14%) and inner (+15%) membrane fractions. The phospholipids in the outer and inner membranes from the polyunsaturated milks had a larger proportion of linoleic acid than the phospholipids from the conventional milks. However, this increase in unsaturation was less than that of the core neutral lipids. Pancreatic lipase hydrolysis of the core fractions showed that the increased linoleic acid was introduced preferentially at the 2-position of the triglycerides. In general, the differences in the relative proportions of the various classes of lipids are consistent with observed changes in physical properties and in susceptibility of polyunsaturated milk to the development of oxidized flavor.

## 83

FEEDING OR ABOMASAL ADMINISTRATION OF POLYUNSATURATED VEGETABLE OILS TO LACTATING COWS. T.R. WRENN, APGI-Nutrient Utilization Lab, ARS, USDA, Bldg. 161, ARC-East, Beltsville, MD 20705, H.K. GOERING, NI-Ruminant Nutrition Lab, ARS, USDA, Bldg. 200, ARC-East, Beltsville, MD 20705, L.F. EDMONDSON, Dairy Lab, Eastern Regional Research Center, ARS, USDA, 600 E. Mermaid Lane, Philadelphia, PA 19118, J.R. WEYANT, D.L. WOOD, and JOEL BITMAN, APGI-Nutrient Utilization Lab, ARS, USDA, Bldg. 161, ARC-East, Beltsville, MD 20705.

Holstein cows on concentrate:hay diets were fed supplements of soybean oil plus casein (SBO), soybean oil protected from ruminal hydrogenation by encapsulation in a casein-formaldehyde coat (SBO-F), cottonseed oil plus casein (CSO), or cottonseed oil protected with casein-formaldehyde (CSO-F) for 14 days. The supplements were fed at rates calculated to give a linoleic acid intake of 225 g/day. Milk, fat, and protein yields were not significantly affected by treatment. Milk 18:2 was not increased by the unprotected SBO and CSO, but SBO-F and CSO-F increased 18:2 from 2% to 6%. Milk 18:1 and 18:0 also increased significantly. Compensatory declines were observed in milk palmitic and myristic acids. Rumen and feces fatty acids during the treatment periods showed a decrease in 18:2 and marked increases in 18:1 and 18:0, indicating hydrogenation of the dietary oils in the alimentary tract. Rumen and feces 16:0 and 14:0 decreased. Hydrolysis of the formaldehyde protective coating is minimal at the high pH of the rumen but is accelerated at the low pH of the abomasum, thus freeing the polyunsaturated oils for absorption without microbial hydrogenation. Trial experiments were conducted with an abomasally fistulated cow to simulate this process and bypass the rumen. After control periods, soybean, cottonseed, safflower, or corn oil was infused abomasally over 8-hr periods at the rate of 225 g/day C18:2. Milk 18:2 increase was very similar to that observed when protected oils were ingested, although the onset of the increase in 18:2 was more rapid. In contrast to the pattern observed after feeding, increases in 18:0 and 18:1 and decreases in 16:0 and 14:0 were not observed, due either to lack of exposure to hydrogenating microorganisms in the rumen or to short single infusions as compared to constant dietary loads.

## 84

CHARACTERIZATION OF SUBFRACTIONS DERIVED FROM PURIFIED MYELIN ISOLATED FROM MOUSE BRAIN. LINDA D. SHEADS, MICHAEL J. EBY, and JOSEPH SAMPUGNA, Chemistry Department, University of Maryland, College Park, MD 20742.

Purified myelin isolated from mouse brain was separated on discontinuous sucrose density gradients into seven bands and a pellet. The distribution of myelin among the subfractions, as monitored by absorbance at 280 nm, was reproducible at any given age; however, compared to myelin isolated from older mice, younger myelin always contained significantly greater proportions of material banding at lesser sucrose densities. Examination of the absolute amount of protein in each subfraction revealed that young myelin was actually deficient in the heavier myelin subfractions. Consistent differences among the subfractions were noted when the myelin protein patterns were examined by gel electrophoresis. In addition, there was a higher percentage of total lipid in subfractions banding at lighter density sucrose layers. Analyses of lipid classes failed to reveal any differences among the subfractions with regard to the molar proportions of cholesterol:phospholipid:galactolipid:sulfatide. However, all subfractions isolated from younger mice contained significantly higher ratios of both cholesterol and phospholipid relative to galactolipid compared to subfractions isolated from older animals. Studies of lipid turnover in the myelin fractions indicated that, relative to the heavier subfractions, radioactivity appeared to accumulate in subfractions banding at lighter density sucrose layers; however, there was no clear cut evidence for product-precursor relationships among the subfractions studied. Preliminary studies of myelin subfractions isolated from different areas of the brain revealed that hind brain, compared to the cerebrum or midbrain, contained proportionally more myelin which banded at lighter density sucrose layers. Thus, one explanation for the different banding patterns observed between young and mature myelin may be the different proportions of myelin in the various regions of the brain at different ages.

## 85

SYNTHESIS AND STUDY OF LARGE RING CYCLOALKENE-1-CARBOXYLIC ACIDS. A. SILVEIRA, JR., Chemistry Department, 219A Snygg Hall, State University of New York, College at Oswego, Oswego, NY 13126, Y.R. MEHRA, Chemistry Department, University of Denver, Denver, CO 80210, and W. ATWELL, Chemistry Department, 219A Snygg Hall, State University of New York, College at Oswego, Oswego, NY 13126.

Convenient methods for the preparation of large ring cycloalkene-1-carboxylic acids have not been available. These acids are of interest to other workers because compounds of this type structure and their salts that have been successfully synthesized have been shown to be very powerful cholertics. Also, these compounds have been used in the treatment of heptovascular conditions and hepatic insufficiency, and their esters are of interest in the preparation of perfumes. This paper will present a general method of synthesis of cycloalkene-1-carboxylic acids. The general synthesis used involved reaction of the appropriate cycloalkanone with sodium hydride and diethyl carbonate to form the respective $\beta$-ketoester. The $\beta$-ketoesters were converted to the corresponding pyrazolone by the reaction of hydrazine, then were chlorinated to form the appropriate 4-chloropyrazolone. Treatment of the resultant chloro product with dilute aqueous alkali gave the desired cycloalkene-1-carboxylic acid derivatives. Specifically, *trans* cyclononene-1-carboxylic acid, *trans* cyclodecene-1-carboxylic acid, *cis* and *trans* cycloundecene-1-carboxylic acids, and *cis* and *trans* cyclododecene-1-carboxylic acids were synthesized by this general method. The structure assigned to the final acid products was deduced using infrared, ultraviolet, and especially nuclear magnetic resonance evidence. In the case of *cis* and *trans* cycloundecene-1-carboxylic acids, structure elucidation was substantiated by synthesizing these acids by an alternate route and comparing spectral and chromatographic data of the products with those obtained from the chloropyrazolones. The versatility of the reaction will be discussed together with essential experimental conditions needed to give optimum yields of products. A proposed mechanism of the product forming reaction will be presented, and important properties of these acids will be briefly outlined.

## 86

CHEMISTRY OF AFLATOXIN INACTIVATION. F.G. DOLLEAR, E.T. RAYNER, and L.P. CODIFER, JR., Southern Regional Research Center, ARS, USDA, PO Box 19687, New Orleans, LA 70179.

Chemicals which have been found to inactivate aflatoxins include oxidizing agents, acids, bases, and aldehydes. The conditions required for chemical inactivation of aflatoxin in products such as contaminated oilseed meals using the more effective reagents are reviewed. The chemistry of inactivation with reagents such as ammonia and alkalis is presented from the standpoint of reaction with aflatoxin or compounds of similar structure where products have been identified. Reactions that have been proposed or postulated are discussed. The biochemical approach to aflatoxin inactivation is reviewed briefly. Evidence of aflatoxin inactivation is generally obtained initially by thin layer chromatography. Confirmation of chemical evidence by biological testing is required for ultimate evaluation of any proposed inactivation process.

## 87

SEPARATION OF AFLATOXIN-CONTAMINATED COTTONSEED BY PHYSICAL CHARACTERISTICS OF THE GINNED SEED. LOUISE S. LEE, ALVA F. CUCULLU, and WALTER A. PONS, JR., Southern Regional Research Center, ARS, USDA, PO Box 19687, New Orleans, LA 70179.

Because aflatoxin content of samples of ginned whole cottonseed is associated with a few highly contaminated seed,

efforts were made to determine the physical characteristics associated with such seed. Several composite samples of seed containing 200–300 parts per billion total aflatoxins were separated according to appearance of the seed in ultraviolet and in daylight and categorized as (a) bright yellow-green fluorescence (termed cateye), (b) partially bald plus cateye, (c) partially bald no cateye, (d) discolored, usually yellow linted seed, (e) thin linted seed, and (f) remaining good seed. The highest percent of total aflatoxins was contained in categories (b) and (c). Segregation of the seed in these two categories removed only 5% of the total sample, yet reduced the aflatoxin content by 75%, whereas removal of seed exhibiting any cateye fluorescence, (a) and (b), reduced the aflatoxin content by only 17%. Elimination of all seed exhibiting the balding characteristic, in addition to those exhibiting cateye fluorescence, may prove a practical and effective method for reducing the aflatoxin content of cottonseed samples.

## 88

PROCESSING EDIBLE PEANUT PROTEIN CONCENTRATES AND ISOLATES TO INACTIVATE AFLATOXINS. KHEE-CHOON RHEE, Food Protein R&D Center, Texas A&M University, College Station, TX 77843, K.R. NATARAJAN, Presidency College, India, CARL M. CATER, and KARL F. MATTIL, Food Protein R&D Center, Texas A&M University, College Station, TX 77843.

Frequent contamination of peanuts with aflatoxins has caused a serious problem for the peanut industry in utilizing peanut products as a source of low cost protein ingredients in various foods. Therefore, several measures have been applied or proposed for removal or detoxication of aflatoxins in peanuts and other agricultural commodities. One of the most promising methods is to apply processing methods that detoxicate aflatoxins in contaminated peanuts. Over the years, it has been shown that some oxidizing or other reactive chemicals have the potential to destroy or detoxicate aflatoxins under certain processing conditions. The thrust of our investigation was therefore geared to the use of various chemicals in conjunction with the aqueous extraction process for the production of peanut protein concentrates and/or isolates directly from raw peanuts. The chemicals tested include acetone, hexane, isopropyl alcohol, methylamine, hydrogen peroxide, chlorine gas, ammonia gas, and sodium hypochlorite. Among these chemicals, hydrogen peroxide, chlorine gas, ammonia gas, and sodium hypochlorite showed very effective destruction of aflatoxins during the aqueous extraction process of peanuts. However, the use of chlorine gas and ammonia gas required high process temperatures to be really effective and also a careful manipulation of process steps to prevent the escape of these harmful gases, whereas hydrogen peroxide and sodium hypochlorite are as effective at room temperature as at elevated temperatures. It was therefore concluded that aflatoxins can be effectively detoxicated during wet processing of peanuts by properly utilizing either sodium hypochlorite or hydrogen peroxide to produce either peanut protein concentrates or isolates.

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PROCESSING CONDITIONS FOR INACTIVATING AFLATOXINS IN COTTONSEED MEAL BY AMMONIATION. STANLEY P. KOLTUN, ERIC T. RAYNER, and JAMES I. WADSWORTH, Southern Regional Research Center, ARS, USDA, PO Box 19687, New Orleans, LA 70179.

Aflatoxin contaminated cottonseed meal can be detoxified by treatment with anhydrous ammonia under pressure. Although there are commercial plants equipped to detoxify aflatoxin contaminated cottonseed meal by ammoniation, information is needed to establish the optimum conditions of ammoniation to determine more practical processing parameters, minimize damage to nutrients, reduce cost, and avoid pollution. In pilot plant runs, contaminated cottonseed meal at constant percent moisture level was ammoniated at varying levels of ammonia pressure, reaction time, and temperature. Data obtained from these runs were analyzed by statistical methods and computer technology, and a preliminary mathematical model was developed relating the processing parameters and interactions on the reduction of aflatoxin levels.

## 90

SOLVENT EXTRACTION OF AFLATOXINS FROM CONTAMINATED AGRICULTURAL PRODUCTS. ERIC T. RAYNER and STANLEY P. KOLTUN, Southern Regional Research Center, ARS, USDA, PO Box 19687, New Orleans, LA 70179.

Solvent extraction of agricultural products has been suggested as an effective means of removing aflatoxins from mold damaged commodities. The use of various polar solvents such as the azeotrope of acetone-hexane-water, aqueous acetone, aqueous ethanol, and the azeotrope of 2-propanol-water, has been reported in the literature. This paper examines the overall aspects of solvent extraction, with particular emphasis on the use of azeotrope of 2-propanol-water, for removing aflatoxins in prepressed, solvent extracted cottonseed meal.

## 91

A RAPID SCREENING METHOD FOR THE AFLATOXINS AND OCHRATOXIN A. CHARLES E. HOLADAY, National Peanut Research Laboratory, PO Box 637, Dawson, GA 31742.

A rapid minicolumn procedure for screening a wide range of products for the aflatoxins and ochratoxin A is presented. High speed blending of the sample with aqueous methanol followed by purification with zinc sulfate and phosphotungistic acid and reextraction with benzene before subjecting to minicolumn chromatography is a simple, economical, and rapid method for the detection of the aflatoxins and ochratoxin A. Sensitivities of 4 parts per billion for the aflatoxins and 8 parts per billion for ochratoxin A can be achieved, and the use of disposable plastic and glass items makes the method practical for field or in-plant applications.

## 92

TYPE AND LEVEL OF DIETARY FAT, VITAMIN E DEFICIENCY, AND CHRONIC AFLATOXIN TOXICITY. R.B. ALFIN-SLATER, L. AFTERGOOD, A. ALEXANDER, and P. WELLS, UCLA School of Public Health, 405 Hilgard, Los Angeles, CA 90024.

To further elucidate the basic mechanisms of aflatoxin action and to determine whether certain dietary modifications might alter aflatoxin toxicity, the effects of graded levels of two different Vitamin E-stripped fats, one primarily saturated (lard) and one primarily unsaturated (corn oil), with and without the addition of Vitamin E, on chronic aflatoxin toxicity in rats fed an otherwise nutritionally adequate diet were studied. Male weanling rats were fed 1.7 ppm aflatoxin $B_1$ for 3 months and then maintained on aflatoxin free diets for 9 months to allow time for tumor development. Inhibition of growth resulted from both aflatoxin administration and also from Vitamin E deficiency. Among the Vitamin E deficient rats, however, aflatoxin administration did not interfere with wt gain as severely as among the Vitamin E sufficient rats. At high levels of fat intake, the aflatoxin induced reduction in wt gain was eliminated completely in both groups. With the exception of liver, wts of various organs were unaffected by aflatoxin administration. Wts of liver reflected tumor involvement and in all cases, as the fat content of the diet increased, aflatoxin induced liver pathology decreased. This was most significant among the Vitamin E deficient rats fed high levels of corn oil. Aflatoxin administration caused increases in levels of plasma cholesterol, regardless of the type or quantity of fat in the diet. This effect was most pronounced in rats on Vitamin E supplemented, lard containing diets and was least pronounced on Vitamin E deficient, corn oil containing diets. Aflatoxin administration also resulted in marked increases in liver cholesterol among Vitamin E sufficient rats fed moderate and high levels of lard and among all rats consuming fat free diets. In tumor tissue, the percent of free cholesterol was generally lower than in liver tissue; this was most pronounced in rats fed corn oil containing diets. Under the experimental conditions employed here, high fat diets were found to exert a protective action against aflatoxin toxicity. The protective effect was most pronounced when the diet was Vitamin E deficient and contained corn oil as the fat source.

## 93

DIETARY INTERVENTION. DAVID KRITCHEVSKY, The Wistar Institute, 36th & Spruce Sts., Philadelphia, PA 19104.

Abstract not available at press time.

## 94

INTERVENTION STUDIES. W. FRIEDEWALD, NIH Heart Institute, Bethesda, MD.

Abstract not available at press time.

## 95

CORONARY DRUG PROJECT. KENNETH BERGE, Mayo Clinic, Rochester, MN.

Abstract not available at press time.

## 96

SURGICAL INTERVENTION. HENRY BUCHWALD, University of Minnesota, Minneapolis, MN 55455.

Abstract not available at press time.

## 97

FDA CONSIDERATIONS REGARDING NEW HYPOLIPIDEMIC AGENTS. MARIAN J. FINKEL, Food and Drug Administration, Rockville, MD.

Abstract not available at press time.

## 98

ANALYSIS OF VEGETABLE OILS FOR FLAVOR QUALITY BY DIRECT GAS CHROMATOGRAPHY. H.P. DUPUY, E.T. RAYNER, and J.I. WADSWORTH, Southern Regional Research Center, ARS, USDA, PO Box 19687, New Orleans, LA 70179.

Samples of vegetable oil were placed in gas chromatograph inlet liners that were especially packed with glass wool. The liner was taken, then secured in the heated inlet of the gas chromatograph. Volatiles from the oil were eluted onto the column as the carrier gas flowed through the sample. After removing the liner with spent sample, profiles of volatiles were obtained by temperature programming the column oven between 30–190 C. Some of the volatile components considered separately and multiple volatile components considered together correlate well with oil flavor score.

## 99

MEASURING FLAVOR DETERIORATION OF FATS, OILS, DRIED EMULSIONS, AND FOODS. JOSEPH A. FIORITI, General Foods Technical Center, General Foods Corp., 250 North St., White Plains, NY 10625.

Past work has shown that most of the common methods (peroxide value, active oxygen method, pentane value, etc.) are sufficient to indicate flavor deterioration of many of the commonly used fats and oils. Subsequently, it has been found that in a model system containing carbohydrate, oil, and protein (a dried emulsion) off-flavor development more nearly parallels oxygen absorption and total carbonyl development. In the case of foods (bread crumbs, snack items, etc.), considerable oxidation has to take place before noticeable flavor deterioration occurs. Concomitant processes such as $CO_2$ evolution and loss of the natural food flavor are often indicative of the reactions on hand. Some of these will be detailed and discussed.

## 100

A QUALITY CONTROL PROCEDURE FOR THE GAS LIQUID CHROMATOGRAPHIC EVALUATION OF THE FLAVOR QUALITY OF VEGETABLE OILS. HELEN ZMACHINSKI and ARTHUR E. WALTKING, CPC International Inc., Best Foods Research Center, 1120 Commerce Avenue, Union, NJ 07083.

An objective procedure that is relatively simple and rapid is under study for the determination of the flavor quality of vegetable oils. This procedure utilizes the direct injection of an oil sample to which has been added an internal standard, into a packed precolumn of a gas chromatograph. The volatiles are swept from the precolumn through a 10% SE-30 column under operating parameters which permit complete elution of all volatiles and internal standard within 20 min. Some 15–20 samples can be evaluated in 1 day before it is necessary to replace the foot long precolumn. Evaluations have been made by the gas liquid chromatographic procedure and by a flavor panel of oil samples subjected to a variety of storage conditions. Generally, differences in the gas liquid chromatographic pattern are reflected in the flavor panel results.

## 101

ROUND TABLE DISCUSSION: INSTRUMENTAL ANALYSIS OF FLAVOR AND FLAVOR STABILITY OF FATS AND OILS. T.H. APPLEWHITE, Edible Oil Products Laboratory, Kraftco Corporation, 801 Waukegan Rd., Glenview, IL 60025.

Some of the advantages and disadvantages of the instrumental methods suggested in the literature as applicable to the flavor and flavor stability of fats and oils will be discussed. Correlation with classical sensory evaluation techniques is a severe test and appears to be a chief limitation to the development and acceptance of such analytical methodology.

## 102

EVALUATION OF FAT AND OIL FLAVOR QUALITY BY GAS LIQUID CHROMATOGRAPHY USING A SELECTIVE

ADSORPTION DESORPTION TECHNIQUE. J.A. KIRKPATRICK and G.A. JACOBSON, Campbell Institute for Food Research, Campbell Place, Camden, NJ 08101.

There has been a need for many years for an objective instrumental test for evaluating the flavor of fat and oil products sold in commerce. The estimates of the flavor quality of various fats and oils of the supplier and purchasing company or consumer do not always agree, and this disparity between laboratories or individuals can be compounded by changes in flavor that take place during delivery of the fat and oil products. A test has been devised which will help "grade" oils by means of gas liquid chromatography. Preparation for gas liquid chromatography separation consists of the following: nitrogen or helium stripping of the heated fat or oil, with adsorption of the volatiles on the adsorbent Tenax GC; transfer of the heated Tenax GC to the glass liner of the injection port of the gas chromatograph; desorption of volatiles from the Tenax GC in the heated injection port; and separation of flavor components on a suitable column, such as 100 ft SCOT-DEGS column. This procedure has been useful for studying changes in the flavor score and volatile pattern of oils, such as lightly hydrogenated soybean oil exposed to different degrees of light; frying fat used to fry potatoes; and other fat and oil applications. Examples of the above experiments will be shown.

## 103

DETERMINATION OF FLAVOR SCORES OF FATS AND OILS BY INSTRUMENTAL METHODS. THOMAS H. SMOUSE, JAMES K. MAINES, and JOHN W. BODDIE, Anderson Clayton Foods, PO Box 63, Richardson, TX 75080.

The sensation of flavor is very sensitive, rapid, and direct. It does not need the extraneous isolation, concentration, and measuring techniques that are necessary with all instrumental methods. Although an organoleptical evaluation has many excellent characteristics, it lacks the precision and reproducibility of an instrumental method. Therefore, it is necessary to obtain many observations collected under careful supervision to yield statistically sound data. By aging samples of soybean oil and repetitive tasting at specific intervals, various chemical methods have been compared with flavor scores obtained on the same samples. The correlation of each method with flavor scores will be presented. Also, several chromatographic methods have been studied simultaneously to evaluate the flavor quality of soybean oil. The methods are gas chromatography of the volatiles from the oil samples obtained by (1) direct helium stripping, (2) vacuum degassing and condensation, and (3) nitrogen stripping and adsorption. The differences between these methods and their degree of predicting the flavor scores of the soybean oil samples will be presented.

## 104

ESSENTIAL FATTY ACID DEFICIENCY IN EXPERIMENTAL CANINE ATHEROSCLEROSIS. ALLEN EHRHART, ANTANAS BUTKUS, and KEITH MCCULLAGH, Research Division, The Cleveland Clinic Foundation, 9500 Euclid Ave., Cleveland, OH 44106.

Atherosclerosis was induced in adult dogs by feeding an essential fatty acid deficient diet for 1 year without suppression of thyroid function. Lipid constituents of the diet were 16% hydrogenated coconut oil and 5% cholesterol, with linoleic acid comprising $< 0.2\%$ of the total fatty acids. Plasma cholesterol levels rose to a mean of 1250 mg/dl and remained elevated throughout the period of dietary feeding. Visible lesions were found in the coronary, cerebral, mesenteric, and femoral arteries and were more prevalent in the abdominal than in the thoracic aorta. A diet identical to the atherogenic diet with the exception of replacement of 4% of the hydrogenated coconut oil with 4% safflower oil was fed to a second group of eight dogs for 1 year. Plasma lipids were only slightly elevated in these animals, compared to the hyperlipidemia observed in dogs fed the essential fatty acid deficient diet. Atherosclerotic lesions were absent after 1 year. Atherosclerosis was thus abolished in dogs receiving the essential fatty acid supplement despite ingestion of a diet containing the same amounts of fat and cholesterol as the atherogenic diet.

## 105

TISSUE LIPIDS IN EXPERIMENTAL CANINE ATHEROSCLEROSIS. ANTANAS BUTKUS and ALLEN EHRHART, Research Division, The Cleveland Clinic Foundation, 9500 Euclid Ave., Cleveland, OH 44106.

Severe atherosclerosis was produced in dogs by feeding semisynthetic diet containing 5% cholesterol and 16% hydrogenated coconut oil (diet A) Atherosclerotic lesions were absent in dogs on diet B which differed from A only in that one-quarter of hydrogenated coconut oil was replaced by safflower oil. Group C ate a controlled diet of meat and kibble. Diet A contained no essential fatty acids whereas diets B and C contained sufficient amounts of linoleic acid to satisfy established nutritional requirements. All dogs of group A had profound elevations in plasma lipid concentrations when compared with dogs of group C. Dogs of group B had moderate increases. The largest elevation occurred in cholesteryl esters of group A. The predominant cholesteryl ester in the plasma of group A was cholesteryl oleate. In contrast, the major plasma cholesteryl ester of groups B and C was linoleate. Intimamedia from atherosclerotic aortic segments showed large increases in lipid concentration. The bulk of the increase was due to the accumulation of cholesteryl esters, and the major cholesteryl ester within the lesion was oleate. The predominant cholesteryl ester in the normal intimamedia of groups B and C was cholesteryl linoleate. Fatty acid analyses suggested that much of the lesion cholesteryl ester was derived from plasma, but preferential accumulation of cholesteryl oleate and eicosatrienoate suggested that there was also considerable local cholesteryl ester synthesis. Livers of group A showed profound elevation in cholesteryl ester and triglyceride concentrations as compared to livers of groups B and C. Livers of group B had moderate increases. As with plasma and sclerotic intimamedia of A, cholesteryl oleate increased most. In the absence of essential fatty acids, the dog apparently becomes intolerant of dietary cholesterol, resulting in hyperlipemia and atherosclerosis.

## 106

CHOLESTEROL STIMULATION OF LIPID ABSORPTION IN RABBITS. JOEL BITMAN, J.R. WEYANT, D.L. WOOD, and T.R. WRENN, Nutrient Utilization Laboratory, USDA-ARS-APGI, Bldg. 161, ARC-East, Beltsville, MD 20705.

Plasma cholesterol, lipids, and vitamin E were studied in rabbits fed chow diets for 12 weeks with or without 0.3% cholesterol and 10% fat from either commercial butter or safflower oil. The large difference in the saturated and unsaturated nature of these dietary fats—commercial butter, 3% 18:2, and safflower oil, 75% 18:2—provided a large difference in total 18:2 intake. The 10% commercial butter diet increased cholesterol two times, whereas 10% safflower oil did not. Both commercial butter and safflower oil increased vitamin E and lipids 1.5–2 times. The cholesterol diet alone caused increases of 10 times in cholesterol, 4 times in lipids, and 3 times in vitamin E. Inclusion of both fat and 0.3% cholesterol in the diet resulted in a synergistic effect, inducing much greater increases. Commercial butter plus cholesterol increased plasma cholesterol 12 times, lipids 7 times, and vitamin E 7 times. Safflower oil plus cholesterol increased plasma cholesterol 12 times and lipids 7 times, but increased vitamin E 14 times, probably due to the greater dietary content of vitamin E present in the added 10% safflower oil. In contrast to the large increases in plasma lipids induced by dietary cholesterol and 10% fat, red blood cell lipids did not change in any dietary group. The cholesterol diet, and cholesterol plus 10% fat diets, produced extensive aortic plaque development. Three comparative studies involving 10% fat and differing levels of dietary cholesterol, 0.3%, 0.5%, or 2%, demonstrated a definite dose-response relationship between dietary cholesterol and plasma cholesterol and lipids. When 10% fat was fed with 0.3%, 0.5%, or 2% cholesterol, plasma cholesterol attained constant levels at 8, 16, and 22 mg/ml, and plasma lipids were 20, 32, and 52 mg/ml, respectively. The nature of the fat, whether saturated or unsaturated, did not influence the plasma cholesterol or lipid levels attained. Our results suggest that the lipid mobilizing effect in rabbits is mediated by cholesterol.

## 107

LIPIDS OF CULTURED HEPATOMA CELLS: VIII. UTILIZATION OF 1-$^{14}$C-GLUCOSE IN CELLULAR AND MEDIA LIPID SYNTHESIS. CHARLES L. WELCH and RANDALL WOOD, Departments of Biochemistry and Medicine, University of Missouri, Columbia, MO 65201.

Minimal deviation hepatoma 7288C cells were cultured in serum-supplemented and serum-free Swim's 77 medium with 1-$^{14}$C-D-glucose for 1,2,4,8,12, and 24 hr. 1-$^{14}$C-glucose oxidation, incorporation into total cell mass, and incorporation into cellular and medium lipids was determined. Distribution of radioactivity into individual neutral lipids and phospholipids was followed as a function of time. Degradation studies of individual lipid classes were also performed to ascertain the percentage of radioactivity in acyl and glycerol moieties. In general, the amount of $^{14}$C-glucose oxidized, incorporated into cell matter, and more specifically, incorporated into cell lipids was elevated with cells cultured in serum free medium as opposed to serum supplemented medium. The distribution of radioactivity into cellular neutral lipid classes was ca. the same for both incubation media: sterols triglycerides free fatty acids sterol esters. The observed increase in incorporation of radioactivity into the lipids of serum-free cells was confined to the polar lipids, with phosphatidylcholine, phosphatidylinositol, and sphingomyelin containing much higher amounts of $^{14}$C than was found with the serum supplemented cells. Glycerol from all glyceride classes contained a higher percentage of radioactivity than the acyl moieties, with the percentage of radioactivity incorporated into glyceride fatty acids being significantly reduced in the cells incubated in serum free medium. The ratios of fatty acyl to glycerol radioactivity for phosphatidylserine and phosphatidylethanolamine were similar, suggesting a relationship, but were different from fatty acyl/glycerol ratios of the other glyceride classes. These data indicate that glucose is a source of glyceride glycerol but is not a good substrate for de novo fatty acid biosynthesis in this hepatoma.

## 108

STRAIN DIFFERENCES IN DEGREES OF HYPERLIPIDEMIA IN MICE BEARING EHRLICH ASCITES TUMOR. RAMASWAMY KANNAN and NOME BAKER, (691/151N), VA Wadsworth Hospital Center, Bldg. 115, Room 316, Wilshire & Sawtelle Blvds., Los Angeles, CA 90073.

Ehrlich ascites carcinoma growth in mice induces hypertriglyceridemia. The degree of hypertriglyceridemia found in one laboratory (Spector's) was much greater than we observed in our laboratory. Moreover, major differences were reported with respect to fasting (no effect on hypertriglyceridemia in Spector's tumor-bearing mice, marked decrease in ours) and triglyceride levels in the tumor extracellular fluid (high in his, low in ours). We have obtained tumorous CBA mice from Spector's laboratory and have studied them simultaneously with our Swiss-Webster mice. Triglyceride data from the above two groups and from two controlled crossover groups, included to evaluate the influence of mouse and tumor strains on hypertriglyceridemia, are as follows:

| | TRIGLYCERIDES (mg/dl) | | |
|---|---|---|---|
| Strains (Mouse-Tumor) | Tumorous Mice Plasma | Tumor Extracellular Fluid | Control Plasma |
| SW-Our | 449 ± 63 | 50 ± 9 | 169 ± 17 |
| CBA-Spector | 1032 ± 64 | 309 ± 72 | 264 ± 40 |
| SW-Spector | 453 ± 149 | 27 ± 9 | 96 ± 16 |
| CBA-Our | 1493 ± 114 | 346 ± 52 | 192 ± 37 |

The ad libitum-fed CBA mice had intense hypertriglyceridemia and high triglyceride levels in tumor extracellular fluid with both sources of ascites tumor. Thus, the variations in plasma and tumor extracellular fluid triglyceride levels probably arise from the mouse strains and not from the variations in tumor itself. A mouse strain difference was also evident from a significant decrease in wet wts of adipose tissues like epididymal fat, inguinal fat, and intermuscular fat with tumor growth in one strain (CBA) which was not observed in the other strain. Study of these strain differences may lead to an understanding of factors that regulate hyperlipidemia. (VA Project RI 3–60, MRIS No. 0790.)

## 109

FATTY CHAIN ELONGATION AND SHORTENING IN HUMAN HEART MITOCHONDRIA. WILLIAM J. FERRELL, Department of Pathology, University of Michigan, Ann Arbor, MI 48109, and KUO-CHING YAO, Mayo Clinic, Rochester, MN 55901.

Previous studies from our laboratory have shown that in human heart palmitaldehyde is rapidly oxidized to palmitic acid, which is then incorporated into other complex lipids. The present work was undertaken to study the fatty chain elongation and shortening processes of human heart mitochondria. Mitochondria were incubated with either palmitaldehyde-U-$^{14}$C or palmitaldehyde-1-$^{14}$C and appropriate cofactors. Lipids were

extracted and the fatty moieties analyzed by gas liquid chromatography, the various components being collected and their radioactivity determined. Appreciable amounts of radioactivity were found in both elongated and shortened free fatty acids and the acyl chains of cholesterol esters and polar lipids. The wt percentage composition of fatty acids from various lipid fractions showed increases in 10:0, 12:0, and 14:0 following incubation, with lauric acid being the predominant product. The use of palmitaldehyde U-$^{14}$C resulted in substantial incorporation into 20:2 and 20:4 acyl chains of polar lipids as well as chains $<$ 16:0 in the nonpolar lipids. Cofactor studies showed that the elongation process required acetyl-CoA and reduced nicotinamide adenine dinucleotide phosphate, whereas shortening was favored by nicotinamide adenine dinucleotide.

## 110

OPERATION OF THE ACYL DIHYDROXYACETONE PHOSPHATE PATHWAY FOR TRIGLYCERIDE BIOSYNTHESIS IN MAMMARY GLANDS OF LACTATING MICE. G. ANANDA RAO and S. ABRAHAM, Biochemistry-Cancer Research Laboratory, Veterans Administration Hospital, 150 Muir Road, Martinez, CA 94553.

Recently, we reported that triglyceride synthesis from acetate or palmitate, by slices of mammary glands from lactating mice, was stimulated by glucose. Although acetate was a precursor for both the medium and the long chain fatty acids in triglyceride, palmitate was incorporated only as an intact unit. In lactating mammary tissue, glucose oxidation via the pentose phosphate pathway produces the reduced nicotinamide adenine dinucleotide phosphate (NADPH) required for fatty acid synthesis from acetate. If the acyl dihydroxyacetone phosphate (acyl-DHAP) pathway for glyceride synthesis is functional in the gland, then NADPH would also be required for triglyceride synthesis. We now show that microsomal fractions isolated from mammary glands of lactating mice actively synthesize triglyceride from DHAP in the presence of 1-$^{14}$C palmitate, adenosine triphosphate, CoASH, reduced glutathione, and NADPH. When NADPH is omitted, acyl-DHAP accumulates and fatty acid esterification decreases, suggesting that reduction of acyl-DHAP can be a regulatory step in triglyceride synthesis. The microsomal fraction did not contain glycerol 3-phosphate: nicotinamide adenine dinucleotide oxidoreductase, an enzyme present in the cytosol which is active only with reduced nicotinamide adenine dinucleotide. When 2-monopalmitin served as a glyceride precursor, only trace amounts of triglyceride were produced. These data and previous observations on the conversion of glycerol 3-phosphate to glycerides suggest that lactating mammary glands synthesize triglyceride by both the glycerol 3-phosphate and the acyl-DHAP pathways. (Supported by Veterans Administration Hospital, Martinez, CA, and a grant from National Institutes of Health, CA 11736.)

## 111

A REDUCTION IN THE SIZE OF MOUSE MAMMARY ADENOCARCINOMAS INDUCED BY FEEDING INHIBITORS OF PROSTAGLANDIN SYNTHESIS. G. ANANDA RAO, Biochemistry-Cancer Research Laboratory, Veterans Administration Hospital, 150 Muir Rd., Martinez, CA 94553, and S. ABRAHAM, Veterans Administration Hospital and Bruce Lyon Memorial Research Laboratory, Children's Hospital Medical Center, Oakland, CA 94609.

Previously, we demonstrated that the mammary adenocarcinomas which grew subsequent to transplantation into both male and female CaH mice weighed three to four times more and contained higher levels of linoleate and arachidonate when animals were fed a linoleate rich (15% corn oil) diet than when fed fat free or saturated fat (15% of either hydrogenated cotton seed or coconut oil) containing diets. To investigate the possible role of these essential fatty acids in the stimulation of tumor growth via conversion to prostaglandins, the present study was carried out. Here, we added inhibitors of prostaglandin synthesis such as 5,8,11,14-eicosatetraynoic acid or acetyl salicylic acid (aspirin) to the aforementioned diets. The enhanced growth rate of the tumors which occurs when mice are fed the corn oil diet was not observed when these inhibitors were added to the diet. Analysis of both fatty acid content and composition of various tissues suggests that 5,8,11,14-eicosatetraynoic acid inhibits conversion of linoleate to arachidonate. Our data also demonstrate that the total fatty acid content of the liver is increased by this inhibitor of prostaglandin synthesis. Aspirin, a more specific inhibitor of prostaglandin synthesis (acetylation of prostaglandin synthetase) also reduces the growth rate of the tumor. It would appear that prostaglandins are involved in neoplastic growth and inhibition of prostaglandin synthesis can diminish tumor size. (Supported by Veterans Administration Hospital, Martinez, CA, and a grant from the National Institutes of Health, CA 11736.)

## 112

EFFECT OF CYCLOPROPENE FATTY ACIDS ON THE DISTRIBUTION OF ISOMERIC OCTADECENOATES IN INDIVIDUAL LIPID CLASSES OF LIVER AND HEPATOMA. REX D. WIEGAND, FRED CHUMBLER, and RANDALL WOOD, Departments of Medicine and Biochemistry, University of Missouri School of Medicine, Columbia, MO 65201, and Veterans Administration Hospital, Columbia, MO.

Groups of normal and hepatoma (7288CTC) bearing rats were maintained on fat free diet containing 0.5% *Sterculia foetida* oil (SFO) for 4 weeks. The fatty acid composition of steryl esters, triglycerides, phosphatidylcholines, and phosphatidylethanolamines derived from normal livers, livers of animals bearing hepatoma (host), and hepatoma was determined. Also the octadecenoate fraction was isolated from steryl esters, triglycerides, phosphatidylcholines, and phosphatidylethanolamines of each hepatic tissue and the positional isomeric composition determined quantitatively. These data were compared with earlier studies using similar groups of rats fed fat free diet as controls. *Sterculia foetida* oil affects the fatty acid composition of the individual lipid classes of both the neutral lipid and phospholipid fraction differently. The fatty acid composition of both triglycerides and steryl esters of normal and host liver showed a dramatic reduction in the level of 18:1 and an increase in the percentage of 16:0 and 18:0 compared to the controls. The 18:0 level in the phospholipid fraction, in contrast to that in the neutral lipid fraction, was lower in normal and host liver phosphatidylcholines and phosphatidylethanolamines, and the 18:1 was unaffected relative to the fat free diet controls. Hepatoma neutral lipid fatty acid composition was only marginally affected by *Sterculia foetida* oil, but the hepatoma phospholipid fraction showed a decrease in the percentage of 18:0 and an elevation of the 20:4 and 22:6 fatty acid percentages. Examination of the positional isomers of the liver octadecenoate fraction revealed an overall reduction in the level of vaccenic acid relative to the fat free diet controls. The characteristic 18:1 isomeric composition of each lipid class apparent in liver of non-hepatoma bearing rats consuming fat free diet was absent in those lipid classes isolated from the liver of rats consuming *Sterculia foetida* oil diet. In the four hepatoma lipid classes examined, all exhibited the same approximate proportion of oleic acid (70%) and vaccenic acid (30%) similar to that observed in hepatoma from rats consuming fat free diet. (This work was supported by USPH Grant CA 12973 from the National Cancer Institute.)

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DISTRIBUTION OF GEOMETRICAL AND POSITIONAL ISOMERS OF OCTADECENOATE DERIVED FROM INDIVIDUAL LIPID CLASSES OF LIVER AND HEPATOMA. RANDALL WOOD, FRED CHUMBLER, and REX D. WIEGAND, Departments of Medicine and Biochemistry, University of Missouri School of Medicine, Columbia, MO 65201, and Veterans Administration Hospital, Columbia, MO.

Groups of rats were inoculated with minimal deviation hepatoma 7288CTC and placed on one of four diets consisting of: a fat free diet supplemented with either 0.5% safflower oil (diet A), 15% safflower oil (diet B), 15% safflower oil free fatty acid (diet C), or 15% partially hydrogenated safflower oil free fatty acids (diet D). After 4 weeks the animals were sacrificed, hepatomas and livers removed, and the lipids were extracted and fractionated into individual lipid classes. Octadecenoate fractions were isolated from cholesteryl esters, triglycerides, phosphatidylethanolamines, and phosphatidylcholines and analyzed quantitatively for geometrical and positional isomer content. The octadecenoate fraction from diet D consisted of 66% *trans* and 33% *cis* isomers. The octadecenoic fraction of cholesteryl esters, triglycerides, phosphatidylethanolamines, and phosphatidylcholines isolated from both hepatoma and liver of animals on diets A, B, and C was $>$ 95% the *cis* isomers. C-18 monoenes of triglycerides, cholesteryl esters, phosphatidylcholines, and phosphatidylethanolamines from liver of animals fed diet D consisted of 12, 27, 46, and 72% *trans* isomers, respectively. In contrast, the octadecenoate fraction of all lipid classes from hepatoma of animals on diet D contained the same approximate *trans* isomer content (15–20%). The positional isomers of both the *cis* and *trans* fractions from diet D ranged from Δ9 to Δ14. The *cis* octadecenoate fraction from all classes of both liver and hepatoma from animals fed diets A, B, and C consisted of predominately the Δ9 and Δ11 isomers, but the quantity of the two isomers differed among lipid classes and between liver and hepatoma. In contrast to the high *cis*, Δ10, octadecenoate content of diet D, all lipid classes of both liver and hepatoma contained very small quantities of this isomer. The positional isomeric composition of *trans* octadecenoate from hepatoma and liver triglycerides and cholesteryl esters was similar to diet D. In contrast, the *trans*, Δ10, octadecenoate isomer was almost excluded from liver phosphatidylcholines and phosphatidylethanolamines. Hepatoma phosphatidylcholines and phosphatidylethanolamines did not exhibit the degree of *trans*, Δ10, octadecenoate exclusion shown by liver. These data demonstrate the preferential incorporation of dietary geometrical isomers in specific lipid classes of liver, but not in hepatoma. The data also show the exclusion of some positional isomers from some lipid classes of liver and the loss of this specificity in some lipid classes of hepatoma. (This work was supported by USPH Grant CA 12973 from the National Cancer Institute.)

## 114

HISTORICAL AND MARKETING TRENDS OF NATURAL/SYNTHETIC FATTY ACIDS. ARNOLD G. JOHANSON, Ashland Chemical Co., Chemical Products Division, PO Box 2219, Columbus, OH 43216.

This presentation will deal with the importance of naturally derived fatty acids and their significant industrial role. Fatty acid markets and trends in raw materials which may affect the future of fatty acids will be discussed. The synthetic fatty acid counterpart synthesized from petroleum feed stock will be examined in view of our present knowledge and possible product substitution. Observations of comparative economics and technology will be made.

## 115

INDUSTRIAL IMPORTANCE OF VEGETABLE OILS AS RAW MATERIALS IN A PETROLEUM-DEFICIENT WORLD. COLIN G. HULL (PVO International Inc.), 1145 S. 10th St., Richmond, CA 94804.

Uncertainty over the future supply and cost of petroleum feedstocks has rekindled industrial interest in natural oils as an alternate raw material source. The driving force behind this interest is, of course, the fact that natural oils are a "renewable resource." A review will be made of the major industrial applications of vegetable oils, with particular emphasis on castor, coconut, safflower, oleic safflower, soybean, tall, and tung oils. Examples will be given of parallel synthetic and natural routes to a particular product or end-use application. In addition, mention will be made of research efforts underway to make new types of plastics, plastic additives, coatings, and lubricants from these oils.

## 116

FATS AND OILS IN AGRICULTURE. WALTER W. ABRAMITIS, Research Laboratory, Armak Company, Akzona Inc., 8401 W. 47th St., McCook, IL 60525.

Fats, oils, and their derivatives are reviewed in their role as emulsifiers and surfactants, as intermediates in pesticides, and their activity per se. As emulsifiers and surfactants they offer a wide range of hydrophile-lipophile balance values to assist formulators in developing salable products. Their lipoid solubilities aid in evaporation retardation, plant penetration, and absorption. Often they greatly improve the performance of the active ingredients. Nitrogen derivatives such as amines and quaternaries, fatty alcohols, acid esters, and other agricultural chemicals are reviewed. Examples are cited on the effect of the length of the carbon chain and their number in such herbicides as 2,4-D, dalapon, as well as their biological properties in insect larvicides, plant growth regulators, and fungicides. The role vegetable oils can play in the looming energy shortages as petroleum oil substitutes is discussed. They offer a challenging future in agricultural applications.

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A CONTINUOUS PROCESS FOR ISOPROPENYL STEARATE. M.F. KOZEMPEL, J.C. CRAIG, JR., H.I. SINNAMON, and N.C. ACETO, Eastern Regional Research Center, ARS, USDA, 600 E. Mermaid Lane; Philadelphia, PA 19118.

Isopropenyl stearate is an excellent acylating agent reacting with active OH or NH groups such as in amides, imides, alcohols, etc. It typically reacts in 10 min at 400 F in the presence of a trace of catalyst, e.g., p-toluene sulfonic acid. The only by-product is acetone. A continuous, integrated pilot plant process has been developed to synthesize isopropenyl stearate from triple pressed stearic acid and a stabilized form of propyne. A flow sheet for this pilot plant process will be presented. The integrated process, with the exception of recycle, has been operated continuously for 2½ hr at a flow rate of 20 lb feed/hr. Operating time was limited by factors external to the process. The reaction was found to be stable and easily controlled, the recovery was simple and straightforward, the product was not apparently variable, and it may reasonably be assumed that this process can be applied on a commercial scale. The product is 92% pure (8% stearic acid and stearic anhydride), is a pale yellow liquid (Gardner color ca. 6.5), has the viscosity of a light lubricating oil, and crystallizes at 62–64 F. Cost data and the recommended process flow sheet for a potential commercial plant will be presented.

## 118

OXIDATION OF FATTY ACIDS BY USE OF PHASE TRANSFER CATALYSIS. T.A. Foglia and P.A. Barr, Eastern Regional Research Center, 600 E Mermaid Lane, Philadelphia, PA 19118.

Phase transfer catalysis facilitates reactions which are inhibited because of the inability of the reagents to physically come together, e.g., the reaction between two substances located in immiscible solvent phases. The use of phase transfer catalysis as an aid in oxidizing long chain olefins with aqueous potassium permanganate ($KMnO_4$) in acid and alkaline media and with aqueous ruthenium tetroxide ($RuO_4$) is reported. The phase transfer catalysts used were either quaternary ammonium halides or crown ethers. The long chain olefins studied were 1-pentadecene, 9-octadecene, and methyl oleate. Oxidation of these olefins with the above reagents in the absence of a phase transfer catalyst requires long reaction times and provides low yields. The use of a phase transfer catalyst not only increases the rate of these reactions but also gives high yields of reaction products. For example, methyl oleate in methylene chloride solvent reacted with aqueous $KMnO_4$ to give good yields of dihydroxystearic acid or a mixture of pelargonic and azelaic acids, depending on pH, when tetrabutylammonium bromide was used as the phase transfer catalyst. In another example, when $RuO_4$ in conjunction with a phase transfer catalyst was used as the oxidant, high yields of myristic acid were obtained from 1-pentadecene. To decrease the amount of $RuO_4$ required for this reaction, a method was developed for regenerating spent oxidizing agent in situ with sodium hypochlorite. This regeneration of spent oxidant was also made possible by the use of the phase transfer catalysts.

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CATALYTIC HYDROFORMYLATION AND HYDROCARBOXYLATION OF UNSATURATED FATTY COMPOUNDS. E.N. Frankel and E.H. Pryde, Northern Regional Research Center, ARS, USDA, 1815 N. University, Peoria, IL 61604.

The two catalyst systems rhodium-triphenylphosphine and palladium chloride-triphenylphosphine were investigated for the respective hydroformylation and hydrocarboxylation of oleic acid or ester to produce C-19 bifunctional compounds. Compared to conventional cobalt carbonyl for making formylstearate, rhodium-triphenylphosphine permits lower pressures (1,000–2,000 psi vs. 3,000–4,000 psi), higher conversions (95% vs. 80%), and no loss of functionality (vs. 15% hydrogenation with cobalt). Although palladium chloride-triphenylphosphine for hydrocarboxylation introduces the carboxyl function directly into the fatty acid chain, CO pressures of 3,000–4,000 psi and corrosion resistant equipment are necessary. When applied to polyunsaturated fatty acids, both of the rhodium and palladium catalyst systems have the outstanding advantage of introducing functionality at each double bond position to produce polyformyl- and polycarboxystearates. Selected formyl derivatives were converted in excellent yield to acetals, to acids and their esters, to hydroxymethyl compounds and their esters, and also to amino methyl compounds that could be condensed to polyamides. Several of the esters and acetals were effective primary plasticizers for poly(vinyl chloride) that had outstandingly low volatility characteristics. Other applications for these new and highly versatile derivatives included rigid urethane foams, urethane-modified coatings, ester lubricants, and a shrink resist treatment for wool.

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GEMINAL HYDROXYMETHYL COMPOUNDS FROM 9(10)-FORMYLSTEARIC ACID. W.R. Miller and E.H. Pryde, Northern Regional Research Center, ARS, USDA, 1815 N. University, Peoria, IL 61604.

9(10)-Formylstearic acid, obtained by selective hydroformylation of oleic acid, reacts readily with formaldehyde in basic methanolic or aqueous medium to undergo the Tollens condensation, followed by a crossed Cannizzaro reaction to give 9,9(10,10)-bis(hydroxymethyl)octadecanoic acid (1) in essentially quantitative yield. Although the chemical industry has used these reactions for some years in synthesis of such short chain polyols as pentaerythritol and trimethylolpropane, our application is the first to a long chain fatty derivative. The geminal hydroxymethyl compound 1 is a trimethyleneglycol with no hydrogens *beta* to the hydroxyl groups. Isolation is most conveniently effected as the acetone acetal of the methyl ester of 1. A series of esters of the carboxyl group has been prepared, and the hydroxymethyl groups have been acetylated and acetalated. These derivatives are stable high boiling (ca. 200 C/0.005 mm) liquids with low (<−70 C) freezing points.

## 121

HEPTANOIC ACID FROM 2-OCTANOL BY CAUSTIC FUSION. Nelson E. Lawson and Thomas E. Farina, Union Camp Corp., PO Box 412, Princeton, NJ 08540.

2-Octanol (capryl alcohol), a by-product of sebacic acid manufacture from castor oil, can be converted efficiently in the laboratory to the alkali salts of heptanoic acid by reaction with mixed molten alkali under the appropriate conditions. If these are exceeded, decomposition of the salts can occur; a radical mechanism is indicated. This paper will discuss the chemistry and thermodynamics of the caustic fusion of 2-octanol, equipment for working with molten caustic in the laboratory, a study of reaction parameters, and an investigation of heptanoate salt thermal decomposition.

## 122

CONSUMERS' FOOD SHOPPING BEHAVIOR AND RELATED FACTORS. Alice E. Fusillo and Arletta M. Beloian, Division of Consumer Studies (HFF-240), Bureau of Foods, Food and Drug Administration, 200 C Street, SW, Washington, DC 20204.

The purpose of the Division of Consumer Studies is to assess consumer population characteristics with regard to food and nutrition to know what consumers need to know and what their nutritional practices are to help protect and maintain the nutritional health of the individual. The Food and Drug Administration sponsored a national probability sample of 1,664 households and the respondents were food shoppers 18 years of age and older with primary responsibility for family food purchases. This survey was conducted by the Response Analysis Corporation. Shoppers were queried about changes in their shopping habits over the past year, and what information they use on food packages. An index was formulated from the questions asked and compared with other factors. These data were analyzed for demographic differences, e.g., age, sex, education, income, and occupaiton. Food shoppers were making changes in their behavior in the buying of meat. Shoppers were buying less meat and cheaper cuts. They also tend to be eating less sweets or snacks. They also tend to be watching specials more and using coupons. Differences in this behavior were found among various population groups.

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DIETARY PATTERNS OF MEN BY PERCENTAGE OF FOOD ENERGY FROM FAT. Eleanor M. Pao, Consumer and Food Economics Institute, ARS, USDA, Federal Center Building, Room 336, Hyattsville, MD 20782.

The significant decline in nutrient fat in U.S. civilian food consumption from 1974 to 1975 brought the average per person per day almost back to the 1965 average equal to 145 g after reaching a peak of 158 g in 1971 and 1972. The average supply of food energy per person per day declined also, down to 3,160 kcal (preliminary 1975) compared with 3,140 kcal in 1965. These concurrent changes have brought the average relationship of fat to food energy nearly back to that of 1965. Accordingly, more intensive analysis of data from the spring 1965 survey of food intake of individuals may be expected to yield findings of current relevance. At that time adult men had the highest proportion of their food energy from fat, on the average, of any sex-age group, specifically 45%. Our recent indepth study of the diets of adult men in the North Central Regional sample utilized the technique of dividing the sample into thirds, based on percentage of food energy coming from fat (<40%, 40–49%, and ≥50%), and comparing the food patterns of the three subgroups. Meat was the primary source of fat for all three groups. Food in the grain products group was the next most important source of fat for the lower two-thirds of the sample and fats and oils for the top third. Meal pattern analysis provided further information about differences.

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NUTRIENT DATA BANK: COMPUTER-BASED MANAGEMENT OF NUTRIENT VALUES IN FOODS. Ritva R. Butrum, Consumer and Food Economics Institute, ARS, USDA, 6505 Belcrest Rd, Room 315, Hyattsville, MD 20782.

A computerized Nutrient Data Bank has been designed for storage and retrieval of food composition data. The system is a repository for data from international sources, including research institutions, industry, and independent laboratories. Source data are carefully screened with regard to identification of the food and conditions which may affect its nutritive value. Variables such as treatment and processing of the food and method of nutrient analysis can be considered in the analysis and retrieval of the data. Summarization of the nutrient data into a composite value is based on selected, unique criteria developed for each food after statistical analysis of primary data. The summarized data will include averages for each nutrient, the number of samples, range values, and some measure of variance such as standard deviation. Data will be further summarized by combining similar commodity items and weighted according to consumption figures resulting in an average nutrient value for most common foods consumed in the U.S. These data can be used for compiling a new nutrition handbook and for rapid retrieval of information for nutritionists.

## 125

FOOD SAFETY AND THE CONSUMER. Arthur F. Novak, Food Science Department, Louisiana State University, Baton Rouge, LA 70803.

American methods of food production, processing, preservation, packaging, and distribution have provided an abundance of safe, nutritious, and tasty foods. Laws and regulatory agencies are protecting our health. Yet much adverse publicity in recent years has misled the consumer into believing that many health hazards exist in our food supply.

## 126

STEAM REFINING COMBINED WITH DEODORIZATION: AN EDIBLE OIL PROCESSING INNOVATION. Stanley C. Loft, Sullivan Corporation, PO Box 158, Tiburon, CA 94920.

The current influx of quality crude palm oil in the edible oil market, along with its economical advantages, has stimulated new interest in the steam refining/deodorizing method of processing edible oils. Laboratory tests have proven that crude palm oil, pretreated to remove trace metals and heat resistant organic compounds, can be simultaneously steam refined and deodorized into a high quality finished product with excellent stability. As a result of these tests, a commercial production facility was put into operation in late 1973, with an annual production of 75,000 metric tons of steam refined/deodorized palm oil. Actual production efficiencies will be presented, along with analytical data relating to crude oil and finished product quality. Recent steam refining tests of several domestic oils will also be discussed.

## 127

A COMPUTERZED OIL REFINERY MONITORING SYSTEM. Peter Elliott, Elliott Automation Co., PO Box 31227, Cincinnati, OH 45231.

Oil refinery losses occur in many areas of an oil refinery and from many causes. Oil refinery loss monitoring can measure those losses, and an oil refinery monitoring system can pinpoint the reason for those losses. Computer technology has been applied in the design of a high resolution and high reliability oil refinery monitoring system to perform this task. On line experience with several computer systems is now being accumulated, and some of the results and experiences will be described. Slides of in-plant computer systems will be shown, as will graphical data on loss monitoring.

## 128

EVALUATION OF PROCESSING ALTERNATIVES TO SAW DELINTERING OF COTTONSEED. S.P. CLARK, Food Protein Research & Development Center, Oilseed Products Division, Texas A&M University, College Station, TX 77843.

Saw delintering of cottonseed has been a standard technique in the cottonseed oil mill industry for many years. This operation is performed to prepare the seed for hulling and the separation of kernels and hulls before extraction of oil from kernels (meats). In recent years some segments of the industry have been considering alternative ways of processing seed. The reasons for interest in alternatives include the difficulty and expense of bringing the saw delintering operation into compliance with Environmental Protection Agency standards on dust emissions and with Occupational Safety and Health Act standards on guarding of machines and on workroom dust and noise. Other reasons for interest in alternative processes are the low prices and limited demand for the linters removed from the seed in times of continual increases in all categories of production costs. This is a description of the results from economic evaluations of several alternative processes to saw delintering. These evaluations have required estimates to be made of the yields, quality of products, monetary returns from sale of products, and processing costs. Comparisons of these estimates for alternative processes are presented. Abrasive and acid delintering processes and hulling without delintering are the processes which appear most attractive as alternatives to saw delintering. Comparisons of these three processes are presented in terms of economic rate of return.

## 129

AN OIL FRACTION FROM EDIBLE BEEF TALLOW AS A CONSTITUENT OF A CHEESE WHEY–SOY FLOUR BEVERAGE BASE. V.H. HOLSINGER, F.E. LUDDY, C.A. SUTTON, H.E. VETTEL, C. ALLEN, F.B. TALLEY, and H.L. ROTHBART, Eastern Regional Research Center, ARS, USDA, 600 E. Mermaid Lane, Philadelphia, PA 19118.

A commercial edible beef tallow was solvent fractionated to yield 65% of an oil fraction. The oil, after steam deodorization at 215 C for 3 hr, was bland in taste and odor. It was stabilized with 0.02% of an antioxidant combination consisting of 31% each of butylated hydroxyanisole and butylated hydroxytoluene and 19% each of propyl gallate and citric acid. Stabilized beef oil was wet blended with fluid sweet cheese whey, defatted soy flour, and corn syrup solids, pasteurized, homogenized, condensed in vacuo to 40% total solids, and spray dried to yield a free flowing powder readily reconstitutable with water. A similar product was made with commercially produced soybean oil for a control. Proximate composition of the dry powder was 5.0% ash, 21.6% protein, 2.0% moisture, 18.2% fat, and 53.2% carbohydrate. Both products were fortified by dry blending with a vitamin-mineral premix containing iron. For storage stability studies, samples of the beef oil and soybean oil containing powders, fortified and unfortified, were air or nitrogen packed in #1 cans and stored at —18, 25, and 37 C and removed at intervals for organoleptic evaluation and peroxide analysis. Although after 3 months' storage at 37 C there was no significant difference in flavor between the beef oil and soybean oil containing powders, peroxide values were nine times greater in the unfortified soybean oil powder and 16 times greater in the soybean oil powder containing iron than in the corresponding beef oil powders.

## 130

RAPID METHOD FOR PARTIAL HYDROLYSIS OF OILSEED PROTEINS FOR FOOD USES. ANTONIO A. SEKUL and ROBERT L. ORY, Southern Regional Research Center, ARS, USDA, PO Box 19687, New Orleans, LA 70179.

Oilseed proteins contain globulins of large mol wt (e.g., arachin in peanuts, acalin-A in cottonseed) that tend to precipitate from solution upon refrigeration. They are less soluble unless salt, buffers, or emulsifiers are added, or unless they are partially hydrolyzed to smaller polypeptides. The use of partially hydrolyzed vegetable proteins in specialty foods is increasing today. Hydrolysis is generally accomplished with acid and neutralization with base which raises the salt content of the product, or with enzymes. A method utilizing activation of endogenous proteases in peanut meals was reported in 1972, but 9–10 hr was required for hydrolysis. The final product also had a microbial content that might hinder its acceptance as a food supplement. A new method, using Food and Drug Administration-acceptable enzymes, was sought that would yield a partially hydrolyzed oilseed protein in considerably less time (to conserve energy in production) and that might lower the microbial count in the original oilseed meal before its incorporation into food products. This report describes reaction conditions for partial hydrolysis of laboratory-prepared peanut flour and pilot plant-prepared peanut and cottonseed flours by three commercial proteases, microbial contents of the flours and after hydrolysis, and suggests potential uses of these proteins in food products.

## 131

SOME PHYSICOCHEMICAL AND FUNCTIONAL PROPERTIES OF PROCESSED PEANUT SEED HIGH PROTEIN DERIVATIVES: A COMPARATIVE SURVEY. JOHN P. CHERRY, KAY H. MCWATTERS, and LINDA P. GARRISON, Department of Food Science, University of Georgia College of Agriculture Experiment Station, Georgia Station, Experiment, GA 30212.

Seventeen high protein peanut derivatives including meals, flours, flakes, concentrates, and isolates were obtained from laboratories throughout the United States to compare their protein characteristics and functional properties. Protein solubility of these derivatives in water and their ability to form emulsions and foams were evaluated at a range of pH levels. Total protein content of the derivatives ranged from 23.6 to 80.6% (macro-Kjeldahl technique; 5.46 conversion factor). Water solubility of protein varied with pH (4.2–8.3) and was highest in all product suspensions at pH 8.2. In most cases, increasing protein solubility improved functional properties; e.g., emulsions ranged from pourable (800–6,400 cps) to mayonnaise-like (54,880–160,000 cps) consistencies. Suspensions with moderate to high protein solubility formed acceptable emulsions (12,960–73,280 cps). At pH 4.0, three of the derivatives functioned well even though protein solubility was low. Gel electrophoresis showed a range of protein solubility among the high protein derivatives. Qualitatively, those products containing most of the major storage proteins, regardless of suspension pH, exhibited good functionality. Data indicate the availability of a wide range of peanut protein derivatives with diverse protein and functional properties that have the potential of meeting specific needs of food processors.

## 132

EFFECT OF ENDOGENOUS REDUCING SUGARS ON STORAGE STABILITY OF PEANUT MEAL. JAIME AMAYA-F. and CLYDE T. YOUNG, Department of Food Science, University of Georgia, Experiment, GA 30212.

Recently there has been some disagreement about the levels of reducing sugars in unprocessed peanut flour. Because defatted peanut meals (ca. 50% protein) are being considered for several uses in food processing, it is important to determine the concentration of reducing sugars more accurately, as they may participate in undesirable Maillard-type reactions. We have reevaluated the hot and cold ethanol extraction methods on defatted Florunner peanut meal (60–80 mesh), analyzing the recovered monosaccharides by liquid chromatography. Extraction with refluxing 80% ethanol (Newell et al., *J. Agric. Food Chem.* 15:767, 1967) for long periods of time produced a wide range of values for glucose (0.005–0.82%) and fructose (0.008–0.80%), largely because of higher saccharide degradation. Direct extraction in 80% ethanol at 80 C yielded extremely low values (12 and 5 ppm glucose, fructose) due mainly to amine-carbonyl interactions. Shaking the prehydrated meal at 28 C for 48 hr (Tharanathan et al., *J. Sci. Food Agric.* 26:749, 1975) resulted in higher recoveries of glucose (0.80%) and fructose (0.41%). Significant amounts of galactose (0.70%) found by the latter method, however, indicated that enzymatic degradation of higher saccharides occurred during hydration of the meal, thereby rendering the method unreliable. The loss of fluoro-2,4-dinitrobenzene–available lysine was measured in Florunner peanut meal as a function of both storage time (37 C, 75% relative humidity) and added reducing sugar. Peanut meal showed a remarkable stability against Maillard storage deterioration. Fluoro-2,4-dinitrobenzene-available lysine was lost at a rate of 0.05 mg/100g/day compared to 0.50 mg/100g/day for soy meal. The rate increased to 0.19 and 0.37 mg lysine/100g/day when two increments (0.24 and 1.2%) of glucose plus fructose were added to peanut meal. Results suggest that total monosaccharides in unheated peanut meal are present in lower concentrations than previously reported (most likely below 0.06%) and, therefore, do not pose a significant problem in storage stability.

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NUTRIENTS AND ANTI-NUTRIENTS IN POTENTIAL EDIBLE PROTEIN PRODUCTS FROM COTTONSEED. LEAH C. BERARDI, Southern Regional Research Center, ARS, USDA, PO Box 19687, New Orleans, LA 70179.

Cottonseed is recognized as a potential source of edible protein products, namely flours, protein concentrates, and protein isolates. The development of glandless cottonseed and the Liquid Cyclone Method for processing glanded cottonseed have provided edible-grade flours. Nutrients, especially those pertinent to nutritional labeling, such as vitamins, trace elements, protein, fat, amino acids, available lysine, carbohydrates, and calories, as well as anti-nutrients, such as gossypol pigments, heavy metals, flatulence producing sugars, and phytic acid will be discussed in relation to processing conditions employed for product production.

## 134

AN AUTOMATED SYSTEM FOR MICRODENSITOMETRY OF LIPOPROTEINS USING AGAROSE GEL ELECTROPHORESIS. R.A. WONG, P.G. BANCHERO, L.C. JENSEN, S. PAN, G.L. ADAMSON, and F.T. LINDGREN, Donner Laboratory, University of California, Berkeley, CA 94720.

An automatic system for microdensitometry has been developed for use with an agarose gel electrophoresis lipoprotein screening facility. The components of the system are a densitometer, an analog to digital converter, a cathode ray tube terminal, a teleprinter, and a small computer. The 4K program provides for sample coding, display of the electrophoretic scan, indexing, and component identification. Data are obtained from the plasma scan or in combination with scans of the 1.006 g/ml top and bottom preparative lipoprotein containing ultracentrifuge fractions. Data from as many as 30 scans are stored in 4K of memory and then are sent via a high speed telephone line to a large computer for remote processing. Features of the calculations and analysis include internal standardization, corrections for baseline drifts and pre-beta asymmetry, as well as proper identification of very low density lipoprotein, low density lipoprotein, and high density lipoprotein. To achieve this, corrections for the amount of "floating beta" and "sinking pre-beta," in very low density lipoprotein and low density lipoprotein, respectively, are made. Final results are given in mg/100 ml and as the percentile rank and $\sigma$ value as compared to an appropriate normal reference population. For normal males and females ($n = 40$), correlations between ultracentrifugal very low density lipoprotein, low density lipoprotein, and high density lipoprotein with manually calculated agarose gel electrophoresis was 0.94, 0.87, and 0.92. The corresponding automated values were 0.94, 0.84, and 0.92, respectively, indicating results essentially equivalent to the manual procedure.

## 135

EVIDENCE FOR HYDROPEROXIDE LYASE ACTIVITY IN SUNFLOWER, FLAX, AND SOYBEAN SEEDLINGS. DON C. ZIMMERMAN and CAROL A. OLSON, Department of Biochemistry, North Dakota State University, Fargo, ND 58102.

The product of hydroperoxide lyase was identified in sunflower, flax, and soybean seedlings. Hydroperoxide lyase, originally discovered in watermelon seedlings, catalyzes the conversion of linoleic acid hydroperoxide to 12-oxo-*trans*-10-dodecenoic acid, a 12-carbon semi-aldehyde. Enzyme activity was observed when crude tissue extracts of 5-day old seedlings were incubated with linoleic acid. These seedlings also contain lipoxygenase anad hydroperoxide isomerase. Activity of the hydroperoxide lyase and hydroperoxide isomerase cannot be distinguished by the standard spectrophotometric assay, because both enzymes cause the loss of absorption at 234 nm. A nonenzymatic breakdown product of linoleic acid hydroperoxide has been tentatively identified as 13-oxo-*cis*-9-*trans*-11-tridecenoic acid. Although it has the same $R_f$ on thin layer chromatography as the 12-carbon semi-aldehyde, separation was accomplished by gas liquid chromatography. The identification of the 12-carbon semi-aldehyde may implicate hydroperoxide metabolism in the expression of hormonal activity in certain plant tissues.

## 136

AN IMPROVED PURIFICATION PROCEDURE FOR ISOLATION OF ALL COMPONENTS OF MICROSOMAL ELECTRON TRANSPORT SYSTEMS. RHEA CRAIG and WAYNE R. BIDLACK, Department of Pharmacology, USC School of Medicine, 2025 Zonal Ave., Los Angeles, CA 90033.

The hepatic microsomal membrane contains many interacting enzymes and cytochromes, which form an intricate electron transport system. Recently, a hydroperoxide peroxidase activity has been described which can use reduced nicotinamide adenine dinucleotide phosphate (NADPH) or reduced nicotinamide adenine dinucleotide (NADH) to reduce lipid hydroperoxides to their respective alcohol forms. In addition, if a drug is added in place of the pyridine nucleotides, the hydroperoxide is used to catalyze the hydroxylation of the drugs even under anaerobic conditions (Kadlubar et al., *Biochem. Biophys. Res. Commun.* 54:1255, 1973). The microsomal mixed function oxidase uses NADPH and oxygen to hydroxyiate many different biological and xenobiotic compounds. Hrycay and O'Brien (*Arch. Biochem. Biophys.* 157:7, 1973) believe that the terminal cytochrome (cytochrome P450) in the mixed function oxidase also acts as the microsomal peroxidase. Although we do not deny the ability of cytochrome P450 to act as a peroxidase, our laboratory feels that another integral component may also have peroxidase activity (Bidlack and Hochstein, *Life Sciences,* 14:2003, 1974). To date, inhibitor and kinetic studies have not clarified this conflict in interpretation. We would like to report an improved methodology for the solubilization and purification of the components involved in the microsomal electron transport systems. The reconstitution of these enzyme activities will allow us to further evaluate and understand the interrelationship of these systems. The membrane proteins are solubilized by a non-ionic detergent, Emulgen 911. The soluble components are then separated into five fractions by elution from a diethylaminoethyl-Cellulose column using a KCl gradient (0.0–0.4M). The initial buffer system also contains 0.5% emulgen. Fractions III, IV, and V contain an unknown protein, cytochrome $b_5$, and NADPH Cytochrome c Reductase, respectively. Each of these fractions is further purified on a second diethylaminoethyl-Cellulose column using the following procedure: an initial wash using KCl gradient (0.0–0.4M), followed by a low ionic strength buffer; then a buffer containing 0.2% Deoxycholate, an ionic detergent, is equilibrated with the column and the remaining proteins are eluted with an additional KCl gradient. All of the eluted fractions are pooled, dialyzed, and concentrated by Amicon-Diaflo apparatus. Fractions I and II pose a special problem due to the tight binding of the non-ionic detergent to these fractions. Cytochrome P450, NADH Cytochrome $b_5$, Reductase, and a new NADPH Cytochrome $b_5$ Reductase are located in these fractions.

## 137

AUTOXIDATION OF LINOLEIC ACID MONOLAYERS. GUEY-SHUANG WU, ROBERT A. STEIN, and JAMES F. MEAD, Laboratory of Nuclear Medicine and Radiation Biology, 900 Veteran Ave., Los Angeles, CA 90024.

A surface monolayer consisting of linoleic acid adsorbed on silica gel has been chosen as a model in a study of nonenzymatic peroxidation of membrane lipids. In this system, as revealed by the studies on adsorption isotherm, IR spectra, and high temperature dehydration, the linoleic acid molecules appear to be bound preferentially to the isolated hydroxyl groups on the surface and not appreciably on other types of surface hydroxyl groups, such as vicinal hydroxyl groups. Autoxidation of such a monolayer system, unlike the case of the bulk phase, produces only small quantities of hydroperoxides. Autoxidation rate studies were carried out on monolayers with the following different composition: (1) pure *cis, cis-* or *trans, trans*-octa-decadienoic acid; (2) other prominent membrane constituents, such as cholesterol (and its acetate) and saturated fatty acids of various chain length, incorporated into the linoleic acid monolayers; and (3) with natural ($\alpha$- and $\gamma$-tocopherol) and synthetic antioxidants (2-[$\omega$-carboxynonyl]-4-methoxy-6-pentylphenol and 3[$\omega$-carboxynonyl]-4-methoxy-5-pentylphenol) as additives in linoleic acid monolayers. Hypotheses will be advanced to rationalize the differences in the rates and extent of autoxidation observed in these experiments.

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SYNTHESIS AND TESTING OF ANTIOXIDANTS DESIGNED FOR MEMBRANE PROTECTION. WILLIAM L. PORTER, ROSE COLGAN, ARMAND PARADIS, and GARY PORFERT, U.S. Army Natick Development Center, Kansas Street, Natick, MA 01760.

Effectiveness of several novel synthetic antioxidants in preventing membrane lipid autoxidation has been studied using oxygen uptake by freeze dried and cobalt activated red blood cell membranes (ghosts). The assay system is specific for polar lipids in membranes. It is highly reproducible and sensitive to added pro- and antioxidant compounds. Antioxidants have been assayed both after uptake during rehydration and a second freeze drying and, where applicable, after vapor-phase transfer. An antioxidant synthesized in these laboratories specifically for membrane protection, phytanyl gallate, has very high effectiveness in these membranes, exceeding any so far studied. Report will be made on studies of this ester and others in red blood cell ghosts and selected freeze dried foods.

## 139

FLUORESCENCE ENHANCEMENT AS A MEANS OF DETECTION OF MIXING OF MEMBRANE MOLECULES. PAUL KELLER and STANLEY PERSON, Department of Biochemistry and Biophysics, 618 Life Sciences Building, The Pennsylvania State University, University Park, PA 16802.

We have been interested in the determination of mixing of membrane molecules, including lipids, during virus induced cell fusion. The assay to measure mixing of lipid molecules is based on the nonradiative (dipole-dipole) energy transfer between two fluorescent probes. Two populations of cells are used, one labeled with a fluorescein derivative (F18) and the other with a rhodamine derivative (R18). The dyes have been covalently linked to 18 carbon hydrocarbon chains so they will effectively partition into cellular membranes. Two conditions are required for energy transfer: F18 and R18 molecules must be close ($<$50A) to each other, and the emission spectrum of one must overlap the absorption spectrum of the other. The emission spectrum of F18 overlaps the absorption spectrum of R18. We have used this technique to measure lipid mixing during virus induced cell fusion. Two virus infected cell populations, one labeled with F18 and the other with R18, are mixed in equal proportions. As a function of time after virus infection, when the infected cells are attached to the surface of a glass culture vessel, the cell monolayer is excited with light of 460 nm and the amount of fluorescence measured at $\geq$600 nm. When the cells fuse and the plasma membrane molecules mix, an increase (enhancement) of fluorescence is observed. This presumably is due to the mixing of membrane molecules, including F18 and R18, that occurs during cell fusion. The method has also been used to follow membrane mixing which occurs when a lipid-containing virus (labeled with F18) attaches and enters a cell (labeled with R18).

## 140

SPIN LABEL STUDIES ON MEMBRANE SURFACES. ALEC D. KEITH and WALLACE SNIPES, Department of Biochemistry and Biophysics, 618 Life Sciences Building, The Pennsylvania State University, University Park, PA 16802.

We will present data and arguments to show that appropriate amphiphilic spin labels can be used to obtain useful information about membrane surfaces. These nitroxides, called surface spin labels, are being used to characterize the surfaces of a variety of different cells in our laboratory. Two of these surface spin labels have been used to study a variety of mammalian cells, including sperm cells. Both of these compounds have an 18-carbon chain connected to a nitroxide-containing pyrroline through a charged group. The one containing a phosphate is designated ($I^-$), and the one containing a quarternery amine is designated ($I^+$). These surface spin labels are particularly sensitive to charge modifications that occur on membrane surfaces. Characterization of this measurement was determined by modifying the net charge on model phospholipid vesicles. Paramagnetic ions and chelates of these ions are used to remove the signal originating from surface spin labels which reside in unhindered positions of cell surfaces. Chelates of paramagnetic ions are used in low concentrations as a means of amplifying small differences between different cell types. The effects of charge groups, protein intercalation into membranes, and cholesterol in membranes will be treated.

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ANTIVIRAL ACTIVITY OF MEMBRANE-PERTURBING MOLECULES. WALLACE SNIPES and ALEC D. KEITH, Department of Biochemistry and Biophysics, 618 Life Sciences Building, The Pennsylvania State University, University Park, PA 16802.

Most antiviral agents developed for clinical use have been designed to interfere with viral nucleic acid synthesis. These compounds are analogues to the purine and pyrimidine nucleosides normally found in DNA and RNA. Unfortunately, these compounds also interfere with cellular nucleic acid synthesis and in some cases may also be mutagenic. We are investigating the properties of potential antiviral agents that are active due to their physical perturbation of viral membranes rather than their biochemical effects on viral nucleic acid metabolism. These compounds have a hydrophobic component, such as a hydrocarbon chain, to pull the molecule into the viral membrane and a polar group to orient the molecule at the membrane-aqueous interface. A bulky, quasi-spherical structure may also enhance their membrane-perturbing properties. An important parameter in the effectiveness of these agents is the length of the hydrocarbon chain. For straight chain, saturated carboxylic acids and alcohols, the chain length must be $>$ eight carbons, and the most effective chain length is ca. 12 carbons. Other parameters that influence the antiviral activity are the nature of the polar group and the presence and configuration of double bonds in the hydrocarbon chain. Replacement of the carboxylic acid group with its methyl ester results in complete loss of antiviral activity, whereas introduction of a double or triple bond into a long chain fatty acid enhances its potency. Proper design of this new class of antiviral agents will rely on an understanding of their physical properties and the nature of their interactions with membrane structures.

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GAS CHROMATOGRAPHIC SEPARATION OF *CIS* AND *TRANS* UNSATURATED LONG CHAIN AMINES. L.D. METCALFE, R.J. JAKUBIEC, and C.N. WANG, Armak Company, 8401 W. 47th St., McCook, IL 60525.

There are important differences in the physical properties of the *cis* and *trans* isomers of unsaturated long chain amines. Because of these differences, it is desirable to know the ratio of the *cis* and *trans* isomers. This separation can be accomplished by capillary column gas chromatography of the amine derivatives; however, the use of capillary columns is too slow for routine analysis. We have found that the *cis* and *trans* isomers of unsaturated amines can be rapidly separated on packed columns containing cyanopropylphenylsilicone liquid phases (Apolar 10C). The primary amines are converted to the trifluoroacetamides and separated on 6–10 ft columns containing 10% Apolar 10C at 180 C. The technique has been applied to unsaturated long chain primary and tertiary amines, diamines, and nitriles. Useful information on the isomerization of these compounds during their synthesis can be obtained.

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ARGENTATION GAS CHROMATOGRAPHY OF *CIS* AND *TRANS* FATTY ACID METHYL ESTERS. P. MAGIDMAN, R.A. BARFORD, and H.L. ROTHBART, Eastern Regional Research Center, ARS, USDA, 600 E. Mermaid Lane, Philadelphia, PA 19118.

A new approach to the gas chromatographic separation of *cis* and *trans* monoenoic compounds up to $C_{18}$ has been developed using a bound cation exchanger in the $Ag^+$ form as the principal constituent of the column packing. Although this material has been used successfully in the gas chromatographic separation of *cis* and *trans* straight chain alkenes up to $C_{18}$, the emphasis of this report is on the modifications necessary to achieve the more difficult separation of the *cis* and *trans* monoenoic fatty acid methyl esters, including the 9-octadecenoates. The bound exchanger was formed by the sulfonation of benzylated silica particles and conversion to the $Ag^+$ form. As a gas chromatographic packing, it exhibited a surprisingly strong attraction for olefinic moieties and required both silanization and the application of a suitable coating to permit the elution of the longer chain compounds. The coating attenuates the $Ag^+$-olefin attraction by providing functional groups which are in competition with the sample for the $Ag^+$ sites. This packing was used in a quantitative gas chromatographic determination of *trans* monounsaturation in a hydrogenated tallow fraction, giving results which agreed very well with those obtained by AOCS Method Cd 14–61.

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GAS LIQUID CHROMATOGRAPHIC ANALYSIS OF *CIS-TRANS* FATTY ACIDS OF STORE PURCHASED MARGARINES. D.M. OTTENSTEIN, G. WALKER, D. BARTLEY, V. MAHADEVAN, and N. PELICK, Supelco, Inc., Supelco Park, Bellefonte, PA 16823.

This paper will highlight the latest gas liquid chromatographic methodology for the analysis of *cis-trans* isomers of fatty acids of margarines. Fatty acid information will be presented on seven popular brands, and comparison data will

be shown using other technology. The elaidate/oleate content is determined on OV-275 columns and is shown to be capable of base-line separation. Fatty acid samples prepared from Blue Bonnet, Mrs. Filbert, Imperial, Parkay, Promise, Soft Promise, and Soft Fleischmanns will be shown.

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A STUDY OF COLOR STABILITY OF COMMERCIAL OLEIC ACID. SHERMAN S. LIN, AN-LI HSIEH, DAVID B.S. MIN, and STEPHEN S. CHANG, Department of Food Science, Rutgers University, New Brunswick, NJ 08903.

Commercial oleic acid has a tendency to develop a dark color during heating. It has been found that this discoloration is partially due to oxidation and partially due to the presence of minor constituents. Their characterization as oxidized and polymerized fatty acids will be reported in a separate paper. The effects of the two factors are synergistic to each other and thus accentuate the darkening of the commercial oleic acid when it is heated under air. Among the different adsorbents evaluated for removal of the minor constituents from commercial oleic acid, the 100 mesh dry silicic acid was most desirable. Removal of the minor constituents from commercial oleic acid by silicic acid can be achieved by either column chromatographic method or batch process. Increasing the column temperature to 70 C will increase the flow rate three times faster than that at room temperature. Although the color of eluate obtained at the higher temperature was slightly higher than that obtained at room temperature, the color stability of the former remained comparable to the latter. Removal of the minor constituents from commercial oleic acid by silicic acid treatment drastically improved its color stability. The generally acknowledged concept that the higher the polyunsaturated fatty acid content in the commercial oleic acid, the lower its color stability, is not correct. The color stability of commercial oleic acid is more predominantly dependent on the content of minor constituents than that of polyunsaturated fatty acid.

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QUANTITATIVE DETERMINATION OF ALPHA-, BETA-, GAMMA- AND DELTA-TOCOPHEROLS IN VEGETABLE OILS AND IN MARGARINES BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY. H.E. WOZIWODZKI, Lever Brothers, R&D, 45 River Rd., Edgewater, NJ 07020.

A novel and rapid procedure was developed for the quantitative determination of alpha-, beta-, gamma-, and delta-tocopherols in vegetable oils and in margarines. The proposed method involves a two step operation: (1) saponification and extraction of the unsaponifiable matter, and (2) separation and quantitative determination of the four tocopherol isomers by high performance liquid chromatography. Advantages of this procedure over previously published ones are (1) complete, baseline separation between beta- and gamma-tocopherol; (2) elimination of a clean-up step of the unsaponifiable matter, i.e., minimized sample handling; and (3) higher sensitivity for detection. Various oils and margarines have been analyzed by the method, and methodology and data obtained will be presented.

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A SIMPLIFIED GAS LIQUID CHROMATOGRAPHIC DETERMINATION FOR VITAMIN E IN VEGETABLE OILS. KENNETH T. HARTMAN, Frito-Lay Research Department, 900 North Loop 12, Irving, TX 75060.

A simple and rapid procedure has been developed for the isolation, concentration, esterification, and gas liquid chromatographic quantitation for the Vitamin E content of vegetable oils. Vitamin E is determined by saponification of the oil, ether extraction of the saponified mixture, drying and evaporation of the extract, followed by closed tube esterification and quantitation of the butyrate ester using a gas chromatograph equipped with a hydrogen flame ionization detector. This technique eliminates the conventional thin layer chromatographic isolation of Vitamin E normally used prior to direct or trimethylsilyl derivative gas liquid chromatographic quantitations. Oils fortified with Vitamin E in the 7–40 mg/100 g range showed recoveries of 93.4–98.6%.

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CORRELATION OF THE FLAVOR SCORE OF VEGETABLE OILS WITH VOLATILES PROFILE DATA. JOSEPH L. WILLIAMS and THOMAS H. APPLEWHITE, Kraftco Corporation, Research and Development, 801 Waukegan Rd., Glenview, IL 60025.

One of the most important quality parameters to users of commercial vegetable oils is flavor. For years taste panels have been used to rate the overall quality of oils in terms of flavor scores. However, flavor scores are subjective, vary considerably among individuals and laboratories, and are not really diagnostic. The need for more adequate quality evaluation of oils has focused attention on chemical changes and sensitive instrumental methods which can be used to differentiate the stage of freshness or deterioration. Dupuy's direct gas chromatographic method for the examination of the volatiles profile of vegetable oils has been applied to 18 fresh soybean oils, and the same 18 oils aged 5 weeks in light at 22 C. Extremely high correlation between the volatiles profile data and the flavor scores was found. The most significant peaks which were positively correlated with flavor score and those which were negatively correlated were obtained, and a prediction equation of flavor score could be calculated from the volatiles profile data.

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VOLATILES AND OIL QUALITY. HAROLD W. JACKSON and DAVID J. GIACHERIO, Kraftco Corporation, Research and Development, 801 Waukegan Rd., Glenview, IL 60025.

A new technique is presented for obtaining and measuring volatiles from lipids. The technique involves a simple sampling apparatus external to the gas chromatography instrument. Application to various edible oils will be shown, along with identification of important volatiles.