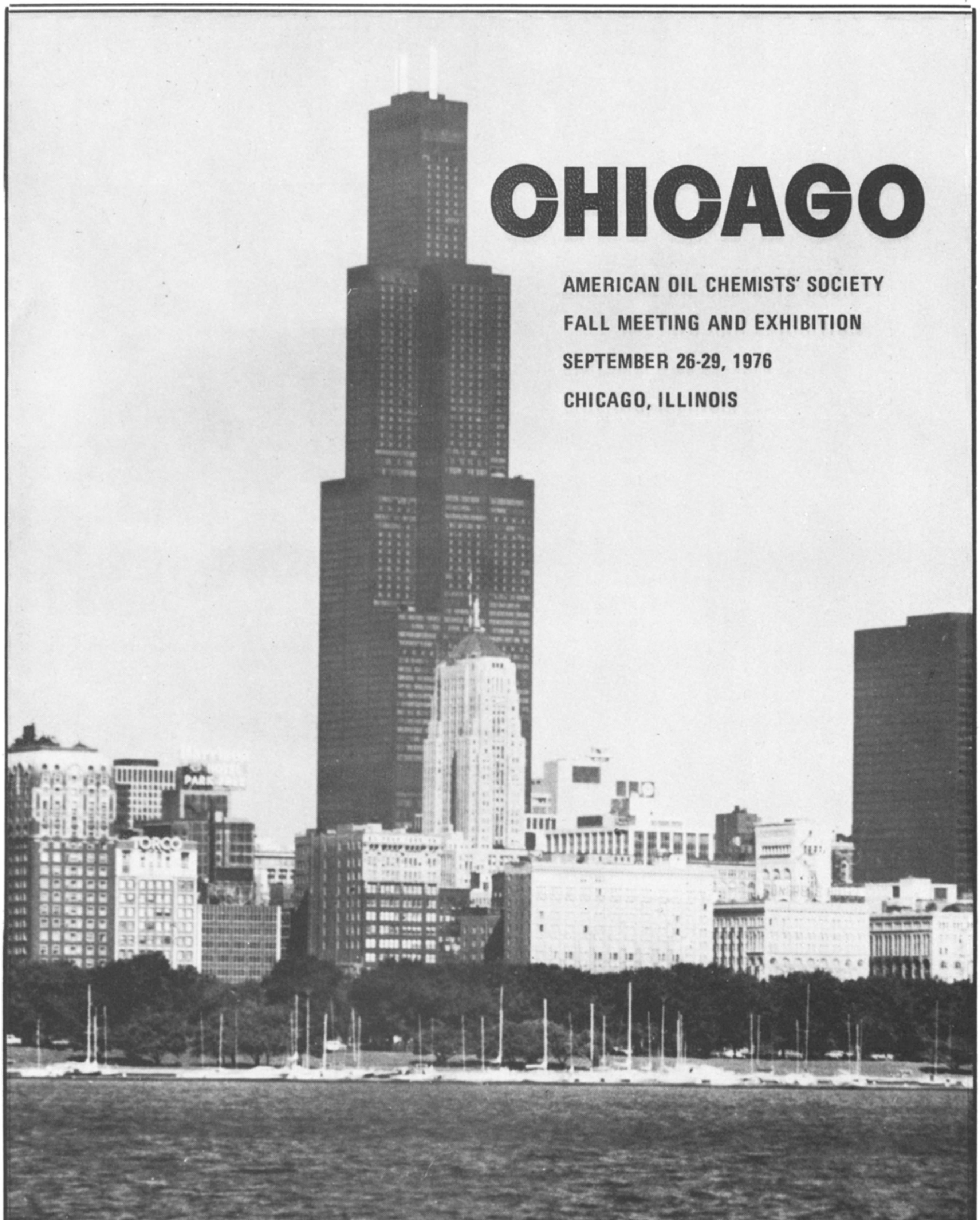

CHICAGO

AMERICAN OIL CHEMISTS' SOCIETY
FALL MEETING AND EXHIBITION
SEPTEMBER 26-29, 1976
CHICAGO, ILLINOIS

MONDAY MORNING—SEPTEMBER 27

10:00 a.m.—Haymarket

SESSION A—DETERGENTS

Chairman: **G. Maerker**, Eastern Regional Research Center, ARS, USDA, Philadelphia, PA

10:00 1. **SURFACE ACTIVE PROPERTIES OF COMBINATIONS OF SOAP WITH LIME SOAP DISPERSING AGENTS**
J.K. Weil* and W.M. Linfield, Eastern Regional Research Center, ARS, USDA, Philadelphia, PA

10:25 2. **SOAP-BASED DETERGENT FORMULATIONS: XXII. SULFOBETAINE DERIVATIVES OF FATTY AMIDES**
N. Parris,* C. Pierce, and W.M. Linfield, Eastern Regional Research Center, ARS, USDA, Philadelphia, PA

10:50 3. **SOAP-BASED DETERGENT FORMULATIONS: XXIII. SYNTHESIS OF p-SULFOBENZYL AMMONIUM INNER SALTS AND STRUCTURAL CORRELATION WITH ANALOGOUS SULFOBETAINES**
J.M. Kaminski,* Fats and Proteins Research Foundation, Inc., Des Plaines, IL, and W.M. Linfield, Eastern Regional Research Center, ARS, USDA, Philadelphia, PA

11.15 4. **SODIUM SILICATES FOR THE DETERGENT INDUSTRY**
E.J. Schuck* and J.H. McCracken, Diamond Shamrock Chemical Co., Cleveland, OH

MONDAY MORNING—SEPTEMBER 27

10:00 a.m.—Regency C

SESSION B—PALM OIL I.

Chairman: **Marshall Pike**, Harrison & Crossfield, Camberly, Surrey, U.K.

10:00 **INTRODUCTORY REMARKS**

10:15 5. **WHAT PRICE PALM OIL?**
D. Billings,* Liverpool Central Oil, U.K.

11:00 6. **RECENT DEVELOPMENTS IN THE MALAYSIAN PALM OIL INDUSTRY**
M.L. Yong,* The Oil Palm Growers' Council of Malaysia, Kuala Lumpur, Malaysia

MONDAY MORNING—SEPTEMBER 27

10:00 a.m.—Columbian

SESSION C—PROSTAGLANDINS I.

Chairman: **Rodolfo Paoletti**, University of Milan, Milan, Italy

10:00 **INTRODUCTORY REMARKS**

10:10 7. **BIOCHEMICAL ASPECTS OF CONTROL OF PROSTAGLANDIN BIOSYNTHESIS**
W.E.M. Lands,* The University of Michigan, Ann Arbor, MI

10:50 8. **FUNCTIONAL ASPECTS OF THE PROSTAGLANDIN SYSTEM IN CENTRAL NERVOUS TISSUE**
F. Coceani,* The Hospital for Sick Children, Toronto, Ontario, Canada

11:35 9. **RELATION BETWEEN ESSENTIAL FATTY ACIDS AND PROSTAGLANDINS IN THE CENTRAL NERVOUS SYSTEM**
C. Galli, G. Galli, and R. Paoletti,* University of Milan, Milan, Italy

MONDAY MORNING—SEPTEMBER 27

10:00 a.m.—Gold Coast

SESSION D—ANALYTICAL METHODS I.

Chairman: **Daniel P. Schwartz**, Eastern Regional Research Center, ARS, USDA, Philadelphia, PA

10:00 10. **LIQUID CHROMATOGRAPHIC SEPARATION OF SUCROSE PALMITATES**
G.S. Fisher, H.J. Zeringue, Jr.,* and R.O. Feuge, Southern Regional Research Center, ARS, USDA, New Orleans, LA

10:30 11. **HIGH PRESSURE LIQUID CHROMATOGRAPHY FOR THE ANALYSIS OF SOLUBLE SACCHARIDES IN OILSEEDS**
G.F. Cegla,* Texas A&M University, College Station, TX

11:00 12. **HIGH PRESSURE REVERSE PHASE LIQUID CHROMATOGRAPHY OF FATTY ACID p-BROMOPHENACYL ESTERS**
S. Ramachandran,* P.T.S. Pei, W.C. Kossa, and R.S. Henly, Applied Science Laboratories, Inc., State College, PA

11:30 13. **TRIGLYCERIDE COMPOSITION BY REVERSE PHASE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY**
R.D. Plattner,* G.F. Spencer, and R. Kleiman, Northern Regional Research Center, ARS, USDA, Peoria, IL

MONDAY MORNING—SEPTEMBER 27

10:00 a.m.—Water Tower

SESSION E—GENERAL BIOCHEMISTRY I.

Chairman: **A. Kuksis**, University of Toronto, Toronto, Ontario, Canada

10:00 14. **EFFECT OF DOUBLE BOND POSITION UPON UTILIZATION OF FATTY ACIDS IN BIOLOGICAL SYSTEMS**
R.T. Holman,* The Hormel Institute, Austin, MN

10:30 15. **EFFECT OF DOUBLE BOND GEOMETRY AND POSITION UPON HYDROLYSIS OF MIXED TRIGLYCERIDES BY PANCREATIC LIPASE B**
A.J. Valicenti,* H.L. Brockman, and R.T. Holman, The Hormel Institute, Austin, MN

11:00 16. **METABOLISM OF EICOSA-11,14-DIENOIC ACID IN TESTICULAR TISSUE**
D.H. Albert* and J.G. Coniglio, Vanderbilt University, Nashville, TN

MONDAY AFTERNOON—SEPTEMBER 27

2:00 p.m.—Regency C

SESSION F—PALM OIL II.

Chairman: **Marshall Pike**, Harrison & Crossfield, Camberly, Surrey, U.K.

2:00 17. **ASPECTS ON THE QUALITY OF PALM OIL**
P-O Pehlergaard and G.M.R. Johansson,* AB Karlshamns Oljefabriker, Karlshamn, Sweden

2:45 18. **STEAM REFINING DEODORIZER FOR MALAYSIAN PALM OIL**
A.M. Gavin,* K.T. Teoh, and G.T. Carlin, EMI Corp., Des Plaines, IL

3:30 19. **USE OF PALM OIL IN THE EDIBLE FATS BUSINESS**
J. Rourke,* Unilever Ltd., London, England, U.K.

MONDAY AFTERNOON—SEPTEMBER 27

1:30 p.m.—Regency B

SESSION G—MANAGEMENT PERSPECTIVES

Chairman: **Albert E. Brust**, Swift Edible Oil Co., Chicago, IL

1:30 **INTRODUCTION**

1:45 20. **HOW TO USE THE WONDERFUL GOLD MINE BETWEEN YOUR EARS**
W.N. Schultz,* How To Co., Kenilworth, IL

3:00 21. **COMPENSATION PLANNING—A JUGGLING ACT**
R.L. Istnick,* Hewitt Associates, Deerfield, IL

4:15 22. **THE PROFESSIONAL AS AN EXECUTIVE AND AS A PERSON**
L. Simon*

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* Speaker.

MONDAY AFTERNOON—SEPTEMBER 27

2:00 p.m.—Columbian

SESSION H—PROSTAGLANDINS II.

Chairman: **Rodolfo Paoletti,** University of Milan, Milan, Italy

2:00 23. **BIOSYNTHESIS OF PROSTAGLANDINS (HONORED STUDENT PRESENTATION)**
M. Hemler* and W.E.M. Lands, The University of Michigan, Ann Arbor, MI

2:40 24. **PROSTAGLANDINS IN THE HUMAN FEMALE GENITAL TRACT**
E.J. Singh,* The University of Chicago, Chicago, IL

3:20 25. **PROSTAGLANDINS IN THE CARDIOVASCULAR SYSTEM**
J.B. Lee,* State University of New York at Buffalo, NY

4:00 26. **PROSTAGLANDINS AND INFLAMMATION**
G. Weissmann,* New York University, New York, NY

MONDAY AFTERNOON—SEPTEMBER 27

2:00 p.m.—Gold Coast

SESSION I—ANALYTICAL METHODS II.

Chairman: **Daniel P. Schwartz,** Eastern Regional Research Center, ARS, USDA, Philadelphia, PA

2:00 27. **DIRECT GAS CHROMATOGRAPHIC TECHNIQUE FOR STUDYING NEUTRAL VOLATILES OF MAYONNAISE**
S.P. Fore,* M.G. Legendre, and G.S. Fisher, Southern Regional Research Center, ARS, USDA, New Orleans, LA

2:30 28. **NEW DEVELOPMENTS IN SILVER RESIN CHROMATOGRAPHY OF FATTY METHYL ESTERS**
C.R. Scholfield,* Northern Regional Research Center, ARS, USDA, Peoria, IL

3:00 29. **ANALYTICAL ^{13}C NUCLEAR MAGNETIC RESONANCE: A RAPID, NONDESTRUCTIVE METHOD FOR DETERMINING THE cis-trans RATIO OF COMPLEX UNSATURATED LIPID MIXTURES**
P.E. Pfeffer* and F.E. Luddy, Eastern Regional Research Center, ARS, USDA, Philadelphia, PA, and J.N. Shoolery, Varian Instrument Division, Palo Alto, CA

3:30 30. **EMULSIONS STUDY USING PULSED NUCLEAR MAGNETIC RESONANCE**
J. Trumbetas,* J.A. Fioriti, and R.J. Sims, General Foods Corp., White Plains, NY

4:00 31. **AUTOMATED METHOD FOR DETERMINING OIL STABILITY**
J.M. deMan,* University of Guelph, Guelph, Ontario, Canada

4:30 32. **CHEMILUMINESCENCE FROM FOODSTUFFS**
G.D. Mendenhall* and R.A. Nathan, Battelle Laboratories, Columbus, OH

MONDAY AFTERNOON—SEPTEMBER 27

2:00 p.m.—Haymarket

SESSION J—GENERAL BIOCHEMISTRY II.

Chairman: **J.G. Coniglio,** Vanderbilt University, Nashville, TN

2:00 33. **MURICHOLIC ACID FORMATION IN THE ISOLATED PERFUSED RAT LIVER**
M.M. Fisher and I.M. Yousef,* University of Toronto, Toronto, Ontario, Canada

2:30 34. **EXCLUSION OF β-SITOSTEROL FROM SUBCELLULAR SITES OF RAT LIVER PENETRATED BY CHOLESTEROL**
G. Kakis and A. Kuksis,* University of Toronto, Toronto, Ontario, Canada

3:00 35. **LIPOPROTEIN EQUILIBRATION AND CLEARANCE OF INTRALIPID FROM RAT PLASMA**
G. Kakis,* W.C. Breckenridge, and A. Kuksis, University of Toronto, Toronto, Ontario, Canada

3:30 36. **ISOMERIC DIALKYLACLYGLYCEROLS AS SUBSTRATES FOR DETERMINING THE SPECIFICITIES OF PURIFIED PLASMA AND TISSUE LIPASES**
G.F. Cegla* and H.K. Mangold, Texas A&M University, College Station, TX, and H. Greten, University of Heidelberg, Heidelberg, West Germany

4:00 37. **DIFFERENTIAL SOLUBILIZATION OF BILE CANALICULAR MEMBRANE PHOSPHOLIPIDS BY BILE ACIDS**
I.M. Yousef* and M.M. Fisher, University of Toronto, Toronto, Ontario, Canada

4:30 38. **ISOLATION OF Δ^2-3-CH$_3$ MEVALONOLACTONE DURING THE ASSAY OF HMG-CoA REDUCTASE ACTIVITY IN RAT LIVER MICROSOMES (POSTER SESSION)**
A. Sanghvi* and B. Parikh, University of Pittsburgh, Pittsburgh, PA

MONDAY AFTERNOON—SEPTEMBER 27

1:30 p.m.—Regency A

SESSION K—EMULSIFIERS

Chairman: **David B. Min,** The Quaker Oats Co., Barrington, IL

1:30 39. **CHOOSING EMULSIFIERS FOR FOOD SYSTEMS**
G.E. Petrowski,* Kelco Co., San Diego, CA

1:55 40. **CHEMICAL-PHYSICAL PROPERTIES OF FOOD EMULSIFIERS RELATED TO FUNCTIONS IN FOOD PRODUCTS**
N. Krog,* Grindsted Products, Brabrand, Denmark

2:20 41. **THE ROLE OF SURFACTANTS IN BAKERY FOODS**
C.C. Tsen,* Kansas State University, Manhattan, KS

2:45 42. **ROLE OF EMULSIFIERS IN NONDAIRY TOPPINGS**
J.J. Jonas,* Kraftco Corp., Glenview, IL

3:10 43. **THE APPLICATION OF THE EMULSIFIER HYDROPHILE-LIPOPHILE BALANCE THEORY IN FORMULATING A TEXTURED PROTEIN PRODUCT**
D. Bone and F.R. Kincs,* The Quaker Oats Co., Barrington, IL

3:35 44. **UTILIZATION OF MATHEMATICAL MODELS TO CHARACTERIZE FUNCTIONAL PROPERTIES OF SELECTED EMULSIFIERS IN CONTINUOUS MIX BREAD**
I. Gawrilow,* Glidden-Durkee Div., SCM Corp., Strongsville, OH

4:00 45. **APPLICATIONS OF THE ACYL LACTYLATES IN FOOD SYSTEMS**
A.J. Del Vecchio and A.J. Dankwerth,* C.J. Patterson Co., Kansas City, MO

4:25 46. **MONOGLYCERIDES AS FOOD TEXTURIZING AGENTS**
C.P. Johnson,* Eastman Chemical Products, Inc., Kingsport, TN

MONDAY AFTERNOON—SEPTEMBER 27

2:00 p.m.—Water Tower

SESSION L—INEDIBLE USES OF FATS

Chairman: **Werner R. Boehme,** Fats and Proteins Research Foundation, Inc., Des Plaines, IL

2:00 47. **HYDROXYLATIONS OF FATTY ACIDS AND THEIR DERIVATIVES**
L.A. Messer* and N.C. Deno, The Pennsylvania State University, University Park, PA

2:30 48. **PRODUCTION OF LINEAR DIACIDS FROM NITRIC ACID OXIDATION OF SATURATED FATTY ACIDS**
N.C. Deno,* V.L. Deno, and J.M. Skell, The Pennsylvania State University, University Park, PA

3:00 49. **SELECTIVE CHLORINATION OF FATTY AMIDES**
E.J. Jedziniak* and N.C. Deno, The Pennsylvania State University, University Park, PA

3:30 50. **PROCESS VARIATIONS FOR THE SULFATION OF FATTY ACID ALKANOLAMIDES**
R.G. Bistline, Jr.,* W.R. Noble, and W.M. Linfield, Eastern Regional Research Center, ARS, USDA, Philadelphia, PA

4:00 51. **FAT DERIVATIVES WITH INDUSTRIAL USE POTENTIAL**
D.M. Doty,* Buchanan, TN

4:30 52. **FATS ARE USED FOR MANY PURPOSES**
O.H.M. Wilder,* Consultant, Fayetteville, AR

TUESDAY MORNING—SEPTEMBER 28

9:00 a.m.—Water Tower

SESSION M—INFLUENCE OF FOOD COMPONENTS ON ATHEROSCLEROSIS I.

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

9:00 INTRODUCTORY REMARKS

9:15 53. **DIETARY FATS AND ATHEROSCLEROSIS**
D. Vesselinovitch,* R.W. Wissler, and R. Jones, University of Chicago, Chicago, IL

10:00 54. **ROLE OF DIETARY PROTEIN IN HYPERCHOLESTEROLEMIA AND ATHEROSCLEROSIS**
K.K. Carroll,* University of Western Ontario, London, Ontario, Canada

10:45 55. **THE ROLE OF DIETARY CARBOHYDRATE IN CHOLESTEREMIA AND ATHEROSCLEROSIS**
D. Kritchevsky,* The Wistar Institute, Philadelphia, PA

11:30 56. **DIETARY FIBER AND ATHEROSCLEROSIS**
J.A. Story,* S.A. Tepper, and D. Kritchevsky, The Wistar Institute, Philadelphia, PA

TUESDAY MORNING—SEPTEMBER 28

9:00 a.m.—Regency C

SESSION N—PALM OIL III.—FRACTIONATION

Chairman: **Marshall Pike,** Harrison & Crossfield, Camberly, Surrey, U.K.

9:00 INTRODUCTORY REMARKS

9:10 57. **FRACTIONATION OF PALM OIL: THEORETICAL AND PRACTICAL CONSIDERATIONS**
K.G. Berger,* J. Lyons & Co., Ltd., London, England

9:55 58. **DRY FRACTIONATION OF PALM OIL BY DIRECTED CRYSTALLIZATION AND FILTRATION: THE TIRTIAUX SYSTEM**
A. Tirtiaux,* S.A. Fractionnement Tirtiaux, Fleurus, Belgium

10:40 59. **DETERGENT FRACTIONATION OF FATTY OILS**
B. Braae,* Alfa-Laval AB, Tumba, Sweden

11:25 60. **CONTINUOUS SOLVENT FRACTIONATION OF PALM OIL AND OTHER EDIBLE OILS**
E. Bernardini,* Construzioni Meccaniche, Rome, Italy

TUESDAY MORNING—SEPTEMBER 28

9:00 a.m.—Gold Coast

SESSION O—BIOLOGICAL EFFECTS OF SPECIAL LIPIDS

Chairman: **H. Kaunitz,** Columbia University, New York, NY

9:00 61. **INFLUENCE OF DIETARY FATS ON RESPONSE OF RATS TO AUDITORY STRESS**
H. Kaunitz,* L.M. Geller, R.E. Johnson, and M. Shemesh, Columbia University, New York, NY

9:30 62. **SUCROSE POLYESTERS: UNABSORBABLE, CHOLESTEROL LOWERING FATS**
R.J. Jandacek* and F.H. Mattson, The Procter & Gamble Co., Cincinnati, OH

10:00 63. **POLYGLYCEROLS AND POLYGLYCEROL ESTERS AS BIOLOGICAL TOOLS IN DIETETIC AND METABOLIC FUNCTIONS**
V.K. Babayan,* Stokely-Van Camp, Inc., Indianapolis, IN

10:30 64. **TOXICITY OF THERMALLY POLYMERIZED OIL**
T. Kaneda* and M. Saito, Tohoku University, Sendai, Japan

11:00 65. **EFFECTS OF THERMALLY OXIDIZED OLIVE OIL IN IN VITRO HEART CELLS**
R. Prasad,* J.C. Alexander, and P.K. Basrur, University of Guelph, Guelph, Ontario, Canada

11:30 66. **IN VIVO RED CELL MEMBRANE LIPID PEROXIDATION IN HUMANS AND ANIMALS WITH NORMAL SERUM VITAMIN E LEVELS**
B.D. Goldstein,* New York University, New York, NY

TUESDAY MORNING—SEPTEMBER 28

9:00 a.m.—Regency A

SESSION P—FATS IN THE BAKING INDUSTRY

Chairmen: **George J. Hill** and **John C. Colmey,** ITT Continental Baking Co., Rye, NY

9:00 INTRODUCTORY REMARKS

9:05 67. **BREAD SHORTENINGS**
P.M. Koren,* The Procter & Gamble Co., Cincinnati, OH

9:35 68. **CAKE SHORTENING**
D.I. Hartnett,* ICI United States, Inc., Wilmington, DE

10:05 69. **PASTRY SHORTENINGS**
A. Aslani,* Glidden-Durkee Co., Cleveland, OH

10:35 70. **SHORTENINGS FOR BAKERY TYPE CREAM ICINGS AND FILLINGS**
H. Brody* and W.M. Cochran, Swift Edible Oil Co., Oak Brook, IL

11:05 71. **CONFECTIONERY COATING FATS FOR THE BAKERY INDUSTRY**
T.A. Andrews,* PVO International, Inc., San Francisco, CA

11:35 72. **FRYING FATS IN THE BAKING INDUSTRY**
J.G. Marcus,* Best Foods, Div., CPC International, Roseland, NJ

TUESDAY MORNING—SEPTEMBER 28

9:00 a.m.—Haymarket

SESSION Q—ANTIOXIDANTS

Chairman: **Rex J. Sims,** General Foods Corp., White Plains, NY

9:00 73. **STABLE FREE RADICALS AS ANTIOXIDANTS FOR AQUEOUS LINOLEATE EMULSIONS**
H.S. Olcott,* J.S. Lin, and A. Taslimi, University of California, Davis, CA

9:25 74. **ANTIOXYGENIC ACTIVITY OF SEA ALGAE**
K. Fujimoto* and T. Kaneda, Tohoku University, Sendai, Japan

9:50 75. **NATURAL ANTIOXIDANTS FROM SPICES**
S.S. Chang,* Rutgers State University, New Brunswick, NJ, B. Ostric-Matijasevic, University of Novi Sad-Yugoslavia, O.A.L. Hsieh, Rutgers State University, New Brunswick, NJ, and C-L Huang, Pharmacia Laboratories, Inc.

10:15 76. **USE OF NATURAL ANTIOXIDANTS EXTRACTED FROM Phaseolus Vulgaris IN VARIOUS FISHERY PRODUCTS**
L.R. Tovar* and S.P. Castro, University of Mexico, Mexico

10:40 77. **THE PERFORMANCE OF NONABSORBABLE POLYMERIC ANTIOXIDANTS IN FOODS**
T.E. Furia* and N. Bellanca, Dynapol, Palo Alto, CA

11:05 78. **ANTIOXIDANT LOSSES DURING FOOD PROCESSING**
A.W. Kirleis,* Purdue University, West Lafayette, IN

11:30 79. **COMPARISON OF OXIDATIVE STABILITY OF MACKEREL SKIN OIL WITH VARIOUS ANTIOXIDANTS**
P.J. Ke,* R.G. Ackman, and D.M. Nash, Environment Canada, Fisheries and Marine Service, Halifax, Nova Scotia, Canada

TUESDAY MORNING—SEPTEMBER 28

9:00 a.m.—Columbian

SESSION R—FATTY CHEMICAL TECHNOLOGY

Chairman: **Karl Zilch,** Emery Industries, Cincinnati, OH

9:00 80. **RECENT DEVELOPMENTS IN THE METATHESIS OF FATTY ESTERS**
C. Boelhouower* and E. Verkuijlen, University of Amsterdam, Amsterdam, The Netherlands

9:30 81. **POLYAMIDES FROM CARBOXYSTEARIC ACID**
W.L. Kohlhase, E.N. Frankel, and E.H. Pryde,* Northern Regional Research Center, ARS, USDA, Peoria, IL

10:00 82. **WATER DISPERSIBLE URETHANE POLYESTERAMIDE COATINGS FROM LINSEED AND SOYBEAN OILS**
W.J. Schneider and L.E. Gast,* Northern Regional Research Center, ARS, USDA, Peoria, IL

10:30 83. **WHAT REALLY HAPPENS WHEN THIOCYANOGEN IS ADDED TO UNSATURATED FATTY ACIDS?**
R.J. Maxwell* and L.S. Silbert, Eastern Regional Research Center, ARS, USDA, Philadelphia, PA

11:00 84. **GENERALIZED STRUCTURE/PROPERTY INFLUENCES OF HYDANOTOIN RINGS IN FATTY DERIVATIVES AND THE OVERALL EFFECT ON TECHNOLOGY**
N.O.V. Sonntag,* Glyco Chemicals, Inc., Williamsport, PA

TUESDAY MORNING—SEPTEMBER 28

9:00 a.m.—Regency B

SESSION S—OILSEED PROCESSING—1976 SEED PREPARATION

Chairman: **William M. Barger,** The French Oil Mill Machinery Co., Piqua, OH

9:00 **INTRODUCTORY REMARKS**

9:05 85. **SOYBEAN PREPARATION**
J.G. Fawbush,* Central Soya Co., Fort Wayne, IN

9:30 86. **COTTONSEED PREPARATION**
J.M. Ridlehuber,* Plains Cooperative Oil Mill, Lubbock, TX

9:55 87. **SUNFLOWER SEED PREPARATION**
H.J. Sandvig,* Cargill, Inc., Minneapolis, MN

10:20 88. **RAPESEED PREPARATION**
J. Enns,* CSP Foods, Ltd., Saskatoon, Saskatchewan, Canada

10:45 89. **PREPARATION OF PEANUTS PRIOR TO EXTRACTION**
C.T. Hunt,* Gold Kist, Inc., Atlanta, GA

11:10 90. **SAFFLOWER SEED PREPARATION**
A. Gracia,* Los Molinos, S.A., Sonora, Mexico

11:35 91. **DRYING, STORAGE, AND PREPARATION OF COPRA FOR EXTRACTION OF OIL**
P.A. Malabrigo,* Neumunz, Inc., Leonia, NJ

TUESDAY AFTERNOON—SEPTEMBER 28

2:00 p.m.—Water Tower

SESSION T—INFLUENCE OF FOOD COMPONENTS ON ATHEROSCLEROSIS II.

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

2:00 92. **ZINC/COPPER AND THE EPIDEMIOLOGY OF ISCHEMIC HEART DISEASE**
L.M. Klevay*, Human Nutrition Laboratory, ARS, USDA, Grand Forks, ND

2:45 93. **DOES DIETARY CHOLESTEROL AFFECT SERUM CHOLESTEROL LEVELS?**
R.B. Alfin-Slater,* D. Puppione, A. Alexander, and G. Slater, University of California, Los Angeles, CA

3:30 94. **SOYBEAN PROTEIN DIET IN THE CLINICAL MANAGEMENT OF HYPERCHOLESTERMIA**
C.R. Sirtori,* University of Milan, Milan, Italy, E. Gatti and F. Conti, Maggiore Hospital, Milan, Italy, and S. Zoppi, University of Milan, Milan, Italy

TUESDAY AFTERNOON—SEPTEMBER 28

2:00 p.m.—Regency A

SESSION U—AUTOMATION OF EDIBLE OIL REFINERIES

Chairman: **Herbert J. Dutton,** Northern Regional Research Center, ARS, USDA, Peoria, IL

2:00 **INTRODUCTORY REMARKS**

2:05 95. **TRANSDUCERS FOR COMPUTER MONITORING OF EDIBLE OIL REFINING**
H.J. Dutton* and E.D. Bitner, Northern Regional Research Center, ARS, USDA, Peoria, IL

2:35 96. **COMPUTERIZED BATCH CONTROL AND SEQUENCING**
P.K. Nielsen,* General Meters and Controls Co., Park Ridge, IL

3:05 97. **AUTOMATED SYSTEMS FOR CHEMICAL PROCESS STUDIES FOR THE EDIBLE OIL INDUSTRY**
S.S. Randhava* and S.S. Randhava, Xytel Corp., Lombard, IL

3:35 98. **AUTOMATION IN EDIBLE OIL REFINERIES**
A.J. Duff,* Unilever, N. V., Vlaardingen, The Netherlands

4:05 99. **MISCELLA REFINING**
G.C. Cavanagh,* Ranchers Cotton Oil Co., Fresno, CA

4:35 100. **EVALUATION OF REFINING CHARACTERISTICS OF CRUDE OILS**
Y. Hoffmann* and I. Hoffmann, AB Pellerin/Zenith, Helsingborg, Sweden

TUESDAY AFTERNOON—SEPTEMBER 28

2:00 p.m.—Regency B

SESSION V—OILSEED PROCESSING—1976 EXTRACTION AND MEAL HANDLING

Chairman: **William M. Barger,** The French Oil Mill Machinery Co., Piqua, OH

2:00 101. **MECHANICAL PRESSING**
D. Bredeson,* French Oil Mill Machinery Co., Piqua, OH

2:25 102. **SOLVENT EXTRACTION**
N.W. Myers,* Myers Engineers, Decatur, IL

2:50 103. **MEAL DRYING AND COOLING**
L.W. Follett,* Davenport Machine and Foundry Co., Davenport, IA

3:15 104. **MEAL SCREENING AND MEAL GRINDING**
G.R. Thomas,* Prater Industrial Products, Inc., Chicago, IL

3:40 105. **MEAL PELLETING AND PELLET COOLING**
R.A. Robinson,* California Pellet Mill Co., Crawfordsville, IN

TUESDAY AFTERNOON—SEPTEMBER 28

2:00 p.m.—Gold Coast

SESSION W—SYNTHETIC LUBRICANTS

Chairman: **Norman Baker,** Celanese Chemical Co., New York, NY

2:00 **INTRODUCTORY REMARKS**

2:15 106. **HISTORY AND EXPERIENCE WITH SYNTHETIC LUBRICANTS**
R.T. Trites,* Amzoil, Inc., Plano, TX

3:00 107. **DIESTER SYNTHETIC LUBRICANTS FOR SEVERE SERVICE AUTOMOTIVE AND DIESEL APPLICATIONS**
R.H. Boehringer* and R.J. Ruebusch, Emery Industries, Inc., Cincinnati, OH

3:45 108. **A REVIEW OF SYNTHESIZED HYDROCARBON LUBRICANTS**
D.S. Taber,* Mobil Oil Corp., New York, NY

4:30 **GROUP DISCUSSION**

TUESDAY AFTERNOON—SEPTEMBER 28

2:00 p.m.—Columbian

SESSION X—GENERAL BIOCHEMISTRY III.

Chairman: **A. Kuksis,** University of Toronto, Toronto, Canada

2:00 109. **METABOLISM OF BROMINATED FATTY ACIDS**
I.J. Tinsley,* B. Jones, and R.R. Lowry, Oregon State University, Corvallis, OR

2:30 110. **INFLUENCE OF DIET ON PLASMA CHOLESTEROL LEVELS IN WEANLING RABBITS (HONORED STUDENT PRESENTATION)**
M.W. Huff,* D.C.K. Roberts, and K.K. Carroll, University of Western Ontario, London, Ontario, Canada

3:00 111. **DI-2-ETHYLHEXYL PHTHALATE: AN INHIBITOR OF HEPATIC STEROL AND SQUALENE BIOSYNTHESIS IN THE RAT**
F.P. Bell,* McMaster University, Hamilton, Ontario, Canada

3:30 112. **EFFECT OF CHRONIC INGESTION OF DDT ON PHYSIOLOGICAL AND BIOCHEMICAL ASPECTS OF ESSENTIAL FATTY ACID DEFICIENCY**
D.A. Sampson,* Colorado State University, and R.E. Pitas and R.G. Jensen, University of Connecticut, Storrs, CT

4:00 113. **BLOOD LIPIDS AND THEIR RELATION TO ATHEROSCLEROSIS IN NIGERIANS**
P.O. Egwim,* University of Nigeria, Enugu Campus, Nigeria

4:30 114. **BIOLOGICAL EVALUATION OF CRAMBE MEALS DETOXIFIED BY WATER EXTRACTION ON A CONTINUOUS FILTER**
E.C. Baker* and G.C. Mustakas, Northern Regional Research Center, ARS, USDA, Peoria, IL, and M.R. Gumbmann and D.H. Gould, Western Regional Research Center, ARS, USDA

TUESDAY AFTERNOON—SEPTEMBER 28

2:00 p.m.—Haymarket

SESSION Y—PACKAGING FOR EDIBLE OIL PRODUCTS' INDUSTRY

Chairman: **Howard Richards,** Kraftco Corp., Glenview, IL

2:00 115. **AN UPDATE ON GLASS AND PLASTIC PACKAGING OF SALAD OIL WITH METAL AND PLASTIC CLOSURES**
R. Longsett* and D.E. Parson,* Kerr Glass Manufacturing Corp.

2:45 116. **COMPOSITE CANS—YOUR PRODUCTS' PARTNER**
J. Pricer* and S. Sabath,* Boise Cascade Corp., Hazelwood, MO

3:30 117. **PACKAGING IN THE MARGARINE INDUSTRY**
A.F. Foell, Jr.,* and R.D. Hout, Crown Zellerbach Co., Kansas City, MO

4:15 118. **AEROSOL PACKAGING OF FOODS**
M.A. Johnson,* Peterson Puritan, Inc., IL

TUESDAY AFTERNOON—SEPTEMBER 28

2:00 p.m.—Regency C

SESSION Z—GENERAL PROCESSING

Chairman: **T.H. Smouse,** Anderson Clayton Co., Richardson, TX

2:00 119. **CHARACTERISTICS OF THE PROTEIN SOLIDS FROM HIGH AND LOW TEMPERATURE RENDERINGS**
G. Matern,* South Chicago Packing, Chicago, IL

2:25 120. **COMPARISON OF PROCEDURES FOR EXTRACTION OF LIPIDS FROM SOYBEAN PROTEIN MATERIAL (HONORED STUDENT PRESENTATION)**
R.M. Moyers,* S.L. Melton, and C.G. Playford, University of Tennessee, Knoxville, TN

2:50 121. **CHOLESTEROL REMOVAL FROM EDIBLE BEEF FAT FRACTIONS**
F.E. Luddy,* J.W. Hampson, P. Magidman, and H.L. Rothbart, Eastern Regional Research Center, ARS, USDA, Philadelphia, PA

3:15 122. **OXYGENATED FATTY ACID CONSTITUENTS OF SOYBEAN PHOSPHATIDYL CHOLINES**
D.J. Sessa, H.W. Gardner,* R. Kleiman, and D. Weisleder, Northern Regional Research Center, ARS, USDA, Peoria, IL

3:40 123. **VACCENIC ACID CONTENT IN EDIBLE FATS AND OILS (POSTER SESSION)**
E. Wasowicz* and F.W. Hougen, University of Manitoba, Winnipeg, Manitoba, Canada

4:05 124. **FATTY ACID COMPOSITION OF FINFISH, SHELLFISH, AND SOME OTHER AQUATIC ANIMALS (POSTER SESSION)**
J. Exler* and J.L. Weihrauch, Consumer and Food Economics Institute, ARS, USDA, Hyattsville, MD

WEDNESDAY MORNING—SEPTEMBER 29

9:00 a.m.—Regency C

SESSION AA—HYDROGENATION

Chairman: **Edwin Frankel,** Northern Regional Research Center, ARS, USDA, Peoria, IL

9:00 **INTRODUCTORY REMARKS**

9:05 125. **HYDROGENATION AND ISOMERIZATION OF METHYL OLEATE, METHYL ELAIDATE, AND COTTONSEED OIL**
S. Stefanovic, Food and Drug Administration, R.H. Price, University of Cincinnati, and L.F. Albright,* Purdue University, West Lafayette, IN

9:30 126. **EFFECT OF THE UNSATURATED ACYL POSITION IN TRIGLYCERIDES ON THE HYDROGENATION RATE**
B. Drozdowski,* Gdansk Technical University, Gdansk, Poland

9:55 127. **HYDROGENATION OF RAPESEED OIL**
P.S. Puri* and J.M. deMan, University of Guelph, Guelph, Ontario, Canada

10:20 128. **EFFECT OF THE CONCENTRATION OF SOME NICKEL CATALYST POISONS IN OILS ON THE HYDROGENATION COURSE**
B. Drozdowski* and M. Zajac, Gdansk Technical University, Gdansk, Poland

10:45 129. **HIGH-SPEED HYDROGENATION OF FATS AND FATTY ACIDS IN CONTINUOUS FLOW REACTORS**
K. Ilsemann and K.D. Mukherjee,* Bundesanstalt fur Fettforschung, Munster, Germany

11:10 130. **LABORATORY SCALE CONTINUOUS HYDROGENATION**
J.M. Snyder,* H.J. Dutton, and C.R. Scholfield, Northern Regional Research Center, ARS, USDA, Peoria, IL

11:35 131. **RELATIONSHIP BETWEEN COMPOSITION AND ODOR IN COPPER HYDROGENATED OILS**
P.Y. Vigneron,* LeSieur-Cotelle & Associes, Seine, France

WEDNESDAY MORNING—SEPTEMBER 29

9:00 a.m.—Water Tower

SESSION BB—ANALYTICAL METHODS III.

Chairman: **Daniel P. Schwartz,** Eastern Regional Research Center, ARS, USDA, Philadelphia, PA

9:00 132. **APPLICATION OF CHRONIC ACIDCELITE COLUMN TO LIPID MICROANALYSES**
D.P. Schwartz,* Eastern Regional Research Center, ARS, USDA, Philadelphia, PA

9:25 133. **APPARATUS FOR MICRO-OZONOLYSIS AND HYDROGENATION**
N. Pelick* and V. Mahadevan, Supelco, Inc., Bellefonte, PA

9:50 134. **A DERIVITIZATION METHOD FOR DETERMINATION OF BROMINATED FATTY ACIDS**
R.R. Lowry* and I.J. Tinsley, Oregon State University, Corvallis, OR

10:15 135. **SYNTHESIS OF SPECIFICALLY DIDEUTERATED OCTADECANOATES AND OXOOCTADECANOATES**
A.P. Tulloch,* National Research Council of Canada, Saskatoon, Saskatchewan, Canada

10:40 136. **SYNTHESIS OF 1-^{14}C LABELED trans-OCTADECENOIC ACIDS**
A.J. Valicenti,* F.J. Pusch, and R.T. Holman, The Hormel Institute, Austin, MN

11:05 137. **A MICROSCOPIC METHOD FOR THE ESTIMATION OF FRAGILITY, SIZE, AND NUMBERS OF GOSSYPOL PIGMENT GLANDS IN GLANDED COTTONSEED**
C.W. Monagle,* G.J. Glenn, and J.T. Lawhon, Texas A&M University, College Station, TX

11:30 138. **AN ANALYSIS OF WATER BINDING TO PHOSPHATIDYL CHOLINES**
G.L. Jendrasiak,* University of Illinois, Urbana, IL, and J.H. Hasty, Kendall Research Center, Barrington, IL

WEDNESDAY MORNING—SEPTEMBER 29

9:00 a.m.—Gold Coast

SESSION CC—SPECIAL FOOD FATS

Chairman: **Francis E. Luddy,** Eastern Regional Research Center, ARS, USDA, Philadelphia, PA

9:00 139. **FATS AND OILS IN THE 1980s**
J.L. Heimann,* Emery Industries, Inc., Cincinnati, OH

9:25 140. **SYMMETRICAL ETHERS AND ETHERS-ESTERS OF GLYCEROL**
G.F. Cegla,* Texas A&M University, College Station, TX, and H.K. Mangold, University of Heidelberg, Heidelberg, West Germany

9:50 141. **PERFORMANCE CHARACTERISTICS OF PEANUT OIL PRODUCTS**
R.O. Feuge, M.S. Gray,* and J.L. White, Sr., Southern Regional Research Center, ARS, USDA, New Orleans, LA

10:15 142. **ZERO trans MARGARINES: PREPARATION, STRUCTURE, AND PROPERTIES OF INTERESTERIFIED SOYBEAN OIL-SOY TRISATURATE BLENDS**
G.R. List,* E.A. Emken, W.F. Kwolek, T.D. Simpson, and H.J. Dutton, Northern Regional Research Center, ARS, USDA, Peoria, IL

10:40 143. **CONFECTIONARY FATS FROM PALMITIC-OLEIC-LINOLEIC ACID OILS**
R.O. Feuge,* Southern Regional Research Center, ARS, USDA, New Orleans, LA

11:05 144. **ON COCOA BUTTER SUBSTITUTE TECHNOLOGY**
M.D. Baijal,* Chemical Consulting, Painesville, OH

11:30 145. **PRODUCT DESIGNING IN SPECIALTY FATS**
M.D. Baijal,* Chemical Consulting, Painesville, OH

WEDNESDAY MORNING—SEPTEMBER 29

9:00 a.m.—Regency A

SESSION DD—NUTRITIONAL EFFECTS OF UNUSUAL FATTY ACIDS I.

Chairmen: **James G. Hamilton,** Hoffmann LaRoche Co., Nutley, NJ, and **John C. Cowan,** Formerly of USDA

9:00 **INTRODUCTORY REMARKS**

9:05 146. **HYDROGENATION OF FOOD FATS**
R.R. Allen,* Anderson Clayton Co., Richardson, TX

9:40 147. **INHIBITION OF CELLULAR GROWTH AND METABOLISM BY ISOMERIC trans-OCTADECENOATES**
W.E.M. Lands,* The University of Michigan, Ann Arbor, MI

10:15 148. **DISTRIBUTION OF POSITIONAL AND CONFIGURATIONAL MONOENE ISOMERS IN LIPID CLASSES OF LIVER AND HEPATOMA**
R. Wood* and F. Chumbler, Texas A&M University, College Station, TX

10:50 149. **SOME NUTRITIONAL ASPECTS OF PARTIALLY HYDROGENATED OILS**
J.L. Beare-Rogers,* and E.A. Nera, Health and Welfare, Ottawa, Ontario, Canada

11:25 150. **CHANGES IN THE ALK-L-ENYL AND ACYL GROUP COMPOSITION IN CARDIAC PHOSPHOLIPIDS OF BOARS FED CORN OR RAPESEED OIL**
J.K.G. Kramer* and H.W. Hulan, Agriculture Canada, Ottawa, Ontario, Canada

WEDNESDAY MORNING—SEPTEMBER 29

9:00 a.m.—Regency B

SESSION EE—FUNCTIONALITY OF PROTEINS

Chairman: **Charles V. Morr,** Ralston Purina Co., St. Louis, MO

9:00 **INTRODUCTORY REMARKS**

9:10 151. **PROTEIN-WATER INTERACTIONS AND FUNCTIONAL PROPERTIES**
D. Chou* and C.V. Morr, Ralston Purina Co., St. Louis, MO

9:55 152. **RHEOLOGY OF FOOD PROTEINS**
E.W. Meyer,* Central Soya Co., Chicago, IL

10:40 153. **TEXTURIZATION: PHYSICOCHEMICAL ASPECTS**
J. Shen,* D. Chou, and C.V. Morr, Ralston Purina Co., St. Louis, MO

11:25 154. **PROTEINS AS EMULSIFIERS**
C.J. Cante,* R.W. Franzen, and F.Z. Saleeb, General Foods Corp., Kankakee, IL

WEDNESDAY AFTERNOON—SEPTEMBER 29

2:00 p.m.—Regency C

SESSION FF—ENVIRONMENTAL CONTROL

Chairman: **Giles S. Farmer,** Anderson Clayton Co., Richardson, TX

2:00 **INTRODUCTORY REMARKS**

2:05 155. **PRETREATMENT OF EDIBLE OIL REFINERY WASTE**

2:35 156. **JOINT TREATMENT OF EDIBLE OIL REFINERY WASTE**

3:05 157. **LOOK AT THIS CITY SEWER SERVICE BILL**
G.N. McDermott,* The Procter & Gamble Co., Cincinnati, OH

3:35 158. **NEGOTIATIONS: SEWER CONTRACTS WITH MUNICIPALITIES**

4:05 **GROUP DISCUSSION**

WEDNESDAY AFTERNOON—SEPTEMBER 29

2:00 p.m.—Regency A

SESSION GG—NUTRITIONAL EFFECTS OF UNUSUAL FATTY ACIDS II.

Chairmen: **Herbert J. Dutton,** Northern Regional Research Center, ARS, USDA, Peoria, IL, and **Joyce P. Beare-Rogers,** Health and Welfare, Ottawa, Ontario, Canada

1:30 159. **STUDIES ON GLYCERIDE COMPOSITION AND SYNTHESIS IN RAT HEART AFTER FEEDING HIGH AND LOW ERUCIC ACID RAPESEED OILS**
S. Hung,* B.J. Holub, M.K. Bhatnagar, T. Umemura, and S.J. Slinger, University of Guelph, Guelph, Ontario, Canada

2:05 160. **METABOLISM OF LINOLEATE VS. LINOELAIDATE IN THE LAYING HEN**
A.C. Lanser,* T.L. Mounts, and E.A. Emken, Northern Regional Research Center, ARS, USDA, Peoria, IL

2:40 161. **METABOLIC PROPERTIES OF HYDROGENATED FATS**
F.A. Kummerow,* S. Cho, W. Huang, and L. Lawson, University of Illinois, Urbana, IL, H. Imai, Albany Medical School, and A. Kamio, Harlan E. Moore Heart Research Foundation, Champaign, IL

3:15 162. **INFLUENCE OF DIETARY UNSATURATED cis AND trans AND SATURATED FATTY ACIDS ON TISSUE LIPIDS OF SWINE**
C.E. Elson,* N.J. Benevenga, D.J. Canty, R.H. Grummer, A.E. Johnston, J.J. Lalich, J.W. Porter, and E.S. Shrago, University of Wisconsin, Madison, WI

3:50 163. **NUTRITIONAL EVALUATION OF trans FATTY ACIDS**
R.B. Alfin-Slater,* L. Aftergood, and T. Whitten, University of California, Los Angeles, CA

4:25 164. **METABOLISM OF LINOELAIDIC ACID IN RAT LIVER AND BRAIN (HONORED STUDENT PRESENTATION)**
R. Karney,* G.A. Dhopeshwarkar, and R.B. Alfin-Slater, University of California, Los Angeles, CA

WEDNESDAY AFTERNOON—SEPTEMBER 29

1:30 p.m.—Regency B

SESSION HH—FUNCTIONALITY OF PROTEINS

Chairman: **Charles V. Morr,** Ralston Purina Co.,
St. Louis, MO

1:30 165. **FOAMING PROPERTIES OF PROTEINS**
V. Moreno,* FBI Foods, Ltd., Montreal, Quebec, Canada

2:15 166. **DOUGH FORMING PROPERTIES**
R.C. Hoseney,* Kansas State University, Manhattan, KS

3:00 167. **COMPARISON OF FUNCTIONAL PROPERTIES OF DIFFERENT OILSEED PROTEINS**
D.W. Johnson,* Food Ingredients, Inc., Wheeling, IL

3:45 168. **YEAST PROTEIN: FUNCTIONAL PROPERTIES**
P.G. Schnell,* J.H. Pearce, and C. Akin, Amoco Foods Co., Naperville, IL

4:15 169. **QUALITY CHARACTERISTICS OF GROUND BEEF PATTIES EXTENDED WITH MOIST-HEATED AND UNHEATED DEFATTED OILSEED MEALS**
K.H. McWatters* and E.K. Heaton, University of Georgia, Experiment, GA

WEDNESDAY AFTERNOON—SEPTEMBER 29

1:30 p.m.—Water Tower

SESSION AAA—PROCESSING TECHNOLOGY EQUIPMENT

Chairman: **Robert L. Husch,** Interstate Foods Corp.,
Chicago, IL

1:30 170. **MIXING SCALEUP IN THE OIL PROCESSING INDUSTRY**
J.Y. Oldshue,* Mixing Equipment Co., Inc., Rochester, NY

1:55 171. **AUTOMATIC BATCH WEIGHING SYSTEMS: USES AND ADVANTAGES**
F.W. Spencer,* H.J. Fuller & Sons, Inc., Columbus, OH

2:20 172. **FLOWMETERS OLD AND NEW**
P. Elliott,* Elliott Automation Co., Cincinnati, OH

2:45 173. **FLOAT ACTUATED LEVEL GAUGING IN GENERAL AND AS APPLICABLE TO EDIBLE OILS**
J.P. Cummings,* Varec, Inc., Chicago, IL

3:10 174. **PROPERTIES OF BLEACHING CLAYS**
L.L. Richardson,* Filtrol Corp., Los Angeles, CA

3:35 175. **TILTING FILTER: ITS POSSIBLE USES**
N. Brinkmeyer,* North American Filtration, Wheaton, IL

4:00 176. **APPLICATIONS OF INDUSTRIAL GASES IN THE PROCESSING AND PRODUCTION OF OIL AND OIL BY-PRODUCTS**
J.H. Love,* Airco, Inc., Western Springs, IL

4:25 177. **PROCESSING IN RELATION TO PERFORMANCE**
M.D. Baijal,* Chemical Consulting, Painesville, OH

WEDNESDAY AFTERNOON—SEPTEMBER 29

1:30 p.m.—Gold Coast

SESSION BBB—OXIDATIVE DECOMPOSITION OF LIPIDS

Chairman: **Rex J. Sims,** General Foods Corp.,
White Plains, NY

1:30 178. **HEXANAL AS A MEASURE OF OXIDATIVE DETERIORATION OF FOOD PRODUCTS**
C.W. Fritsch* and J.A. Gale, General Mills, Inc., Minneapolis, MN

1:55 179. **OXIDATIVE CHANGES IN COMMERCIAL FATS DURING FRYING**
W.W. Nawar,* University of Massachusetts, Amherst, MA

2:20 180. **FORMATION AND CHARACTERISTICS OF FLAVOR COMPONENTS DERIVED FROM FOOD LIPIDS**
P.S. Dimick,* The Pennsylvania State University, University Park, PA

2:45 181. **REACTION OF HISTIDINE WITH METHYL LINOLEATE: CHARACTERIZATION OF THE HISTIDINE DEGRADATION PRODUCTS (HONORED STUDENT PRESENTATION)**
S.H. Yong* and M. Karel, Massachusetts Institute of Technology, Cambridge, MA

3:10 182. **ANALYSIS OF AUTOXIDIZED FATS BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY: METHYL OLEATE AND LINOLEATE**
E.N. Frankel,* W.E. Neff, W.K. Rohwedder, Northern Regional Research Center, ARS, USDA, Peoria, IL, B.P.S. Khambay and B.C.L. Weedon, University of London

3:35 183. **DETERMINATION OF HYDROPEROXIDES OF METHYL OLEATE AND LINOLEATE IN OXIDIZED METHYL ESTER MIXTURES**
W-S D. Wong and E.G. Hammond,* Iowa State University, Ames, IA

4:00 184. **OAT OIL REFINING AND STABILITY TESTS**
A. Kalbasi-Ashtari,* E.G. Hammond, and K.J. Frey, Iowa State University, Ames, IA

4:25 185. **LIPID HYDROPEROXIDE DEGRADATION BY A MODEL SYSTEM (POSTER SESSION)**
H.W. Gardner,* R. Kleiman, and D. Weisleder, Northern Regional Research Center, ARS, USDA, Peoria, IL

ABSTRACTS OF PAPERS

1

SURFACE ACTIVE PROPERTIES OF COMBINATIONS OF SOAP WITH LIME SOAP DISPERSING AGENTS. J.K. WEIL and W.M. LINFIELD, Eastern Regional Research Center, ARS, USDA, 600 E. Mermaid Lane, Philadelphia, PA 19118.

An apparatus is described for the continuous recording of surface tensions of solutions which are slow to reach constant surface tension values. Surface tension versus log concentration curves were thus obtained for combinations of several lime soap dispersing agents (LSDA) with sodium oleate. Salient features of the curves for these mixtures were (a) critical micelle concentration (cmc) of the mixtures were close to those for LSDA alone, (b) absence of a surface tension minimum or substantial reduction of the minimum as compared with that found with LSDA alone, (c) surface tension values above the cmc were very close to those found for soap alone above its cmc, and (d) curve slopes below the cmc closely resembled those of lime soap dispersing agents alone, rather than those of soap alone. These curves provided further evidence for the mixed micellar nature of soap-LSDA mixtures and show that the addition of LSDA to soap may increase its surface concentration. Solubilization of Oil Red O by these soap-LSDA mixtures also indicated a mixed micellar system and further elucidated the colloidal nature of these mixtures.

2

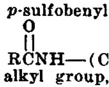
SOAP-BASED DETERGENT FORMULATIONS: XXII. SULFOBETAINE DERIVATIVES OF FATTY AMIDES. N. PARRIS, C. PIERCE, and W.M. LINFIELD, Eastern Regional Research Center, ARS, USDA, 600 E. Mermaid Lane, Philadelphia, PA 19118.

Previously reported simple sulfobetaines possess outstanding lime soap dispersing ability and excellent detergency properties in combination with soap. Since such sulfobetaines were prepared from expensive fatty tertiary amines and the costly and hazardous propanesultones, alternate procedures were developed which avoid the use of the above materials. Reaction of a fatty acid, its methyl ester, or glyceride with N,N-dimethyl-1,3-propanediamine leads to the formation of an aminoamide which can be reacted with either sodium 3-chloro-2-hydroxy-1-propanesulfonate (from epichlorohydrin and sodium bisulfite) or with allyl chloride followed by addition of sodium bisulfite to form sulfobetaines. The conditions for the reaction between aminoamide and sodium 3-chloro-2-hydroxy-1-propanesulfonate were studied in an effort to minimize the extent of hydrolysis of the 3-chloro-compound and thus increase the yield of desired quaternary amphoteric compound. Investigation of the quaternization of the aminoamide with allyl chloride showed that this reaction proceeded readily at pressures above atmospheric. Likewise, the addition of sodium bisulfite to the resulting unsaturated quaternary ammonium compound took place readily at above atmospheric pressure in the presence of certain free radical initiators. Solution properties and detergency performance of the compounds are reported. Detergency of ternary formulations of soap, glassy silicate builder, and the above sulfobetaines was the same as that obtained with ternary formulations containing the analogous sulfobetaines obtained from fatty tertiary amines and propanesultone.

3

SOAP-BASED DETERGENT FORMULATIONS: XXIII. SYNTHESIS OF *p*-SULFOBENZYL AMMONIUM INNER SALTS AND STRUCTURAL CORRELATION WITH ANALOGOUS SULFOBETAINES. JOHN M. KAMINSKI, Fats and Proteins Research Foundation, Inc., Des Plaines, IL, and WARNER M. LINFIELD, Eastern Regional Research Center, ARS, USDA, 600 E. Mermaid Lane, Philadelphia, PA 19118.

Two series of *p*-sulfobenylammonium inner salts $R\overset{+}{N}(CH_3)_2CH_2C_6H_4SO_3^-$ and $R\overset{\overset{O}{\|}}{C}NH{-}(CH_2)_3\overset{+}{N}(CH_3)_2C_6H_4SO_3^-$, where R is a straight chain alkyl group, were prepared by sulfonation of the corresponding quaternary ammonium chlorides. Although both series of amphoteric compounds displayed excellent lime soap dispersion properties, the former series showed optimum detergency at considerably shorter chain length than the latter series. The detergency, lime soap dispersion ability, and water solubility (Krafft points) of these compounds were compared with those of analogous aliphatic sulfobetaines. Structural variations, such as length and nature of the bridge between the cationic and anionic groups, length of the lipophilic chain, and insertion of an amide group into the lipophilic portion of the molecule, significantly altered the surface active properties of the amphoterics.



4

SODIUM SILICATES FOR THE DETERGENT INDUSTRY. E.J. SCHUCK and J.H. MCCRACKEN, Diamond Shamrock Chemical Company, 1100 Superior Ave., Cleveland, OH 44114.

This presentation consists of a review of liquid and dry sodium silicate technology. Since sodium silicates are used in a wide variety of detergent products ranging from household laundry compounds to heavy duty industrial cleaners, the chemical and physical properties of the various sodium silicates available to detergent compounders are described. Applications of silicates to household, institutional, and industrial cleaning compounds are discussed.

5

WHAT PRICE PALM OIL. D. BILLINGS, Liverpool Central Oil, United Kingdom.

The paper discusses the commercial relationship between palm oil and other competing oils and fats from the standpoint of pricing which is influenced, first of all, by the technical aspects in the sense of chemists' requirements and secondly by the fact that refiners' end products can be made from a variety of competing materials. The influence of government policy, the relationship of the political powers of the developing countries, the influence of United Nations Conference on Trade and Development negotiations, and the difference between the developing and developed countries within that context are discussed. The influence of the farming community, i.e. grower and planter of products, and the way in which all that ties together in the international commodity market are also covered in the paper.

6

RECENT DEVELOPMENTS IN THE MALAYSIAN PALM OIL INDUSTRY. M.L. Yong, The Oil Palm Growers' Council of Malaysia, PO Box 272, Kuala Lumpur 01-02, Malaysia.

A brief history of palm oil cultivation in Malaysia, showing the spectacular growth of palm oil production in the past few years, and production processes from palm oil fruit bunch harvesting through to shipment of palm oil are described. The quality of palm oil is discussed in general, together with the methods of quality control used at each stage of production. The various end uses of palm oil are mentioned, and some of the more important uses are discussed in detail. The paper will also deal with the important role research and development have played in the Malaysian palm oil industry, both in agricultural research which is carried out by government and private establishments within the industry, and also in the research effort which has been directed to palm oil itself, especially in respect of the control of palm oil quality.

7

BIOCHEMICAL ASPECTS OF CONTROL OF PROSTAGLANDIN BIOSYNTHESIS. WILLIAM E.M. LANDS, Department of Biological Chemistry, Medical Science I, The University of Michigan, Ann Arbor, MI 48104.

Prostaglandins (and the closely related chromboxanes) are formed by the oxidative cyclization of essential fatty acids. The reaction appears to require the nonesterified form of acid so that carboxyesterase action releasing the substrate from esterified precursors may often be a rate-limiting step. Stimulating the hydrolytic enzymes can then lead to greater production of the hormones (or autacoids). The cyclooxygenase enzyme exhibits both negative and positive feedback characteristics and appears to have binding sites for the substrates, oxygen and fatty acid, and also an activator. Interference with the binding of any of the ligands can decrease the rate of biosynthesis. The purified cyclooxygenase contains nonheme iron and acts kinetically like the lipoxygenase from soybeans. It differs, however, in requiring heme to facilitate the reaction of two oxygen molecules with the acid, as it forms the cyclic endoperoxide derivative. Thus, cyanide can inhibit the mammalian enzyme although it does not inhibit the plant lipoxygenase. Reduction of the concentration of required activator will also reduce the rate of synthesis, and glutathione peroxidase has been shown to inhibit both types of fatty acid oxygenase. Thus, factors reducing glutathione peroxidase activity in the cell (Se deficiency, low GSH concentrations, enzyme repression) can allow greater rates of biosynthesis of prostaglandins and thromboxanes. Reduction of inflammation and pain associated with excessive biosynthesis of prostaglandins might be achieved by decreasing carboxyesterase action or increasing the esterification rates. It may also be achieved by interfering with the binding of substrate fatty acid to its active site by agents such as analogous fatty acids (20:3 or 22:6 [n−3]) or by pharmacologic agents such as ibuprofen (Motrin) or flufenamate. Acetamidophenol (Tylenol) appears to block binding of the activator to its site to a greater extent than it blocks the fatty acid substrate binding. Some agents (aspirin, indomethacin, flurbiprofen, meclofenamate) bind at the fatty acid site in such a manner that they cause an inactivation of the cyclooxygenase activity. Destruction of biosynthetic activity then may require formation of new catalytic protein before a cell can regain full biosynthetic capacity.

8

FUNCTIONAL ASPECTS OF THE PROSTAGLANDIN SYSTEM IN CENTRAL NERVOUS TISSUE. FLAVIO COCEANI, Research Institute, The Hospital for Sick Children, 555 University Ave., Toronto, Ontario, Canada M5G 1X8.

There is now ample evidence that the prostaglandins, which are formed from essential fatty acids, are implicated in the function of central neurons. Arachidonic acid is the most common precursor in mammals. Nervous tissue is endowed with the enzyme system for the synthesis of prostaglandins, and its activity is influenced by a number of physiological and pathological factors. A novel class of biologically active derivatives of arachidonic acid, the thromboxanes, are also present in the tissue. Prostaglandin actions are potent and varied and include effects on behavior, regulation of food intake, body temperature, and cardioregulatory and motor functions. No information is available as yet on the role of the thromboxanes in neural mechanisms. The mechanism of action of the prostaglandins is still ill-defined, but much evidence links these compounds to the neurotransmitters and the cyclic nucleotides. (Supported by the Medical Research Council of Canada).

9

RELATION BETWEEN ESSENTIAL FATTY ACIDS AND PROSTAGLANDINS IN THE CENTRAL NERVOUS SYSTEM. CLAUDIO GALLI, GIOVANNI GALLI, and RODOLFO PAOLETTI, Institute of Pharmacology and Pharmacognosy, University of Milan, Via A. Del Sarto 21-20129 Milano, Italy.

Arachidonic acid (AA), a precursor of physiological prostaglandins, is present in large concentrations in the membranes of the central nervous system (CNS), bound to glycerophospholipids. Anoxia, convulsions, and sacrifice by decapitation induce a rapid and selective release of free AA from cell membranes. Free AA is then efficiently converted to prostaglandins (PGs). The rate of release of free AA differs greatly in different brain areas, and a relation has been observed between AA release and formation of prostaglandins. The concentrations of both free AA and formed PGs are therefore considerably increased when the tissues are removed and analyzed after killing of the rats by decapitation. Correct and constant values have been obtained by killing the animals with a focused microwave oven, a procedure which rapidly inactivates brain enzymes. The release of arachidonic acid and therefore the rate of formation of endogenous PGs are inhibited by in vivo administration of mepacrine, which also antagonizes the prostaglandin-mediated fever induced by yeast injection in the rat. The effects of nonsteroideal anti-inflammatory drugs on AA release in the brain and PG formation have been also tested in vivo and in vitro. A significant relation has also been observed between dietary fats and brain free AA concentrations. The total reduction of essential fatty acids (EFA deficient diet) and modifications of the ratio between linoleic (the precursor of arachidonic acid) and linolenic acid in the diet greatly affect the level of free AA measured in brain during anoxia, without corresponding changes of total AA bound to glycerolipids. These results underline the importance of dietary factors and oxygen supply for the control of PG formation in the CNS.

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LIQUID CHROMATOGRAPHIC SEPARATION OF SUCROSE PALMITATES. G.S. **Fisher**, H.J. **Zeringue, Jr.**, and R.O. **Feuge**, Southern Regional Research Center, ARS, USDA, PO Box 19687, New Orleans, LA 70179.

Solvent-gradient, forced-flow liquid chromatographic techniques for the separation of sucrose palmitates by degree of acylation will be discussed. The lower sucrose esters (mono- through tetra-) were separated using methylene chloride at the less polar eluent and methanol as the more polar one. The higher sucrose esters (penta- through octa-) were separated using petroleum ether as the less polar solvent and methylene chloride as the more polar solvent.

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HIGH PRESSURE LIQUID CHROMATOGRAPHY FOR THE ANALYSIS OF SOLUBLE SACCHARIDES IN OILSEEDS. G.F. **Cegla**, Food Protein Research and Development Center, Texas A&M University, 216 Teague Building, College Station, TX 77843.

There is an increasing interest in using, in food products, defatted oilseed flours, which are comprised essentially of protein and carbohydrates. It follows that there is also a need for a simple, rapid analytical method for the composition of these potential food ingredients. It was found that typically 45–55% of the carbohydrates in cottonseed and soy defatted flours were water soluble and thus extractable. Over 97% of the soluble carbohydrates could be extracted from the flours with water or alcohol-water. Two methods were used for separation of the protein out of the extract: (a) precipitation of most of the protein with 15% trichloroacetic acid, and (b) purification of the carbohydrates with a preparative hydroxylapatite packed column using high pressure liquid chromatography (HPLC). HPLC proved an excellent, precise method for analysis of carbohydrates without derivatizing. Several different column packings have been used for analyzing the extracted oilseed carbohydrates. The best results were obtained with the Micro-Bondapack/Carbohydrate column, with a 1.2 ml/min effluent rate and acetonitrile:water (70:30) as solvent. The main carbohydrates for cottonseed and soybean were: raffinose, sucrose, and stachyose.

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HIGH PRESSURE REVERSE PHASE LIQUID CHROMATOGRAPHY OF FATTY ACID *p*-BROMOPHENACYL ESTERS. S. **Ramachandran**, P.T.S. **Pei**, W.C. **Kossa**, and R.S. **Henly**, Applied Science Laboratories, Inc., PO Box 440, State College, PA 16801.

High pressure reverse phase liquid chromatography has been employed to separate saturated and unsaturated fatty acids as the corresponding *p*-bromophenacyl esters. Rapid separations of fatty acids differing in chain length and number of carbon-carbon double bonds have been achieved. Through the use of a highly efficient C_{18} reverse phase column packing, it has also been possible to distinguish among geometrical and positional isomers of the unsaturated acids. The use of ultraviolet-sensitive esters has permitted the detection of low (nanogram range) concentrations of fatty acids. The time required for analysis has been further reduced by employing a novel and rapid method for the preparation of the esters.

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TRIGLYCERIDE COMPOSITION BY REVERSE PHASE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY. R.D. **Plattner**, G.F. **Spencer**, and R. **Kleiman**, Northern Regional Research Center, ARS, USDA, 1815 N. University St., Peoria, IL 61604.

Rapid separations of triglycerides by chain length and degree of unsaturation were made by high-performance liquid chromatography (HPLC) on a μ-Bondapak C-18 column with acetonitrile-acetone solvent mixtures. A 2:1 acetonitrile-acetone mixture eluted all triglycerides found in most seed oils within about 10 column volumes. When sizeable amounts of triglycerides larger than C_{54} were also present, stronger solvent mixtures with a higher percentage of acetone were necessary to lower retention volumes. Oils with large amounts of short chain triglycerides or triglycerides containing oxygenated acyl groups could be completely eluted by using 100% acetonitrile with good separation of the components. For saturated triglycerides, a linear relationship was observed between the log of the retention volume and carbon number. Each double bond present in the triglyceride decreased the retention volume to approximately that of a saturated triglyceride two carbon atoms smaller. Epoxy or hydroxy groups caused a larger reduction in retention volume equal to about four carbon atoms. When information on the total fatty acid composition, as determined by gas liquid chromatography (GLC), is applied to the HPLC curves, much additional insight can be obtained about the triglyceride makeup of a seed oil. To calculate the total triglyceride composition of a seed oil, an internal standard, tripentadecanoin, was added to collected fractions before analysis by GLC.

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EFFECT OF DOUBLE BOND POSITION UPON UTILIZATION OF FATTY ACIDS IN BIOLOGICAL SYSTEMS. **Ralph T. Holman**, The Hormel Institute, University of Minnesota, 801 16th Ave. N.E., Austin, MN 55912.

Soluble enzymes, membrane-bound enzyme systems, cellular organisms, and organs of invertebrates have been tested for their responses to series of isomeric aliphatic compounds. In each case, the positions of double bonds controlled the acceptabilities of compounds as substrates, energy sources, or stimulants. For each tested enzyme system, dealing with unsaturated fatty acids, the pattern of acceptability was different, and displacement of a double bond one carbon atom up or down the chain often caused radical changes in rate of reaction. Several examples related to fatty acid metabolism will be discussed.

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EFFECT OF DOUBLE BOND GEOMETRY AND POSITION UPON HYDROLYSIS OF MIXED TRIGLYCERIDES BY PANCREATIC LIPASE B. **Anthony J. Valicenti**, **Howard L. Brockman**, and **Ralph T. Holman**, The Hormel Institute, University of Minnesota, 801 16th Ave. N.E., Austin, MN 55912.

A series of random mixed triglycerides containing lauric, myristic, palmitic, linoleic, and one isomer of octadecenoic acid were prepared by standard methods. Partial hydrolysis of these triglycerides was performed using pancreatic lipase B. The unhydrolyzed triglycerides and the hydrolysis products were separated by thin layer chromatography (TLC) and analyzed by gas liquid chromatography (GLC) of the fatty acid methyl esters derived from them. The degree of discrimination in the hydrolysis of the 18:1 isomer was expressed as the difference between the content of 18:1 in the diglyceride and free fatty acid fractions. The enzyme was observed to discriminate on the basis of geometry and position of the double bond in the 18:1 isomers.

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METABOLISM OF EICOSA-11,14-DIENOIC ACID IN TESTICULAR TISSUE. **Daniel H. Albert** and **John G. Coniglio**, Department of Biochemistry, Vanderbilt University School of Medicine, Nashville, TN 37232.

Biosynthesis of 20:4ω6 (arachidonate) from 18:2ω6 (linoleate) in rat liver is through the intermediates 18:3ω6 and 20:3ω6 (J. F. Mead, *Fed. Proc.* 20:952, 1961). A proposed alternative pathway (E. Klenk and H. Mohrhauer, *Z. Physiol. Chem.* 320:218, 1960) in which 18:2ω6 is first elongated to 20:2ω6 before desaturation to the triene and finally to 20:4ω6 is apparently inoperative in rat liver (D. Ullman and H. Sprecher, *Biochem. Biophys. Acta* 248:186, 1971). Recently, however, it was reported (Nakazawa et al., *Lipids* 11:79, 1976) that 20:2ω6 can serve as a substrate for the synthesis of arachidonate in human colon and bladder, thus indicating that the alternative pathway involving 20:2ω6 desaturation may be active in some tissues (or in human tissue). In view of the role this fatty acid may play as an intermediate in the biosynthesis of arachidonate, studies have been initiated on the metabolism of 11, 14–20:2 in testes, a tissue which actively synthesizes arachidonate and other polyunsaturated fatty acids (J. Davis and J. Coniglio, *J. Biol. Chem.* 241:610, 1966). Preliminary in vivo experiments using rats demonstrated that a large portion of intratesticularly injected $1\text{-}^{14}C$ 20:2ω6 was rapidly oxidized and expelled as $^{14}CO_2$, indicating that the injected substrate is actively metabolized. A substantial portion of the injected ^{14}C-20:2ω6 was desaturated to a 20 carbon trienoic fatty acid (tentatively identified as 5,11,14 20:3). Smaller amounts of radioactivity were detected in other polyunsaturated fatty acids including arachidonate. Results of tests for additional characterization of the trienoic fatty acid formed and results from currect additional in vivo and in vitro experiments will be presented in an attempt to clarify the role that 20:2ω6 plays in the biosynthesis of polyunsaturated fatty acids in testicular tissue. (Supported by Grants HD 06070, HD 07694, and HD 07043.)

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ASPECTS ON THE QUALITY OF PALM OIL. P-O **Pehlergaard** and G.M.R. **Jonansson**, AB Karlshamns Oljefabriker, S-292 00 Karlshamn, Sweden.

The paper discusses the improvement in the quality of crude palm oil during 1965–1975 from the point of view of North European refiners. In recent years a considerable improvement in the quality has taken place, particularly in respect of oxidation values. The effect of transport on the quality is dealt with as well as the quality changes which take place during transshipment. The authors also discuss the possibilities of storing and transporting the refined palm oil products. The methods used for evaluation of the oxidation deterioration of the oil are described. These methods include determination of peroxide value, anisidine value, ultraviolet absorption, and active-oxygen method stability.

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STEAM REFINING DEODORIZER FOR MALAYSIAN PALM OIL. **Arnold M. Gavin**, EMI Corporation, 3166 Des Plaines Ave., Des Plaines, IL 60018, **Kah Tin Teoh**, Palmex Industries, and **George T. Carlin**, Consultant.

The production of Malaysian palm oil is expected to increase 20% per year for the next five years. Already planted are hundreds of thousands of acres of palm trees which will start to produce in the next few years. Recent plantings of new strains will produce 2,400 to 3,000 lb of palm oil per acre as compared to a few hundred pounds of soybean oil produced per acre. Palmex Industries, Penang, Malaysia, has installed a degumming, steam refining deodorizer to produce a deodorized palm oil with 0.03% free fatty acid (FFA) from crude oil containing 5.0% FFA. Production records confirm the feasibility of the steam refining deodorizing process.

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USE OF PALM OIL IN THE EDIBLE FATS BUSINESS. **John Rourke**, Unilever Limited, PO Box 68, Unilever House, London, England EC4P 4BQ.

The paper will discuss the use of palm oil in edible fats with reference to (a) quality criteria for specific product applications; (b) limitations of the incorporation level of palm oil due to its characteristics; (c) increased palm oil incorporation by fractionation and interesterification; (d) the importance of economy of scale and outlets for by-products when considering palm oil fractionation; (e) incorporation of palm oil, interesterified palm oil, and palm fractions in European and nontemperate climates; and (f) consideration of factors restricting incorporation level with reference to: color problems, oxidation difficulties, fatty acid composition limits, and glyceride composition problems.

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HOW TO USE THE WONDERFUL GOLD MINE BETWEEN YOUR EARS. **Whitt N. Schultz**, How To Company, PO Box 100, Kenilworth, IL 60043.

For more than 20 years, Dr. Whitt N. Schultz of Kenilworth, Illinois, has studied the subjects of creativity, innovation, communications, motivation, and leadership. He has written more than 100 articles on these subjects, and they have appeared world-wide in leading journals and newspapers. From this deep, far reaching research, Dr. Schultz has capsulized what makes a person happy, well, fully functioning, creative, and motivated to develop his (or her) full potential. In summary, these leaders are optimistic, enthusiastic, individualistic, and imaginative. And, they have definite, observeable behaviors which will be spotlighted in his address.

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COMPENSATION PLANNING—A JUGGLING ACT. **Robert L. Istnick**, Hewitt Associates, 102 Wilmot Rd., Deerfield, IL 60015.

Executives concerned with compensation planning have been doing a juggling act, simultaneously balancing multiple forces over which they have little or no control. Inflation, recession, unemployment, increased governmental regulation, and changing employee attitudes are some of the major forces which have had to be brought into balance. And since in many enterprises, employee compensation is the largest single cost of doing business, a well planned and cohesive pay policy is crucial to maintaining employee satisfaction and maximixing the bottom line. The discussion will examine those broad forces which have shaped compensation planning in the past, and extrapolate those factors which are most likely to impact the future.

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THE PROFESSIONAL AS AN EXECUTIVE AND AS A PERSON. **L. Simon.**

Experience has shown the very real existence of certain personal needs for all of us; their relationship and priority may vary with individuals, but all of these must be considered. In very rough order these needs can be outlined as security, social acceptance, status, good family life, to live in a compatible area, variety, to learn, to use skills and training, independence, time for oneself, achievement, power, to define oneself, and money.

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BIOSYNTHESIS OF PROSTAGLANDINS. **Martin Hemler** and **William E.M. Lands**, The Department of Biological Chemistry, The University of Michigan, Ann Arbor, MI 48109.

The fatty acid oxygenase, a membrane-bound enzyme which converts arachidonate (20:4, n-6) into the precursor of prostaglandins and thromboxanes, was purified 230-fold from sheep vesicular glands. Solubilization, followed by salt fractionation, column chromatography on several stationary phases, and isoelectric focusing yielded an enzyme with a specific activity of 46,000 units/mg protein. The isoelectric point was approximately pH 6.5, and electrophoresis of the purified preparation on sodium dodecyl sulfate gels yielded one band corresponding to a molecular weight of 70,000. The purified oxygenase was acetylated and inactivated upon incubation with 300 μM acetylsalicylic acid. The purified oxygenase contained a significant amount of nonheme iron, and it was activated by added hemin. Thus, two forms of iron seem to be involved in the synthetic reaction. The heme protein complex with (ϵ_{278} of 150 mM^{-1}) showed a major absorption peak at 407 nm. Upon reacting the oxygenase with 1-^{14}C-arachidonic acid, a mixture of radioactive products was formed characteristic of the nonenzymic breakdown of PGG$_2$. In the presence of SnCl$_2$, only PGF$_{2\alpha}$ was observed. Thus, the isolated protein catalyzed the insertion of both O$_2$ molecules needed for thromboxane and prostaglandin biosynthesis. Although the cyclooxygenase is similar to the nonheme lipoxygenase from soybean in many respects, the requirement for heme is evidence for a more complex polyatomic mechanism involving the dual insertion of two oxygen molecules. Also, the loose apoenzyme:heme interaction suggests that heme availability and mobility within the membrane might regulate in vivo the ability of the bound cyclooxygenase to form prostaglandins.

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PROSTAGLANDINS IN THE HUMAN FEMALE GENITAL TRACT. **Eric J. Singh**, 5500 South Shore Dr., Chicago, IL 60637.

In recent years a great deal of interest has centered on the prostaglandins which have striking pharmacologic effects on uterine function. Human cervical mucus prostaglandins are compared with endometrium prostaglandins during the menstrual cycle. The content of human cervical mucus and endometrium prostaglandins F$_{2\alpha}$ and E$_2$ is related to three phases of the menstrual cycle and correlates with cyclic ovarian hormone variations. The dominating fraction was PGF$_{2\alpha}$ in cervical mucus and endometrium during all phases of the menstrual cycle. The PGF$_{2\alpha}$/PGE$_2$ ratio was higher in the luteal phase. The most significant finding was the high prostaglandin (F$_{2\alpha}$) content of the human cervical mucus and endometrium during the period of progesterone secretion after ovulation. In conclusion, prostaglandin plays a significant role in the human reproductive process. The role of prostaglandins in the human female reproductive tract will be discussed.

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PROSTAGLANDINS IN THE CARDIOVASCULAR SYSTEM. **James B. Lee**, State University of New York at Buffalo, Buffalo General Hospital, 100 High St, Buffalo, NY 14203.

With the discovery of the renal prostaglandins, PGA$_2$ (medullin), PGE$_2$, and PGF$_{2\alpha}$ in rabbit renal medulla, considerable attention has been directed to the possibility that two of these (PGA$_2$ and PGE$_2$) may be involved in the control of renal homeostasis, salt and water excretion, and systemic blood pressure. The basic thesis underlying the role of the renal prostaglandins in blood pressure regulation is that hypertension may not solely be due to an increase in agents or mechanisms which elevate blood pressure but may be an absolute or relative deficiency of compounds such as prostaglandins which normally maintain peripheral vasodilation, promote enhanced renal blood flow, and therefore maintain normotension and normal renal blood flow and sodium and water excretion. At present, the evidence in support of such a theory is entirely circumstantial based primarily on the fact that infusion of PGA$_2$ or PGA$_1$ in humans with essential hypertension results in the production of normotension by "ideal" mechanisms involving total peripheral resistance, renal resistance, sodium and water excretion, plasma volume, and baroreceptor activity in blood pressure—all factors known to be intimately involved in the genesis of human essential hypertension. Evidence against this theory has been presented by several investigators who are unable to detect PGA$_2$ by gas liquid chromatography-mass spectrometry (GLC-MS) in either rabbit renal medulla or in plasma from normotensive humans or humans with essential hypertension. On the other hand, utilizing radioimmunoassay for PGA, a number of investigators have observed immunoreactive PGA in the peripheral venous blood of human which rises under conditions of a low sodium intake and falls under conditions of high sodium intake. This has led to the hypothesis that the beneficial effects of low sodium diet and diuretic therapy in human essential hypertension may be a reflection of increase peripheral vasodilating PGA levels. The failure to detect PGA$_2$ in human blood by GLC-MS may possibly be explained by the fact that this compound is not elaborated into the renal vein under appropriate stimuli but rather that its active metabolite, 13, 14-dihydro PGA$_2$, may be responsible for the natriuretic, vasodepressor, and antihypertensive activity of PGA$_2$. Attallah et al. (*Life Sci.* 16:1743, 1975) have demonstrated that PGA$_1$ and PGA$_2$, if injected into the renal artery of the rabbit, is metabolized to 13, 14-dihydro PGA, 15-keto PGA, and 13,14-dihydro 15-keto PGA in a single passage through the renal cortex. Of these three, PGA metabolite 13,14-dihydro PGA is at least as potent as PGA itself in reduction of blood pressure. The hypothesis is advanced that immunoreactive PGA may reflect circulating 13,14-dihydro PGA and that the antihypertensive endocrine function of the kidney may be ascribed at least in part to circulating 13,14-dihydro PGA$_1$.

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PROSTAGLANDINS AND INFLAMMATION. **G. Weissmann.** New York University Medical Center, New York, NY.

Abstract not available at press time.

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DIRECT GAS CHROMATOGRAPHIC TECHNIQUE FOR STUDYING NEUTRAL VOLATILES OF MAYONNAISE. **Sara P. Fore, M.G. Legendre**, and **G.S. Fisher**, Southern Regional Research Center, ARS, USDA, PO Box 19687, New Orleans, LA 70179.

A technique for direct gas chromatograph analysis of the neutral volatiles of mayonnaise is described. A glass liner containing glass wool coated with sodium bicarbonate in the lower quarter and plain glass wool in the remaining space is placed in the heated inlet of a gas chromatograph, and mayonnaise and water are injected onto the plain packing. Neutral volatiles eluted from mayonnaise by the combined action of water, carrier gas, and heat collect on the cool column of the gas chromatograph, but acetic acid is trapped by the sodium bicarbonate and thus does not interfere with the analysis. After the liner with the spent sample has been removed from the inlet, the temperature of the column oven is programmed to resolve and elute the volatiles. Alternatively, neutral volatiles can be passed directly from the chromatograph inlet to a second inlet liner containing Porapak P, a porous polymer that traps most organic compounds but does not retain water. These neutral organic volatiles are then desorbed from Porapak P in the inlet of a chromatograph interfaced with a mass spectrometer, and analyzed. This procedure allows components resolved by the gas chromatograph to be identified by mass spectrometry without interference from water or acetic acid. Ethanol, pentane, pentene, methylpropanal, ethyl acetate, pentanal, hexanal, nonane, xylene, allyl isothiocyanate, decane, and benzaldehyde have been identified in volatiles from old mayonnaise by this method.

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NEW DEVELOPMENTS IN SILVER RESIN CHROMATOGRAPHY OF FATTY METHYL ESTERS. **C.R. Scholfield**, Northern Regional Research Center, ARS, USDA, 1815 N. University St., Peoria, IL 61604.

The difference in stability of their silver ion complexes is the basis of several widely used methods for separating *cis* and *trans* isomeric fatty esters. Publications from this laboratory have described the use of a silver sulfonate macroreticular exchange resin for the chromatographic separation of geometric isomers of methyl octadecenoates and octadecadienoates. The effectiveness of these separations depends upon the surface area of the resin; an experimental resin with about 122 m^2/g area was necessary for useful separations. Recently macroreticular resins with still greater surface area have become available, and we have reexamined our procedures with one of these which has a surface area of about 570 m^2/g. With this resin, better separations are obtained especially between saturates and *trans* octadecenoates. In a 185 cm × 1 cm ID column, 400 μl of a methyl palmitate, stearate, elaidate, oleate mixture can be separated in 6 hr with a resolution of 1.1 between saturates and elaidate and with still greater resolution between elaidate and oleate. Although the effectiveness of the separation seems to be related primarily to the surface area of the resin, resolution is also increased by a decrease in particle size. When the resin is ground to 100–200 mesh, separation of 200 μl of the same mixture is achieved in 1 hr in a 65 cm × 1 cm ID column with a resolution of 1.03 between saturates and elaidate. While attempting to determine a value for V$_o$, the elution volume for an unretained solute, it was found that small molecules including water and the alcohols ethanol through decanol are retarded on the column relative to long chain saturated esters. However, methyl laurate, palmitate, stearate and arachidate are all eluted in the same volume, and this volume is believed to correspond to V$_o$.

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ANALYTICAL ^{13}C NUCLEAR MAGNETIC RESONANCE: A RAPID, NONDESTRUCTIVE METHOD FOR DETERMINING THE *cis/trans* RATIO OF COMPLEX UNSATURATED LIPID MIXTURES. **Philip E. Pfeffer** and **Francis E. Luddy**, Eastern Regional Research Center, ARS, USDA, 600 E. Mermaid Lane, Philadelphia, PA 19118, and **James N. Shoolery**, Varian Instrument Division, Palo Alto, CA 94303.

High resolution natural abundance ^{13}C Fourier transform nuclear magnetic resonance (NMR) has been found to be an effective tool for the rapid and direct determination of the *cis, trans* double bond ratio in partially hydrogenated and isomerized lipids. Unlike the three established chemical-physicochemical procedures used for determination of *cis, trans* compositions, i.e., infrared-gas liquid chromatography (IR-GLC), the mercuric acetate-^{1}H NMR and the epoxidation-GLC method, the present technique does not require prior chemical alteration of the triglyceride mixtures. In contrast to previous NMR methods which utilized resonances assigned to the double bond carbons, the proposed method uses allyl carbon resonances.

It is *nondestructive* and *utilizes small samples* (150–250 mg) that can be analyzed within 15–20 min. Allylic carbon resonances have been observed to be strongly field dependent with respect to the stereochemical environment of their adjacent double bonds and largely field independent of adjacent double bond position, i.e. *cis* allylic carbons resonate at approximately 27.3 ppm and *trans* allylic carbons at approximately 32.6 ppm for double bonds located at chain positions 8–12 of octadecenoates. Unlike the olefinic carbons the allylic carbons of *cis* and *trans* double bonds exhibit single resonances from which the *cis/trans* ratio of complex mixtures can be derived directly. Carbon spin-lattice relaxation times (T_1) were ascertained for both *cis* and *trans* allylic resonances of isomeric mixtures of varying composition to ensure quantitative relative peak intensity measurements. Analyses of mixtures of pure isomeric methyl esters and triglycerides as well as partially hydrogenated, double bond migrated triglycerides were made and the results *compared with the* IR-GLC *procedure. Migration* of both single and multiple double bonds as well as formation of conjugated unsaturation in catalytically treated fats will be discussed as possible sources of error in the evaluation of the stereoisomer ratios.

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EMULSIONS STUDY USING PULSED NUCLEAR MAGNETIC RESONANCE. J. TRUMBETAS, J.A. FIORITI, and R.J. SIMS, General Foods Corporation, Technical Center, 250 North St., White Plains, NY 10625.

Application of pulsed nuclear magnetic resonance (NMR) to the measurements of solid fat content is well known. When these measurements are made on fatty emulsions, contributions to the total signal from the water phase are quite small due to R_t saturation. As a consequence, pulsed NMR is also useful in *studying properties of fatty emulsions.* We have measured both the degree of emulsification and the stability of emulsions by this technique. The degree of emulsification was shown to relate to the inhibition of the rate of fat solidification during cooling. Optimization of emulsification also results in the most stable emulsion for a given system. Aging promotes the breaking of an emulsion, and this can be measured quantitatively by pulsed NMR. The techniques used will be explained, data obtained will be presented, and correlations with results predicted by the hydrophile-lipophile balance (HLB) system will be given.

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AUTOMATED METHOD FOR DETERMINING OIL STABILITY. J.M. DEMAN, Department of Food Science, University of Guelph, Guelph, Ontario, Canada N1G 2W1.

The most commonly used method for determining oil stability in North America is the active oxygen method (AOM). The major disadvantage of this method is the relatively great amount of work involved in the test. Several attempts have been made to automate the AOM. These automated versions have been based on various principles, e.g. the Warburg method or a conductometric procedure. A description will be presented of an automated stability testing device based on the conductometric principle. Results obtained with the instrument will be used to illustrate the range of applications of the instrument. The end point detection is based on the production of formic acid at the end of the induction period. The presence of the formic acid is detected by bubbling the exit gas through a vessel containing distilled water and a conductivity electrode.

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CHEMILUMINESCENCE FROM FOODSTUFFS. G.D. MENDENHALL and R.A. NATHAN, Battelle Laboratories, Columbus, OH.

Chemiluminescence, the light emitted by a chemical reaction, accompanies the autoxidative degradation of many foodstuffs in assessing changes that are too slow or too inconvenient to determine by conventional techniques. The apparatus for measuring chemiluminescence is described along with the methods for obtaining chemiluminescence under different conditions, including temperature and atmosphere variations, and light-induced chemiluminescence. Equations to treat the resulting data are presented together with a description of their significance. Examples of chemiluminescence emission from a number of foodstuffs are presented.

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MURICHOLIC ACID FORMATION IN THE ISOLATED PERFUSED RAT LIVER. M.M. FISHER and I.M. YOUSEF, Medical Sciences Building, Room 7258, University of Toronto, Toronto, Ontario, Canada M5S 1A8.

The *muricholic acids are important metabolites of chenode*oxycholic acid (CDCA) in the rat. Their synthesis has not been studied extensively, but it is currently thought that α-muricholic acid (3α,6β,7α-trihydroxy-cholanic acid) is formed by the 6β-hydroxylation of CDCA and that α-muricholic acid is then converted to β-muricholic acid (3α,6β,7β-trihydroxy-cholanic acid). β-Muricholic acid is thought to be the major metabolite of CDCA in the rat. Our studies of CDCA metabolism using the isolated perfused rat liver do not support these concepts. (Supported by the Medical Research Council of Canada and the Canadian Hepatic Foundation.)

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EXCLUSION OF β-SITOSTEROL FROM SUBCELLULAR SITES OF RAT LIVER PENETRATED BY CHOLESTEROL. G. KAKIS and A. KUKSIS, Banting and Best Department of Medical Research, University of Toronto, Toronto, Ontario, Canada M5G 1L6.

Previous work (Kuksis and Kakis, *Fed. Proc.* 32: 238, 1973) has shown that intravenous infusion of cholesterol in Intralipid leads to a suppression of hepatic cholesterol biosynthesis while a similar infusion of β-sitosterol has no effect upon cholesterogenesis. In an attempt to account for the lack of inhibition of cholesterogenesis by the plant sterol, injections of 4-^{14}C-cholesterol and 22,23-^{3}H-β-sitosterol in Intralipid were made, and the appearance of label in hepatic subcellular fractions and plasma lipoproteins prepared by standard methods was followed over a period 0–24 hr after injection. After 1 hr, the appearance of label in the plasma *membranes* and *hepatic* cytosol was the same for both sterols and closely similar to that observed in the plasma very low density lipoprotein (VLDL). The specific activity of the sterols in the microsomes was about 20–25% of that in the cytosol and nearly the same for both sterols (^{14}C/^{3}H = 1.27). Between 1 and 2 hr and later, there was a continued high uptake of cholesterol but not β-sitosterol by the microsomes (^{14}C/^{3}H = 3.3). At 24 hr the plasma VLDL contained much more radioactive cholesterol than β-sitosterol (^{14}C/^{3}H = 4) indicating that the liver was not incorporating the plant sterol into the newly synthesized lipoproteins. Likewise β-sitosterol was relatively absent from the floating fat compartment of the liver cells (^{14}C/^{3}H = 5.0). The present study demonstrates that, unlike cholesterol, intravenously infused β-sitosterol does not equilibrate with all the subcellular pools of hepatic sterol. It is hypothesized that the failure of β-sitosterol to inhibit hepatic cholesterogenesis is due to its inability *to penetrate the control sites.*

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LIPOPROTEIN EQUILIBRATION AND CLEARANCE OF INTRALIPID FROM RAT PLASMA. G. KAKIS, W.C. BRECKENRIDGE, and A. KUKSIS, Banting and Best Department of Medical Research, University of Toronto, Toronto, Ontario, Canada M5G 1L6.

Male Wistar rats (250 g) were injected via the femoral vein with 2 ml of Intralipid containing 1 mg of cholesterol along with a 4-^{14}C-cholesterol marker, and the appearance of radioactivity, sterol mass, and molecular species characteristic of the phosphatidylcholines (egg yolk) and triacylglycerols (soybean oil) of Intralipid in the plasma lipoproteins was determined over the next 24 hr. There was a rapid removal from circulation of both triacylglycerols and cholesterol (80–85%) within the first 5 min. Apoprotein C polypeptide was demonstrated by gel electrophoresis to have become associated with Intralipid particles at this time. Following hydrolysis and clearance of the triacylglycerols, there occurred a marked increase in cholesterol (75%), phosphatidylcholine (50%), and protein (200%) content in the LDL_1 (low density lipoprotein) subfraction (d = 1.006 – 1.030) while only trace amounts of lipid were found in LDL_2 (d = 1.030 – 1.063). After 1 hr the radioactive cholesterol remaining in plasma was concentrated largely in LDL (58%) with smaller amounts in high density lipoprotein (HDL) (21%) and very low density lipoprotein (VLDL) (10%). With progressing time the distribution of counts shifted towards HDL. A comparison of the molecular species of phosphatidylcholines from VLDL, LDL, and HDL 1 hr after injection with Intralipid showed that the egg yolk phosphatidylcholines were present in much larger amounts in the LDL (60%) and HDL (60%) than in the VLDL (10%) fractions. No evidence was obtained for a significant equilibration of the Intralipid triacylglycerols with the normal triacylglycerols of the plasma lipoproteins. There was little increase in the content of plasma cholesteryl linoleate and oleate in response to the great increase in the proportion of the corresponding phosphatidyl cholines in the HDL lipoproteins. It is concluded that once the Intralipid particles acquire the apo C protein, they undergo a rapid loss of triacylglycerols to give rise to lipoproteins with physical properties *of LDL and HDL without accumulation of particles* similar to VLDL.

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ISOMERIC DIALKYLACYLGLYCEROLS AS SUBSTRATES FOR DETERMINING THE SPECIFICITIES OF PURIFIED PLASMA AND TISSUE LIPASES. G.F. CEGLA and H.K. MANGOLD, Food Protein Research and Development Center, Texas A&M University, 216 Teague Building, College Station, TX 77843, and H. GRETEN, Bundesanstalt für Fettforschung and Medizinische Klinik, Universität Heidelberg, Heidelberg, W. Germany.

Hepatic triglyceride lipase and lipoprotein lipases from human post-heparin plasma (human H-TGL and human LPL), as well as lipoprotein lipase from rat adipose tissue (rat LPL) were purified by use of the following techniques: (a) ammonium sulfate precipitation, (b) affinity chromatography with heparin covalently linked to 'Separose 4 B', and (c) chromatography on 'Concanavalin A'. The positional specificities of these purified enzymes and of crude pig pancreatic lipase were determined using three pairs of isomeric dialkylacylglycerols as substrates. The substrates were prepared by esterifying 1.2- and 1.3-*cis*-9-dioctadecenylglycerols, each, with [1-^{14}C] palmitic, [1-^{14}C] stearic, and [1-^{14}C] oleic acids. It was found that human H-TGL preferentially hydrolyzes acyl moieties esterified in α position, regardless of the chain length and the number of double bonds of these acyl moieties. Human LPL and rat LPL also preferentially attack the α position *when it is occupied by either a palmitoyl or a stearoyl moiety*, but both of these enzymes prefer the β position when it is occupied by the oleoyl moiety. Control experiments with pancreatic lipase confirmed the known positional specificity for the α position. The effects of chain length and double bonds on the enzymic action of lipase will be discussed.

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DIFFERENTIAL SOLUBILIZATION OF BILE CANALICULAR MEMBRANE PHOSPHOLIPIDS BY BILE ACIDS. I.M. YOUSEF and M.M. FISHER, Medical Sciences Building, Rm. 7258, *University of Toronto, Toronto, Ontario, Canada* M5S 1A8.

The biliary secretion of phospholipids appears to depend on that of bile acids, and it is possible that the bile acids actually dissect phospholipids from the bile canalicular membrane during the course of their secretion into the bile. Supportive evidence for this hypothesis was sought in studies of the solubilizing effects of bile acids on bile canalicular membranes in vitro. Liver cell plasma membranes of male rats were isolated and separated into two fractions, one rich in bile canalicular membranes (BCM) and the other comprising the remainder of the plasma membranes (PM). Aliquots of BCM, PM, and microsomes were incubated with deoxycholic, chenodeoxycholic, or cholic acid at bile acid:membrane phospholipid ratios up to 100, and the phospholipids solubilized from the membranes were analyzed. (Supported by the Medical Research Council of Canada [MA-4865] and the Canadian Hepatic Foundation.)

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ISOLATION OF Δ^2-3-CH_3-MEVALONOLACTONE DURING THE ASSAY FOR HMG-CoA REDUCTASE ACTIVITY IN RAT LIVER MICROSOMES. AJIT SANGHVI and BHARAT PARIKH, Clinical Chemistry Laboratory, University of Pittsburgh School of Medicine, 201 DeSoto St., Pittsburgh, PA 15213.

Hydroxymethyl glutaryl (HMG) CoA reductase is the rate-limiting enzyme in hepatic cholesterol biosynthesis. Its activity is determined from the amount of radio-labeled mevalonic acid (MVA) formed from the substrate HMG-CoA. MVA is lactonized by adjusting the [H^+] of the microsomal incubation mixture in the vicinity of pH 1 and extracted with diethyl ether. Recoveries of lactone are usually 60–70%. Changing the $[H^+]$ used to lactonized MVA yields variable recoveries. Use of concentrated or 6.0 N HCl results in significant losses of MVA by way of by-product formation. Identification of the structure of a major by-product formed in such a way by gas chromatography, nuclear magnetic resonance, and mass spectrometry reveals it to be Δ^2-3-CH_3-MVA lactone. This is compatible with theoretical consideration that in a strongly acidic environment protonation of the –OH group of MVA occurs followed by its elimination as water (β-elimination). Such losses are prevented, and optimum and consistent recoveries in the 90% range of MVA lactone are obtained by using 0.5 ml of 3 N HCl for lactoniaztion in a total microsomal incubation mixture of 1.5 ml.

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CHOOSING EMULSIFIERS FOR FOOD SYSTEMS. **Gary E. Petrowski**, Kelco Company, 8355 Aero Dr., San Diego, CA 92123.

In food systems emulsifiers serve one of several purposes: stabilize emulsions, modify lipid properties, and specialty applications. The choice of emulsifiers is limited to those approved by the Food and Drug Administration in the Generally Recognized as Safe (GRAS) and additive categories. These will be discussed in some detail. Within these guidelines, further bases for choice are: structure application, effectiveness, cost, taste, and other physical properties. Emulsifiers can be characterized in general by their relative water-oil solubility. Several methods have been developed to determine this property quantitatively, with the most common being the hydrophile-lipophile balance (HLB) value. The merits and disadvantages of this system will be discussed. While these guidelines serve as an aid to choosing an emulsifier system (at least to the extent that many possible combinations have been eliminated), the final choice for a particular food system must still result from the evaluation of series of experiments in which the emulsifier(s) are varied in a nonhaphazard manner. Evaluation of the emulsions may be expedited if accelerated methods are used; provided this added stress does not alter the normal mode of emulsion destabilization. Illustrative examples utilizing these approaches will be given.

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CHEMICAL-PHYSICAL PROPERTIES OF FOOD EMULSIFIERS RELATED TO FUNCTIONS IN FOOD PRODUCTS. **Niels Krog**, Grindsted Products, Research Laboratories, 38, Edwin Rahrs Vej, DK-8220 Brabrand, Denmark.

The function of food emulsifiers can, generally speaking, be divided into four main areas: (a) stability of emulsions against coalescence of droplets of the dispersed phase (oil/water or water/oil emulsions), and influence on agglomeration of fat globules in whippable emulsions (liquid toppings); (b) complex formation with starch components, especially amylose (bakery products, processed potatoes, and pasta foods); (c) hydrophobic or ionic interactions with proteins (wheat gluten or milk proteins); and (d) influence on the polymorphism of crystalline fats (margarine, chocolate coatings). The individual effect of the various types of food grade emulsifiers within these areas is determined by their chemical structure and physical properties. The stability of emulsions against coalescence of dispersed droplets is dependent on the mechanical strength of mono- or multi-molecular interfacial films formed by absorbed emulsifier molecules. Interfacial films of mixed emulsifiers exhibiting condensed hydrocarbon chain packing conditions give increased emulsion stability due to optimum viscoelastic properties of the film. No food emulsifiers are completely water soluble, but some (distilled monoglycerides a.o.) form liquid crystalline mesomorphic phases in water. The lamellar type of mesophase is a very active physical state in promoting aeration (cake batters, etc.), and interactions with starch and proteins are enhanced when the emulsifier is present in the form of a lamellar liquid crystal in the water. The chemical structure of an emulsifier is a determining factor with regard to forming helical complexes with amylose in starch-containing foods. Only emulsifiers with a single, saturated fatty acid chain esterified to a polar group like glycerol or lactoylic-lactic acid are effective amylose-complexing agents.

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THE ROLE OF SURFACTANTS IN BAKERY FOODS. **Cho C. Tsen**, Department of Grain Science and Industry, Kansas State University, Manhattan, KS 66506.

Surfactants have been widely used as "dough conditioners" and "bread softeners" in the baking industry. The improving mechanism of their actions is, however, not well understood. The interactions between surfactant and protein, lipid, or starch in doughs and in model systems have been examined. Surfactants all contain one or more fatty acid groups to provide hydrophobic bonding sites along with polyols to provide hydrogen-bonding sites. Availability of the sites determines the relative improving effect of surfactants. The ionic nature of surfactants also affects their action. Several models will be proposed to explain the multiple interaction of surfactants, particularly sodium stearoyl-2 lactylate, and dough components.

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ROLE OF EMULSIFIERS IN NONDAIRY TOPPINGS. **John J. Jonas**, Kraftco Research and Development, 801 Waukegan Rd., Glenview, IL 60025.

Emulsion-based, fat-containing fabricated whippable foods, such as nondairy toppings, use emulsifiers to control emulsion functionality. Although emulsifiers contribute primarily to the ease of preparation and stabilization of emulsions in whippables, the emulsifiers also regulate the breaking of the emulsion during whipping. This second aspect of emulsifier functionality is eminently important for finished product properties and organoleptic features. The functionality of emulsifiers will be conceptulized on molecular level, whenever possible. These concepts will lead into the discussion of possible interactions of emulsifiers with the other components of emulsions or whipped products. As a result of the interactions, rather complex colloidal particles are formed built of water, fats, proteins, hydrocolloids, emulsifiers, etc. The ultimate goal is to understand and map the structure of these colloidal particles and explain the changes observed in the life cycle of the emulsion. The role of various proteins as interacting partners of emulsifiers will also be considered.

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THE APPLICATION OF THE EMULSIFIER HYDROPHILE—LIPOPHILE BALANCE THEORY IN FORMULATING A TEXTURED PROTEIN PRODUCT. **Dave Bone** and **Frank R. Kincs**, Quaker Oats Company, 617 W. Main St., Barrington, IL 60010.

The emulsifier hydrophile-lipophile balance (HLB) theory was applied to the formulation of a textured protein product. It was noted that the emulsifier HLB had a strong effect upon the processing parameters of the product. It was further noted that the HLB had a strong influence upon the crispness/chewiness qualities of the finished product. The effect of emulsifier HLB, in this case, was greater than the effects of varying corn starch addition from 5–20%. An HLB of 11 was chosen as the best of values over an initial range of 3–15. A chemical class study resulted in the choice of a blend of polysorbate 60 and propylene glycol monooleate as the best emulsifier system of 10 studied. A narrower range of HLB was then covered with the choice of HLB 11.4 as optimum.

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UTILIZATION OF MATHEMATICAL MODELS TO CHARACTERIZE FUNCTIONAL PROPERTIES OF SELECTED EMULSIFIERS IN CONTINUOUS MIX BREAD. **Ilija Gawrilow**, Glidden-Durkee Division, SCM Corporation, Dwight P. Joyce Research Center, 16651 Sprague Rd., Strongsville, OH 44136.

Research conducted to determine the functional properties of food emulsifiers encompassed by the Bread Standards facilitated the development of mathematical models. Areas of functional utility are characterized by this mechanism. Emulsifiers were investigated individually and in combination with a complementary softener or conditioning agent. The evaluation resulted in classified functionality and ranked responses for specified areas of: (a) bread softness retention, (b) shock tolerance, and (c) specific bread volume. Mathematical techniques employed to describe the models consist of equations having the form:

$$\text{Function Response} = \beta_{S_i}(\%\ S_i) + \beta_{C_j}(\%\ C_j) + \beta_{S_i C_j}(\%\ S_i)(\%\ C_j) \text{ where}$$

$$S_i = \text{softener},\ C_j = \text{conditioner}$$

Binary mixture experiments utilizing interaction modeling to describe functional properties were employed. Regression equations were developed to define staling-softness effects for the investigated emulsifiers. Synergistic responses are also identified. Potential commercial applications via computerization are discussed to assist in selecting emulsifier systems for specific functional applications.

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APPLICATIONS OF THE ACYL LACTYLATES IN FOOD SYSTEMS. **A.J. Del Vecchio** and **A.J. Dankwerth**, C. J. Patterson Company, 3947 Broadway, Kansas City, MO 64111.

A comprehensive survey is given on the functionality and applications of sodium stearoyl-2-lactylate, calcium stearoyl-2-lactylate and the lactylic esters of fatty acids in food systems. Included in the review are the basic physical and chemical properties of the lactylates, along with their varied uses in standardized and nonstandardized baked goods, protein-fortified baked goods, batter systems, puddings, icings, fillings, toppings, dehydrated potatoes, whipped toppings, coffee whiteners, and fluid shortening systems. Functionality of the acyl lactylates vs. other approved emulsifiers will also be covered. Benefits unique to these compounds will be highlighted.

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MONOGLYCERIDES AS FOOD TEXTURIZING AGENTS. **Cynthia P. Johnson**, Eastman Chemical Products, Inc, Building 230, Kingsport, TN 37662.

Distilled monoglycerides offer many advantages as food texturizing agents. They produce equal effects at half the level or less as compared with mono- and diglyceride emulsifiers, and they are available in a variety of physical forms—as powders, small beads, plastics, and liquids. Monoglycerides exhibit multifunctional properties. They function as emulsifiers, starch complexing agents, oil stabilizers, foaming and defoaming agents, water binding agents, and extrusion aids. These properties find use in many different food products; instant potatoes, bread and other bakery products, peanut butter, spaghetti, whipped toppings, icings, and coffee whitener are just a few examples. Other desirable properties may be given to monoglycerides by specific chemical modifications such as succinylation or acetylation. Succinylated monoglycerides have good dough strengthening and softening properties in baked goods. Acetylated monoglycerides have unique properties which allow them to be used as coatings or lubricants in various food applications.

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HYDROXYLATIONS OF FATTY ACIDS AND THEIR DERIVATIVES. **Lauren A. Messer** and **Norman C. Deno**, The Pennsylvania State University, University Park, PA 16802.

It had been reported (Deno and Pohl, *J. Am. Chem. Soc.* 96:6680, 1974) that FeII-et_2NOH or FeII-et_3NO systems oxidize 1-octanol to octanediols (72% selective for the 1,7-isomer) in CF_3COOH. The low yields of 10% that were reported have now been raised to 70–80% by using me_3NO and introducing FeII as $FeCO_3$. The reaction has been extended to acids and amines. It is a characteristic of these oxidations that no further oxidation occurs beyond the alcohol stage and hydroxylation is selective for sites remote from alcohol, carboxyl, or amine group. These hydroxylations are now applied to fatty alcohols, fatty acids, and fatty amines. The results will be reported. It is expected that there will be selectivity for hydroxylation remote from the functional group but that attack beyond C_8 will be approximately random. Uses for such mixtures of hydroxylated derivatives of fats are being sought. For example, the hydroxylated octanoic acids possess a strong coconut odor, perhaps due to lactones.

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PRODUCTION OF LINEAR DIACIDS FROM NITRIC ACID OXIDATION OF SATURATED FATTY ACIDS. **Norman C. Deno**, **Virginia L. Deno**, and **Jeffrey M. Skell**, The Pennsylvania State University, University Park, PA 16802.

A chemical industry based on fatty acids is becoming more attractive with the increasing production of fatty acids from animal and vegetable fats and because of the renewable resource nature of fatty acids and the nonrenewable nature of petroleum. The HNO_3 oxidations of fatty acids are characterized by high selectivity for attack at sites remote from the carboxyl group. Even the eighth carbon away from the carboxyl group is more resistant than more distant carbons. At 10% conversion, the products from palmitic acid are largely C_8–C_{15} diacids and the corresponding C_2–C_8 monoacids. As the reaction progresses, the larger diacids are cleaved in the center, so that at 90% conversion, C_4–C_{12} diacids predominate. Exhaustive oxidation leads to C_4–C_8 diacids plus some of the monoacids from the initial cleavage. The diacids are free of hydroxy and keto acids, but they do contain up to 10% nitropalmitic acids in the early stages of oxidation. No oxidation occurs on the carboxyl group so that palmitic acid does not degrade to C_{15}, C_{14}, etc., monoacids, nor is carbon lost as CO_2. Thus the weights of diacid and monoacid products are greater than the weight of starting palmitic acid. The stoichiometry approaches $CH_3(CH_2)_{14}COOH + 10\ HNO_3 \rightarrow CH_3\ (CH_2)_nCOOH + HOOC\ (CH_2)_{12-n}COOH + 10\ NO_2 + 6\ H_2O$ in that, in using 20% excess of 70–90% aqueous HNO_3, the HNO_3 concentration falls to 10–15% after 24 hr reflux and ca. 10% palmitic acid remains. Runs using a pound of palmitic acid are routine, though in such runs the HNO_3 is added in three portions to moderate NO_2 evolution. After each HNO_3 portion has finished reacting, the aqueous layer is removed before adding the next portion of HNO_3. It is convenient to separate the aqueous layer because it contains most of the C_4–C_7 diacids, and these are readily isolated by rotary evaporation at 100C and 10 torr. The organic layer contains C_8–C_{15} diacids, unreacted palmitic acid, and most of the monoacids.

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SELECTIVE CHLORINATION OF FATTY AMIDES. ELIZABETH J. JEDZINIAK and NORMAN C. DENO, The Pennsylvania State University, University Park, PA 16802.

The light initiated reaction of fatty amides and N-chloroamines in acidic media results in the chlorination of the alkane portion of the molecule. We wish to report selectivity in this reaction due to solvent dictated conformations of the substrate. Previously it had been shown that reactions on octanoamide, when run in aqueous 70–90% sulfuric acid, gave selectivity for the ω-1 position. Using dodecanoamide as the substrate, these reaction conditions produced an unexpected pattern of, not ω-1, but central chlorination. Changing the solvent system to acetic acid-sulfuric acid mixtures produced the ω-1 chlorination pattern. Reactions using hexadecanoamide gave 80% of the chloro substituent on C_7–C_{11} under the acetic acid-sulfuric acid reaction conditions. Experiments on the chlorination of other fatty amides are in progress.

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PROCESS VARIATIONS FOR THE SULFATION OF FATTY ACID ALKANOLAMIDES. R.G. BISTLINE, JR., W.R. NOBLE, and W.M. LINFIELD, Eastern Regional Research Center, ARS, USDA, 600 E. Mermaid Lane, Philadelphia, PA 19118.

Sulfated fatty acid alkanolamides are known to be excellent lime soap dispersants and can be formulated into superior soap-based detergents. Large scale sulfation of the tallow alkanolamides is difficult to achieve without the use of large amounts of solvents, since the amides are high melting waxy compounds which are soluble only in chlorinated solvents. The latter pose environmental and cost problems. It was found that by cosulfation of the amides with low molecular alcohols the use of the undesirable chlorinated solvents can be reduced and even eliminated completely. The surface active properties, such as lime soap dispersing ability and detergency, of the sulfated tallowalkanolamides are unaffected by the cosulfation with the lower molecular alcohol. In unsaturated amides, such as tallow alkanolamides, attack on the double bonds appears slight as long as only a small excess of sulfating agent is used. A larger excess of sulfating agent has an adverse effect on detergency.

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FAT DERIVATIVES WITH INDUSTRIAL USE POTENTIAL. D.M. DOTY, Route 2, Box 132-A, Buchanan, TN 38222.

The increased cost and possible future shortage of petrochemicals make natural fats and oils more attractive as starting materials for the preparation of compounds for many industrial applications. Examples of such fat derivatives include (a) the reaction product of trichlorosilane and tallow (TCST), which can impart a high degree of water repellency to masonry and possibly to leather and fabrics; (b) the reaction product of sulfur dichloride and oleic acid, which could then be reacted with various nucleophilic ions to produce compounds useful as plasticizers, ore flotation agents, rubber cure accelerators, etc.; and (c) the salts of a boric acid-monoglyceride complex, which could find relatively wide use as emulsifiers and in relatively inexpensive detergent formulations.

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FATS ARE USED FOR MANY PURPOSES. O.H.M. WILDER, 2344 Juneway Terrace, Fayetteville, AR 72701.

Animal fats and oils are a very versatile class of raw materials which are used as is or in the form of derivatives by more than a dozen different industries. In addition to their common uses in food, feed, and soap, fats or their derivatives are used in production of cosmetics and other personal grooming aids, the clothing and shoes we wear, the phonograph records that entertain us, and the pharmaceuticals that contribute to our health and well-being. As we travel from place to place, we ride on rubber tires that were produced using fat and on highways of concrete or asphalt that may have been produced with fat additives. The vehicles that we ride in are made with steel that has been processed with specialized plating and cutting oils and are lubricated with high-temperature, high-pressure oils and greases formulated with fat. Specialized oils containing fat are used in drawing wire that delivers power to our homes and factories, and if that power should fail for any reason, we can still light our way with candles containing animal fat. These and other uses of fat will be discussed.

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DIETARY FATS AND ATHEROSCLEROSIS. DRAGOSLAVA VESSELINOVITCH, ROBERT W. WISSLER, and ROSE JONES, Department of Pathology, University of Chicago, PO Box 414, 950 E. 59th St., Chicago, IL 60637.

Light and electron microscopic studies on the effect of dietary fats on the development of atherosclerotic lesions in nonhuman primates will be described. The production of lesions characteristic of a specific diet has been demonstrated in several studies in this laboratory. In these studies the 9 month atherosclerotic lesions from 42 Rhesus monkeys that were fed a ration high in coconut oil, butterfat, and cholesterol were compared with those in 36 monkeys that were fed diets containing 2% cholesterol and 25% lipid (coconut oil-butterfat or corn oil or butter or peanut oil) over a period of 50 weeks. These diets produced variable elevations of serum lipids. Although a wide spectrum of lesions was observed in each dietary group, lesions with the distinguishing features identified for each diet were generally predominant. The coconut oil-butterfat feeding resulted in advanced lipid-rich lesions and prominent cell proliferation. The butterfat diet produced severe lesions characterized by moderate cell proliferation and marked intracellular and extracellular lipid accumulation. In contrast atherosclerotic lesions in monkeys fed peanut oil showed marked cell proliferation accompanied by an increase of fibrous components. These lesions contained less lipid than those of any other dietary group. The corn oil-fed monkeys showed fewer atheromatous lesions with relatively little intimal thickening and lipid deposition. Serum lipid levels and their relationship to the frequency and severity of arterial lesions and to xanthomas will be discussed.

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ROLE OF DIETARY PROTEIN IN HYPERCHOLESTEROLEMIA AND ATHEROSCLEROSIS. K.K. CARROLL, Department of Biochemistry, University of Western Ontario, London, Ontario, Canada N6A 5C1.

Atherosclerosis was first produced experimentally by Ignatowski in 1908 by feeding animal products to rabbits and was attributed by him to the protein component of those products. From time to time other workers have also reported evidence that animal protein can produce hypercholesterolemia and atherosclerosis in rabbits. Studies in our laboratory have shown that the hypercholesterolemia produced in rabbits by feeding cholesterol-free, semisynthetic diets is primarily due to the presence of animal protein in the diets. This effect is not observed when the dietary protein is derived from plant sources (Carroll and Hamilton, *J. Food Sci.* 40:18–23, 1975). An enzymatic digest of casein or a mixture of amino acids corresponding to casein is as hypercholesterolemic as the intact protein. It is less certain that the low plasma cholesterol levels obtained by feeding soy protein isolate can be attributed entirely to its amino acid composition (Huff, Hamilton, and Carroll, *Fed. Proc.* 34:892, 1975). Dietary protein is generally considered to have little or no influence on serum cholesterol levels or atherogenesis in humans. Animal protein intake, however, shows as strong a correlation with coronary heart disease in different countries as any other dietary variable. Dietary protein deficiency tends to be associated with low serum cholesterol levels, and there is some evidence that diets containing large amounts of animal protein have a hypercholesterolemic effect in humans. Vegetarians tend to have lower serum cholesterol levels and less coronary heart disease than the population at large, but this may be related in part to low cholesterol intake. It has also been reported that human serum cholesterol levels can be lowered by substituting vegetable protein for animal protein in the diet. More consideration should perhaps be given to the role of dietary protein in the etiology of atherosclerosis. (Supported by the Ontario Heart Foundation and the Medical Research Council of Canada.)

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THE ROLE OF DIETARY CARBOHYDRATE IN CHOLESTEREMIA AND ATHEROSCLEROSIS. DAVID KRITCHEVSKY, The Wistar Institute, 36th Street at Spruce, Philadelphia, PA 19104.

Although this presentation will be concerned mainly with carbohydrates, it should be understood that carbohydrate effects are mediated by other components of the diet. In general, complex carbohydrates are more cholesteremic than simple carbohydrates. However, in rabbits and pigs, starch and sucrose appear to have similar atherogenic potential. Using a semipurified, cholesterol-free diet we have studied the effects of different carbohydrates in rabbits and in primates. In rabbits, sucrose, fructose, or starch are more atherogenic than glucose or lactose. Baboons fed diets high in fructose exhibited more aortic sudanophilia than did diets containing sucrose, glucose, or starch. All four diets were equally cholesteremic. The glucose and starch diets led to about 40% increases in serum triglycerides; the sucrose diet raised triglycerides by 55%; and the fructose diet led to a 72% elevation. In vervet monkeys, fructose was found to be more atherogenic than sucrose or glucose. In addition to the carbohydrates, which were fed as 40% of the diet (41% of calories) the diets contained 25% casein (26% of calories) and 14% hydrogenated coconut oil (33% of calories).

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DIETARY FIBER AND ATHEROSCLEROSIS. JON A. STORY, SHIRLEY A. TEPPER, and DAVID KRITCHEVSKY, The Wistar Institute, 36th Street at Spruce, Philadelphia, PA 19104.

Atherosclerosis has been epidemiologically linked with the low dietary fiber intake of Western populations, since more "primitive" populations whose fiber intake is much higher are relatively free of atherosclerosis. Some experimental data in animals tend to support this hypothesis. Rabbits fed atherogenic diets, either with or without cholesterol, can be protected from the usual progression of hypercholesteremia and atherogenesis by simultaneously feeding certain types of fiber, e.g., alfalfa or wheat straw. The mechanism involved in the hypocholesterolemic effect of fiber seems to involve neutral and acidic sterol excretion. Fiber has been shown to bind bile acids in vitro. This prevents the bile acids from interacting in micelle formation, thus inhibiting cholesterol absorption. Bile acid excretion would also be increased, thus further decreasing cholesterol pools. Fiber studies in humans have not been conclusive. Bran, which has been widely used to treat diverticular disease, has failed to show efficacy in cholesterol lowering. Some other constituents of fiber, especially pectin and guar gum, have yielded promising results. Much work is needed to ascertain the mechanism by which fiber exerts its hypocholesterolemic and antiatherogenic effects and exactly which components of fiber are responsible for the observed changes.

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FRACTIONATION OF PALM OIL: THEORETICAL AND PRACTICAL CONSIDERATIONS. K.G. BERGER, Central

Laboratories, J. Lyons & Co., Ltd., 149 Hammersmith Rd., London, England W. 14 OQU.

Theoretical aspects of crystallization will be discussed as they relate to the practices of fractionation of oils with and without the use of solvents. Commercial processes apply different methods for the separation of the solid fraction which have different requirements for the physical state of the solids. This in turn is dependent on the rate of nucleation and crystal growth. Factors affecting these parameters include the physical conditions used and the presence of nontriglyceride constituents. The fatty acid and glyceride composition of palm oil will be discussed in relation to the opportunities offered by fractionation to achieve products of practical value. Applications of palm oil fractions in food manufacture will be reviewed briefly. The results of some laboratory studies of crystallization and polymorphism in palm oil will be related to fractionation procedures.

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DRY FRACTIONATION OF PALM OIL BY DIRECTED CRYSTALLIZATION AND FILTRATION: THE TIRTIAUX SYSTEM. A. TIRTIAUX, S.A. Fractionnement Tirtiaux, Chaussée de Charleroi, 601, B6220 Fleurus, Belgium.

Dry fractionation, when crystallization is directed accurately, provides a simple and economical solution to the problem of splitting palm oil into two or three fractions of regular qualities. The seeds, necessary to any crystal growth, are already present in the oil. In the Tirtiaux process, the formation of those seeds and their transformation by appropriate heating into suitable β-prime forms, enable the obtainment of large crystals easily filtrable. However, if the subsequent cooling is scheduled on a time basis, the variations of composition of the feedstock, together with the intersolubility of the crystals during their growth, make crystallization difficult to anticipate. The control of the cooling, in the Tirtiaux process, is, therefore, based on a regulation of the difference in temperature between oil and coolant. The rate of cooling is thereby automatically adapted to the thermic reaction of the oil during its crystallization, whatever its composition. The temperature at which the cooling is stopped can then be chosen according to the qualities required for the fractions. Filtration is done on the Tirtiaux Flo 1000 continuous vacuum filter equipped with a stainless steel perforated belt as filtration support. A recycling device for any crystals sucked through the belt at the edge of the horizontal vacuum area ensures a filtration on a preformed cake. The coarse mesh of the belt, together with the large size of the crystals obtained, allows an easy filtration with low vacuum (50 to 200 mbar) even if the viscosity of the oil is high. It also gives the possibility of filtrating very delicate crystals as those obtained on hydrogenated soybean and fish oil dry fractionation.

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DETERGENT FRACTIONATION OF FATTY OILS. BEN BRAAE, Alfa-Laval AB, Postfack, S-147 00 Tumba, Sweden.

The fractionation of fatty oils can be carried out by three different methods, i.e., by filtration, by solvent fractionation, and by the so-called detergent fractionation. The last mentioned method, here described in some detail, is easy to control, has low running costs, and medium installation costs as compared to other methods. The yield of the low melting fraction is also high. The principle of detergent fractionating and industrial plants for that purpose are described, and practical results obtained by fractionating palm oil, palmkernel oil, and tallow and lard are given. As natural fats contain a mixture of triglycerides containing both saturated and unsaturated fatty acids, the natural compositions put a limit to what can be achieved by detergent fractionation. It is, however, possible to rearrange the fatty acid distribution by means of interesterification, especially when a directed interesterification is carried out prior to the fractionation; two fractions can be obtained of which one contains mainly saturated and the other mainly unsaturated triglycerides.

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CONTINUOUS SOLVENT FRACTIONATION OF PALM OIL AND OTHER EDIBLE OILS. E. BERNARDINI, Construzioni Meccaniche Bernardini, 00040 Pomezia, via della Petronella 2, Rome, Italy.

To produce an edible oil which remains liquid at ambient temperature, starting from fatty substances with a high saturated glyceride content, several processes can be used which aim solely at lowering the amount of such saturated glycerides. The process described in this paper is carried out in the solvent phase and makes use of normal hexane as the solvent. The continuous solvent procedure has the advantage of giving a high yield of liquid edible oil with a low cloud point. The industrial application of this process to palm oil has given excellent results, and the paper lists actual technical and economical data recorded during the operation of fractionating plants which have been running for a number of years in palm oil producing countries. This process has also proved to be particularly suitable for hydrogenated fish and soybean oils. Moreover, it has found application for the fractionation of sundry fats such as tallow as well as for fatty acids. Fractional crystallization and filtration, the two industrial apparatus used to this purpose, are described.

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INFLUENCE OF DIETARY FATS ON RESPONSE OF RATS TO AUDITORY STRESS. HANS KAUNITZ, LESTER M. GELLER, RUTH E. JOHNSON, and MILDRED SHEMESH, Department of Pathology, Columbia University, 630 W. 168th St., New York, NY 10032.

Weanling male rats were fed a diet containing 20% of either lard or corn oil. When they were 94 days old, each rat was permitted to explore an open black box marked off in squares and was observed for 4 min.; the number of squares traversed (open field activity or OFA) was recorded, and the test was repeated on the following three days. On the basis of the performance in the four trials and on body weight and food intake, each dietary group was divided into matching control group and a group to be subjected to randomized, intermittent white noise (93 decibels) and 3 bursts/hr of 4 in. bells. At 191 days, the stressed rats fed lard (SL) were significantly lighter than their unstressed controls (UL), whereas stressed controls (SC) and unstressed controls (UC) were not significantly different. Food intakes were lower in both stressed groups (more so in SC than in SL). These differences have continued. Both stressed groups covered significantly more squares during their open field trials, with OFA being higher among those fed lard. At 338 days, the results were similar. Thus, the kind of fat fed influenced their response to noise stress, food intake, and body weight. (Supported by National Live Stock and Meat Board and National Association for Retarded Citizens.)

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SUCROSE POLYESTERS: UNABSORBABLE, CHOLESTEROL LOWERING FATS. R.J. JANDACEK and F.H. MATTSON, The Procter & Gamble Company, Miami Valley Laboratories, PO Box 39175, Cincinnati, OH 45247.

The esterification of sucrose with six to eight long chain fatty acids produces a fat with physical properties that are similar to those of a triglyceride with the same fatty acid composition. This fat, termed sucrose polyester (SPE), is not hydrolyzed by pancreatic lipase and thus is not absorbed from the intestine. The absorption of dietary cholesterol in rats is reduced by the addition of SPE to the diet. This reduction is a function of SPE dose, with absorption decreasing by 1.2% per 1% of dietary triglyceride replacement by SPE. The effects of SPE on cholesterol metabolism are probably the result of oil/micellar partitioning in the intestine. In the lumen of the small intestine, SPE, unlike triglyceride oils, remains as an unhydrolyzed oil phase that solubilizes dietary or enterohepatic cholesterol and reduces its distribution into mixed bile salt micelles. Tests with humans have shown the organoleptic acceptability and nonabsorbability of SPE. In these studies a 9.4% decrease in serum cholesterol was observed in normal subjects receiving 50 g SPE/day for 10 days.

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POLYGLYCEROLS AND POLYGLYCEROL ESTERS AS BIOLOGICAL TOOLS IN DIETETIC AND METABOLIC FUNCTIONS. V.K. BABAYAN, Stokely-Van Camp, Inc., 6815 E. 34th St., Indianapolis, IN 46226.

Polyglycerols and polyglycerol esters are discussed as possible candidates for dietetic and metabolic application components. Modification of their structure to achieve the functionality desired, such polyglycerol esters can be considered as replacements and/or adjuncts to bile salts and pancreatic lipase. Other polyglycerols and polyglycerol esters are considered as fat replacement agents and components for calorie restricted foods and diets. Polyglycerol esters as hybrid fats with multifunctionality are suggested for various food applications where even the metabolic fate can be controlled by the type and moiety of the fatty acids used in their synthesis.

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TOXICITY OF THERMALLY POLYMERIZED OIL. TAKASHI KANEDA and MORIO SAITO, Department of Food Chemistry, Faculty of Agriculture, Tohoku University, 1-1, Amamiya-Machi, Tsutsumi-Dori, Sendai 980, Japan.

It is known that polymerized oils heated in an inert gas are toxic to rats. The toxic components in these oils are presumed to be the monomeric cyclic fatty acids, but little is known about their exact structure. In order to study the detailed structure and biological properties of such cyclic acids, linseed oil which had been heated in a nitrogen atmosphere was converted to methyl esters, and the most toxic substances were separated by urea adduction, bromo-mercurimethoxy adduction, and silicic acid column chromatography. Gas chromatography-mass spectrometry analysis indicated that toxic compounds had a skeleton of methyl 7-(2′-n-propylcyclohexyl) nonanoate and methyl 6-(2′-n-butylcyclohexyl) octanoate and contained two double bonds. Cyclic fatty acids were administered to rats and were then found to be present in the lipids extracted from blood and liver.

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EFFECTS OF THERMALLY OXIDIZED OLIVE OIL ON IN VITRO HEART CELLS. R. PRASAD and J.C. ALEXANDER, Department of Nutrition, and P.K. BASRUR, Department of Biomedical Science, University of Guelph, Guelph, Ontario, Canada N1G 2W1.

Previous studies have shown that certain fractions of heated fats are toxic to laboratory animals. In order to test their effects on animals' cells, an experiment was undertaken using cultures of newborn rat heart cells. Olive oil was heated at 180 C continuously for 72 hr, aerating the sample for 8 hr every day. The distillable-non-urea-adductable fraction (DNUA) from the thermally oxidized fat was prepared as an ethyl ester fraction, and then hydrolyzed to recover the free fatty acid portion. Free fatty acids from fresh olive oil were used as a control. Bovine serum albumin fraction V (unesterified fatty acid poor form) was found to be an efficient carrier of lipid fractions in the tissue culture medium. These fractions were added to the culture medium at the concentations of 20, 40, 60, 80, and 100 μg/ml. Monolayers derived from heart cells of 2 to 5 day-old rats were exposed to the various concentrations of heated and fresh fatty acids from olive oil. Intracellular lipid accumulation was observed with an inverted phase contrast microscope. Mitotic index, percent pyknotic cells, and the total protein content of the treated and nontreated cultures were determined at different periods (24, 48, and 96 hr) after exposure to the fatty acids. Mitotic index was not significantly different in DNUA treated cells at lower levels (2, 40, and 60 μg/ml) of DNUA, compared to controls. Pyknotic cells were significantly greater in cultures treated with higher concentrations of lipid. There was a small increase in protein content of cultures exposed to DNUA for 24 and 48 hr, after which cells exhibiting abnormalities including vacuolization of the cytoplasm, tripolar spindle formation, and other mitotic aberrations were observed frequently. Studies on the uptake of ^{14}C-palmitic acid by cultured myocardial cells, and its incorporation into different lipid classes showed that the uptake in DNUA treated cells was significantly greater than in control cultures of heart endothelial and muscle cells. A majority of the ^{14}C-palmitic acid administered was in the phospholipid and triglyceride fractions. (Supported by the National Research Council of Canada and the Ontario Ministry of Agriculture and Food.)

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IN VIVO RED CELL MEMBRANE LIPID PEROXIDATION IN HUMANS AND ANIMALS WITH NORMAL SERUM VITAMIN E LEVELS. BERNARD D. GOLDSTEIN, New York University Medical Center, 550 First Ave., New York, NY 10016.

Red cell membrane lipid peroxidation has been suggested to be of pathogenic significance in a number of human hemolytic anemias. However, in the absence of vitamin E deficiency the evidence has been indirect and has been predominantly based on the finding of malonaldehyde (MDA) during in vitro incubation of red cells in model systems. In order to obtain more direct evidence of in vivo red cell lipid peroxidation in hemolytic states, we have utilized a modification of the procedure of Tappel and his colleagues for the detection of fluorescent amino-iminopropene derivatives of MDA. Spectrofluorescent evaluation of extracts of red cells freshly obtained from patients receiving the oxidant hemolytic drug diaminodiphenylsulfone demonstrate fluorescence consistent with the crosslinking of MDA to aminolipid. Vitamin E levels were in the normal range and free MDA was not detectable in freshly drawn blood. Higher levels of fluorescence were detectable in older red cells suggesting that such crosslinks accumulate during the lifetime of the circulating red cells. Similar fluorescence was observed in extracts of red cells obtained from rats, rabbits, and mice receiving the oxidant hemolytic drug phenylhydrazine. Feeding a vitamin E deficient diet to rats treated with phenylhydrazine appeared to potentiate an increase in both hemolysis and fluorescence. Further assessment of the implications of the finding that lipid peroxidation resulting in amino-iminopropene crosslinks can occur in individuals with normal vitamin E levels include in vitro studies suggesting that such crosslinks increase red cell membrane viscosity; and the demonstration that incubation with MDA produces bacterial mutagenesis in a manner consistent with the crosslinking of DNA.

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BREAD SHORTENING. **Paul M. Koren**, Procter & Gamble Company, 6071 Center Hill Rd., Cincinnati, OH 45224.

Bread has traditionally been made with lard as the only shortening because this fat was readily available, economical, and supposedly added a special flavor to the bread. A change in consumer buying and eating habits and the introduction of continuous mix bread necessitated a change in shortening specifications. The trend was towards softer and softer bread which concomitantly required the development of more effective dough strengtheners such as calcium and sodium stearoyl-2-lactylates, ethoxylated mono-diglycerides, polysorbate 60, etc. These additives have made subtle changes in the quality of the bread which could account for the decline in white bread consumption.

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CAKE SHORTENINGS. **Deborah I. Hartnett**, ICI United States Inc., Concord Pike and New Murphy Road, Wilmington, DE 19897.

Triglycerides have been traditionally used in cakes to provide tenderness and grain. Specialty cake shortenings are used today to improve batter aeration, cake volume, grain, and to extend shelf life. The role of emulsifiers in providing improved shortening characteristics will be discussed. The features that will contribute to a quality cake shortening—manufacturing procedures, characteristics, and specifications—will be reviewed. Methods of use and handling will be related to cake quality.

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PASTRY SHORTENINGS. **A. Aslani**, Glidden-Durkee Co., Cleveland, OH 44115.

Shortening is a major component of pastry and several of its characteristics are critical in achievement of desirable structure and texture. The role of shortening, as it specifically applies to pastry products, both Danish and puff types, is discussed. Properties of particular significance in pastries are emphasized including the effects of hydrous and anhydrous systems, solid fat indices, and crystal structures.

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SHORTENINGS FOR BAKERY TYPE CREAM ICINGS AND FILLINGS. **Harry Brody** and **W. Marvin Cochran**, Swift & Company, Research and Development Center, 1919 Swift Dr., Oak Brook, IL 60521.

Quality of shortenings used in cream icings and fillings is measured by their ability to cream well, to retain air with minimal air cell coelescence, and to produce icings and fillings with adequate body. These performance characteristics are related directly to triglyceride composition and to type and amount of emulsifier used. Optimum and less than optimum shortening substrates will be defined in terms of triglyceride profiles. Contributions of lipophilic and hydrophilic emulsifiers will be discussed, and effects of additions of high levels of hydrophilic emulsifiers to less than optimum triglyceride substrates will be shown.

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CONFECTIONERY COATING FATS FOR THE BAKERY INDUSTRY. **Todd A. Andrews**, PVO International, Inc., World Trade Center, San Francisco, CA 94111.

The bakery industry has a diversity of applications for the employ of confectionery coatings in the enrobing of bakery products. Each of these applications has unique requirements for organoleptic, textural, and stability properties of the confectionery coating. The properties of the specific enrobed bakery product, parameter restrictions for handling of the confectionery coating and enrobed bakery product, and the environmental conditions exposed to the enrobed item are factors to consider in determination of the acceptable confectionery coating. Meeting the specific needs of a confectionery coating necessitates the proper choice of fat system. While technology continues to offer improved opportunities toward achieving optimum properties of an enrobed bakery product, fat systems are presently available which, when selected properly, offer the baker the ability to produce outstanding products today. A discussion of commercially available fat systems, the physical properties of the fat systems, and the resultant properties of the confectionery coating and enrobed bakery product is detailed. Recommendations of those fat systems most acceptable and least acceptable for various enrobed bakery products are discussed, with emphasis given to the relative effects of the coating fats on the quality and economics of the enrobed bakery product.

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FRYING FATS IN THE BAKING INDUSTRY. **Jack G. Marcus**, Best Foods Division of CPC International, 26 Condit Court, Roseland, NJ 07068.

This paper will present a review of fats generally used for frying bakery products. Specifications critical to performance in the fryer and to finished goods quality are discussed. The use of additives in frying fats is discussed. The shortenings reviewed will be based on soy oil, coconut oil, cottonseed oil, palm oil, corn oil, and tallow. The specifications reviewed will be color, free fatty acid, iodine value, smoke point, melting point, solid fat index, and base oil choice.

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STABLE FREE RADICALS AS ANTIOXIDANTS FOR AQUEOUS LINOLEATE EMULSIONS. **H.S. Olcott**, **J.S. Lin**, and **A. Taslimi**, Institute of Marine Resources, University of California, Davis, CA 95616.

Stable free radicals (4-hydroxy-2,2,6,6-tetramethyl-piperidinoxyl [Tempol]; 4-keto-2,2,6,6-tetramethyl piperidinoxyl [Tempone]; 6-ethoxy-2,2,4-trimethyl-1,2-dihydroquinolinoxyl [ethoxyquin nitroxide]) act as antioxidants for hemoglobin-catalyzed linoleate emulsions oxidation. The course of the reaction was followed with an oxygen analyzer and by electron paramagnetic resonance spectroscopy. The quantitative relationships will be described. When the peroxide level in the original emulsion was high, no protection was afforded.

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ANTIOXYGENIC ACTIVITY OF SEA ALGAE. **Kenshiro Fujimoto** and **Takashi Kaneda**, Faculty of Agriculture, Tohoku University, 1-1, Amamiyamachi-Tsutsumidori, Sendai, Japan.

In order to know the antioxygenic effect of sea algae, 23 species of algae were screened for this purpose. Ground dried algae were extracted with $CHCl_3$-MeOH mixture and water. The effect of each extract was examined by the method of Olcott's oven test. Methyl ester of safflower oil (free from unsaponifiable matter) was used as substrate oil. The result indicated that the $CHCl_3$-MeOH fraction obtained from brown algae showed the most remarkable antioxygenic activity, and among them, *Eisenia bicyclis* was the most effective followed in order by *Undaria pinnatifida, Ishige okamurai, Sargassum kjellmanianum, Heterochordaria abietina*. Red algae were not appreciable; however, the effect of aqueous fractions obtained from *Dermonea frappieri* and *Gigartina tenella* showed better effect than those of $CHCl_3$-MeOH fraction. The antioxygenic substances contained in $CHCl_3$-MeOH fraction of *Eisenia* and *Undaria* were screened. In *Eisenia*, the substance was identified as phospholipids, especially phosphatidylethanolamine which was the main component in phospholipids. On the contrary, phospholipids in *Undaria* showed no effect. These results indicated that the antioxygenic activity of algae seemed to be manifested by synergistic reaction of several components.

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NATURAL ANTIOXIDANTS FROM SPICES. **S.S. Chang**, Department of Food Science, Rutgers State University, PO Box 231, New Brunswick, NJ 08903, **B. Ostric-Matijasevic**, University of Novi Sad-Yugoslavia, **Oliver A.L. Hsieh**, Department of Food Science, Rutgers State University, New Brunswick, NJ, and **Cheng-Li Huang**, Pharmacia Laboratories, Inc.

Natural antioxidants have definite advantages over synthetic chemicals, particularly at the present when there is a trend to consume more natural foods. In addition, synthetic chemicals available on the market today do not have distinctive antioxidant effects in some applications, such as deep-fat frying and vegetable oil. The presence of antioxidants in spices, specifically rosemary and sage, is well known. However, the extracts of such spices usually have a strong odor and a bitter taste and, therefore, cannot be used in most food products. The present paper will report a patented process for the extraction of rosemary and sage followed by vacuum steam distillation of the extract in an edible oil or fat to obtain a bland natural antioxidant. Fractionation and characterization of the active antioxidant ingredient in the extract of rosemary and sage will also be reported.

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USE OF NATURAL ANTIOXIDANTS EXTRACTED FROM *PHASEOLUS VULGARIS* IN VARIOUS FISHERY PRODUCTS. **L.R. Tovar** and **S.P. Castro**. Department of Food Science, Faculty of Chemistry, University of Mexico, Mexico 20, D.F.

The present work was undertaken in order to study the antioxidant activity of several compounds generated by fermentation of black beans (*P. vulgaris*) with a fungus, *R. oligosporus* NRRL 2710, in oils from anchovy (*E. mordax*) and pilchard (*S. sagax*), species which are very abundant in the Baja California's littorals. Induction periods of both oils were determined by the active oxygen method (AOM) as well as by the Schaal oven tests. Antioxidant effects of the extracts of the fermented beans were compared to commercial food grade antioxidants; results suggest the possibility of mixing fermented beans with these fishes or other foods high in oil content to produce food products that are stable and have an increase in the nutritive value.

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THE PERFORMANCE OF NONABSORBABLE POLYMERIC ANTIOXIDANTS IN FOODS. **Thomas E. Furia** and **Nicolo Bellanca Dynapol**, Palo Alto, CA 94304.

The performance of a nonabsorbable, polymeric antioxidant in a number of model food systems is described. Data are presented comparing the activity of traditional monomeric food grade antioxidants and a polymeric candidate in stabilizing vegetable and essential oils, baked goods, cereals, and fried potato products. Results are discussed in terms of process stabilization and carry-through performance in foods.

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ANTIOXIDANT LOSSES DURING FOOD PROCESSING. **A.W. Kirleis**, Department of Agronomy, Life Science Bldg., Purdue University, West Lafayette, IN 47907.

The current literature dealing with the loss of synthetic antioxidants during food dehydration will be reviewed. Results of an investigation on the loss of three synthetic antioxidants: butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), and tertiary butylhydroquinone (TBHQ) in model freeze-dried systems, designed to simulate a high lipid food, will be presented. Among the antioxidants studied, TBHQ was retained to the greatest extent under all processing parameters used and BHA to a greater degree than BHT. Results of the study indicate residual BHA and BHT were dependent upon the final moisture content of the model freeze-dried system. TBHQ retention appears to be independent of final moisture content.

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COMPARISON OF OXIDATIVE STABILITY OF MACKEREL SKIN OIL WITH VARIOUS ANTIOXIDANTS. P.J. Ke, R.G. Ackman, and D.M. Nash, Environment Canada, Fisheries and Marine Service, Technology Branch, Halifax Laboratory, PO Box 429, Halifax, Nova Scotia, Canada B3J 2R3.

The in vitro rate of autoxidation at 60 C for lipids extracted from the mackerel skin has shown an unusual rapid reaction, about 10 times faster than the meat oil. This indicates that some biochemical pro-oxidative substances in mackerel skin were fat solvent extractable. A comparative study on the effectiveness for inhibiting the fast autoxidation in mackerel skin oil with BHA, TBHQ, tocopherols, and tempeh oil has been investigated. The results of oxidative stability of mackerel skin oil with 0.02% BHA, 0.10% α-tocopherol, and 5% tempeh oil have been comparable, and the antioxidative ability of tempeh oil has been satisfactorily demonstrated. However, the most effective antioxidant is TBHQ, even at a concentration of 0.003%. Autoxidation of polyunsaturates in marked skin lipids can be successfully retarded to the equivalent induction period when 0.02% BHA is used. Differential antioxidation for specific fatty compounds in mackerel skin lipids with various concentrations of TBHQ has also been discussed.

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RECENT DEVELOPMENTS IN THE METATHESIS OF FATTY ESTERS. C. Boelhouwer and E. Verkuijlen, Laboratory of Chemical Technology, Plantage Muidergracht 30, Amsterdam, The Netherlands.

The development of active and selective homogeneous catalysts for the metathesis of mono-unsaturated fatty esters into unsaturated dicarboxylic esters has opened the route to several new applications of which the synthesis of unsaturated polyesters and polyamides should be particularly mentioned. Metathesis of polyunsaturated esters (linoleic, linolenic) leads to very complicated reaction mixtures, which, however, show an amazing regularity as to their nature and composition as a consequence of the merely statistical rearrangement of the alkylidene, carboxyalkylidene, and alkyldiylidene moieties in the starting material. Unsaturated hydrocarbons, monocarboxylic esters, and dicarboxylic esters with a climbing number of propyl-diylidene groups are formed in an exact 1:2:1 molar ratio; besides the formation of relatively large amounts of cyclic olefins, particularly 1,4 cyclohexadiene, should be mentioned (6 mol % from linoleic ester, 30 mol % from linolenic ester, 20 mol % from linseed oil). Metathesis and cometathesis reactions of lower molecular esters of unsaturated mono- and dicarboxylic esters are possible only when the ester groups and the double bond are separated by at least *one* methylene group. Thus, under the conditions of our experiments, acrylic, crotonic, maleic, and fumaric esters do not react; vinylacetic and hydromuconic esters do. Recent work is particularly directed to immobilization of active catalytic complexes on solid organic polymers. Some preliminary results of these experiments will be reported.

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POLYAMIDES FROM CARBOXYSTEARIC ACID. W.L. Kohlhase (deceased), E.N. Frankel, and E.H. Pryde, Northern Regional Research Center, ARS, USDA, 1815 N. University St., Peoria, IL 61604.

Applications for carboxystearic acid have been reported previously from this Center both in lubricants (*JAOCS* 51:351, 1974) and in plasticizers (*JAOCS*, in press). Also reported were the preparation and some properties of noncrystalline polyamides and copolyamides from carboxystearic acid (*JAOCS* 50:301A, 1973). We have continued these studies and now have some evaluation results on adhesive uses for both nonreactive and reactive types of polyamides. Two nonreactive polyamides were evaluated commercially: one sample contained only carboxystearic acid and hexamethylenediamine and the other also contained 30 mol % adipic acid. Although the tensile strengths of these particular samples were too low in comparison with commercial polyamide adhesives from dimer acid, the samples did give some interesting results: better rapid elongation, equivalent Al/Al shear strength, and equivalent impact resistance. Liquid, low molecular weight, reactive polyamides were made from di-, tri-, and tetramers of ethylenimine for use as one component of 2-component epoxy adhesives. Some of these, when formulated with a commercial epoxide, gave much higher impact resistance as steel coatings and much better Al/Al adhesion than comparable commercial resins. These encouraging results could no doubt be improved by adjustments to the formulation and point to another area for potential application for these interesting fatty derivatives.

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WATER DISPERSIBLE URETHANE POLYESTERAMIDE COATINGS FROM LINSEED AND SOYBEAN OILS. Wilma J. Schneider and L.E. Gast, Northern Regional Research Center, ARS, USDA, 1815 N. University St., Peoria, IL 61604.

Water dispersible coatings from vegetable oils were easily prepared from products of the aminolysis reaction of linseed or soybean oil and diethanolamine, polybasic acid anhydrides, and tolylene diisocyanate. Polymers studied in detail to date were based on phthalic anhydride, but preliminary data indicate that pyromellitic and 3,3',4,4'-benzophenone tetracarboxylic dianhydrides, or trimellitic and maleic anhydrides, also give polymers that result in satisfactory water dispersible systems. A detailed study of some of the variables, i.e., acid value of the urethane polyesteramides, the resin/water/butyl cellosolve cosolvent ratio and pH, was related to dispersibility and stability of the products and to their film properties, i.e., drying times, hardness, impact resistance, and chemical, solvent, and water resistance. A series of 45 linseed-phthalic anhydride-urethane polyesteramide dispersions was prepared. Polymers with acid values ranging from 30 to 70 were studied at three resin/butyl cellosolve ratios in 10, 20, or 30% resin concentrations in water/butyl cellosolve. All samples dispersed readily to yield products which ranged from solutions to emulsions with Gardner viscosites of A to >Z6. Films from the 30, 40, and 50 acid value polyesteramides had rapid drying times (TF < 1 hr), good hardness (Rocker values of 34 to 62), excellent xylene resistance (>1 wk) but poor to moderate resistance to 1% heavy duty detergent solution (1.5–4 hr). Cost savings could be substantial in these preparations since neither long processing times nor high temperatures normally used in alkyd technology are employed; reaction temperatures do not exceed 110 C in our process. Further savings could be realized because these materials air dry rapidly and for certain applications only low baking schedules would be required.

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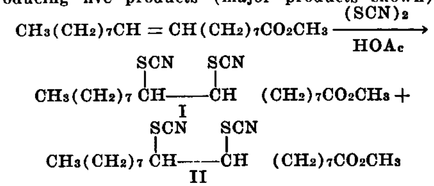
WHAT REALLY HAPPENS WHEN THIOCYANOGEN IS ADDED TO UNSATURATED FATTY ACIDS? R.J. Maxwell and L.S. Silbert, Eastern Regional Research Center, ARS, USDA, 600 E. Mermaid Lane, Philadelphia, PA 19118.

The nonstoichiometric addition of thiocyanogen to polyolefinic acids and esters is the basis for the utility of the classical thiocyanogen number in fat analysis, although a rationale accounting for this behavior has not been proposed. Our recent studies of the olefin thiocyanation reaction have elucidated several aspects of its mechanism and have led to new areas of research. Thiocyanogen reacts with methyl oleate in acetic acid producing five products (major products shown).



$$CH_3(CH_2)_7CH = CH(CH_2)_7CO_2CH_3 \xrightarrow[HOA_c]{(SCN)_2}$$

$$CH_3(CH_2)_7\overset{SCN}{\overset{|}{C}H}—\overset{SCN}{\overset{|}{C}H}\ (CH_2)_7CO_2CH_3 +$$

I

$$CH_3(CH_2)_7\overset{SCN}{\overset{|}{C}H}—\overset{SCN}{\overset{|}{C}H}\ (CH_2)_7CO_2CH_3$$

II

The reaction in acetic acid is stereospecific and essentially quantitative, producing the expected α,β- dithiocyanate adduct (I) as the major constituent. However, the newly isolated α-isothiocyanate-β-thiocyanate adduct (II) becomes the major *stereoselective* product in nonpolar solvents (OH, $CHCl_3$, CH_2Cl_2). Reversal in product distribution is the result of solvent interaction with the intermediate ambident thiocyanate anion, an aspect of the reaction sequence that had not been considered until the isolation of adduct II. In contrast to the above results, adduct I is formed preferentially in benzene solution when transition metal salts in the series $Ti(SCN)_4$ to $Cu(SCN)_2$ are employed, indicating the powerful influence of metal-ligand interactions on the product outcome. Transition metal salts were also observed to enhance thiocyanogen's reactivity toward previously unreactive fatty acids. The simple halogen-like mechanism for thiocyanogen addition is thus challenged by these studies. The nonquantitative addition of thiocyanogen to dienoic and trienoic acids and esters will also be discussed in view of these current findings.

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GENERALIZED STRUCTURE/PROPERTY INFLUENCES OF HYDANTOIN RINGS IN FATTY DERIVATIVES AND THE OVERALL EFFECT ON TECHNOLOGY. N.O.V. Sonntag, GLYCO Chemicals, Inc., PO Box 330, Williamsport, PA 17701.

Hydantoin rings, mostly derived from the 5,5-dimethyl analog, contribute a number of desirable characteristics to fatty derivatives. Among these are included thermal stability, adhesion properties, an unusual degree of hydrophilic and water-loving character, "antistatic" qualities, and additional contributions. Selected examples from relatively new hydantoin-containing fatty derivatives will illustrate the nature and degree of these influences. The ester derivatives containing hydantoin rings provide a number of examples of how conventional fatty acid derivative technology must be modified in order to achieve satisfactory preparative results.

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SOYBEAN PREPARATION. Jerry G. Fawbush, Central Soya Company, Inc., 1300 Fort Wayne National Bank Building, Technical Department, Fort Wayne, IN 46802.

Details and flow of soybean preparation are presented. Included in this article are soybean cleaning, drying, storing and tempering, cracking, front end dehulling, conditioning, and flaking.

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COTTONSEED PREPARATION. Jim M. Ridlehuber, Plains Cooperative Oil Mill, PO Box 1889, Lubbock, TX 79408.

Conventional methods of cottonseed preparation are reviewed and described, including seed cleaning, saw delinting, dehulling, conditioning, and flaking. The use of screw presses for pre-press conditioning ahead of solvent extraction is discussed as compared to conditioning for direct solvent extraction. Newer methods and proposed alternate methods of cottonseed preparation are discussed including: abrasive delinting, acid delinting by gas or liquid acid, and the decorticating of undelinted seed. The effect of cracking rolls, moisture addition, moist cooking and flaking on gossypol gland rupture, the binding of gossypol to protein, and the effect of these processing or preparation variables on the residual oil in the extracted meal and on the oil quality are discussed.

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SUNFLOWER SEED PREPARATION. Harold J. Sandvig, Cargill, Inc., 1330 Cargill Building, Minneapolis, MN 55402.

Sunflowers, being an oilseed of 40% or higher oil content, requires pre-press prior to solvent extraction. The fibrous outer hull and the soft meat require special care and equipment to dehull efficiently. Dehulling systems used for other oilseeds may be adapted with modifications. An economical use for hulls can be a problem because of the high fiber and low protein content.

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RAPESEED PREPARATION. J. Enns, CSP Foods, Ltd., Saskatoon, Saskatchewan, Canada.

Abstract not available at press time.

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PREPARATION OF PEANUTS PRIOR TO EXTRACTION. C. Terry Hunt, Gold Kist, Inc., PO Box 2210, Atlanta, GA 30301.

Preparation of peanuts prior to pre-press-solvent extraction will be discussed. A discussion of present practices in harvesting, in-shell storage, and shelling will be presented. Raw material specifications for crushing stock will be covered with recommendations on cleaning. The effect of cleaning on final production specifications will be reviewed. Cooking prior to pre-pressing will be investigated, and the time temperature relationship will be compared to efficiency of oil removal, protein quality, and energy consumption. Moisture levels and drying air temperatures prior to blanching will be discussed. The effect of moisture and drying air temperature on skin removal and protein solubility will be presented.

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SAFFLOWER SEED PREPARATION. A. **Gracia**, Los Molinos, S.A., Sonora, Mexico.

Abstract not available at press time.

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DRYING, STORAGE, AND PREPARATION OF COPRA FOR EXTRACTION OF OIL. **Pedro A. Malabrigo**, Neumunz, Inc., 117 Fort Lee Rd., Leonia, NJ 07605.

Freshly split coconut exposes the whitest, most palatable of nut meats, but it soon ferments unless dried properly. To be discussed are various methods of copra making, storage, and preparation for oil extraction. Copra making practices, hence quality, are dictated by economics and convenience particular to locality. Fatty acid formation continues and color deteriorates in poor storage conditions. Foreign materials such as rocks and metal get into the copra between plantation and oil mill. The smart oil mill operator pays particular attention to quality of his copra receipts, provides good storage facilities, and utilizes reliable machinery for cleaning, size reduction, drying, cooking, and pre-pressing.

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ZINC/COPPER AND THE EPIDEMIOLOGY OF ISCHEMIC HEART DISEASE. **L.M. Klevay**, ARS, USDA, Human Nutrition Laboratory, Grand Forks, ND 58201.

The widely publicized hypothesis relating risk of ischemic heart disease (IHD) to the amount and type of fat habitually consumed fails to explain many apparently diverse epidemiologic features of the disease. Experiments with animals (e.g., Klevay, *Am. J. Clin. Nutr.* 26:1060, 1973) have shown that an increase in the ingested ratio of zinc to copper (Zn/Cu) produces a metabolic imbalance resulting in hypercholesterolemia. This metabolic imbalance has been associated with many apparently diverse observations on the epidemiology of IHD and the metabolism of cholesterol by people. Associated with high Zn/Cu and either high risk of IHD or hypercholesterolemia are diets high in fat or sucrose, pregnancy, chronic kidney disease, and hypertension. Associated with low Zn/Cu and either low risk of IHD or hypocholesterolemia are diets high in fiber, calcium, or bread, liver cirrhosis, strenuous exercise, and availability of hard drinking water. It has been hypothesized (Klevay, *Am. J. Clin. Nutr.* 28:764, 1975) that Zn/Cu is the preponderant factor in the etiology of IHD.

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DOES DIETARY CHOLESTEROL AFFECT SERUM CHOLESTEROL LEVELS? **R.B. Alfin-Slater**, **D. Puppione**, **A. Alexander**, and **G. Slater**, University of California School of Public Health, 405 Hilgard Ave., Los Angeles, CA 90024.

Although some published reports have indicated a positive relationship between serum cholesterol levels and amount of cholesterol ingested, the experiments on which these results were obtained were done, for the most part, either using synthetic diets or subjects who had previously been fed cholesterol-free diets. More recent experiments in our laboratory revealed no increases in serum cholesterol levels in a small, selected group of young males fed an additional 500 mg cholesterol (two eggs) per day and middle aged males fed an additional 250 mg of cholesterol (1 egg) per day while ingesting their usual diets. *Experiments* are now in progress to study the possible relationship between dietary cholesterol and serum cholesterol levels using a large male population at the University of California, Los Angeles. The results-to-date of this study will be presented.

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SOYBEAN PROTEIN DIET IN THE CLINICAL MANAGEMENT OF HYPERCHOLESTEREMIA. **Cesare R. Sirtori**, Center E. Grossi Paoletti, University of Milano, Via A. Del Sarto 21–20129 Milano, Italy, **Ennio Gatti** and **Franco Conti**, Maggiore Hospital, Milano, and **Silvana Zoppi**, University of Milano.

Substitution of animal proteins with a soybean textured protein derivative (Temptein, Miles Laboratories) was attempted in hospitalized patients with stable hypercholesteremia. The protocol required comparison of a period (generally 3 weeks) of standard low lipid isocaloric diet (P/S 2.2, 100 mg cholesterol/1,000 KCal) with a similar dietary period, where animal proteins were totally replaced with soybean period. Twenty-four patients entered the trial, and complete results are available for 20 of them (10 males and 10 females, aged, respectively, 22–63 and 40–68), of which 9 were Fredrickson type IIA, 10 type IIB, and 1 type III. Ten patients completed the soybean-low lipid dietary sequence, 10 the opposite sequence. The soybean textured protein allowed preparation of a large variety of entrees, well tolerated and liked by the patients. In the course of the study, no clinical or biochemical abnormalities were noted. Analysis of the plasma lipid levels in the two dietary periods indicated a negligible hypocholesteremic effect of the low lipid diet and a remarkable effectiveness of the soybean proteins. The low lipid diet, when given first, caused a 1.7% average weekly decrease of serum total cholesterol and a 2.4% decrease of low density lipoprotein (LDL) cholesterol. Administration of the soybean diet first caused a 7.1% weekly decrease of total cholesterol (from a mean of 313 to 254 mg/dl in 3 weeks) and a 6.1% decrease of LDL cholesterol. Switching from the low lipid to the soybean diet again caused a remarkable fall of total and LDL cholesterol levels, while the change from soybean to low lipid significantly increased total and LDL cholesterol levels. Such a striking hypocholesteremic response to the soybean protein diet cannot be explained solely because of a slight increase of the P/S ratio or because of the absence of cholesterol. Indeed, addition of cholesterol to the soybean diet in another group of patients did not modify the effect. A cholesterol lowering action of soy protein itself, as recently suggested by Carroll and Hamilton (*J. Food Sci.* 40:18, 1975), is probably operative also in hypercholesteremic patients.

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TRANSDUCERS FOR COMPUTER MONITORING OF EDIBLE OIL REFINING. **Herbert J. Dutton** and **E. Duane Bitner**, Northern Regional Research Center, ARS, USDA, 1815 N. University Ave., Peoria, IL 61604.

Transducers that convert pertinent analyses to electrical signals are required before vegetable oil refining can be monitored and controlled by computer. Readily available are thermocouples for temperature, pH meters for caustic and acid concentrations, and electronic tachometers for stirring rates. Now on crude oil and alkali-refined streams, filter photometry has been used to measure oil color, flame photometry to determine sodium soap content, and automattic titrimetry to analyze free fatty acids. In hydrogenating oils, transducers for rate and total volume of hydrogen consumed have been devised. Instruments to determine *trans* acids by attenuated total reflectance and to measure change in fatty acid composition by refractive index, as well as by automated gas chromatography, have been investigated.

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COMPUTERIZED BATCH CONTROL AND SEQUENCING. **Paul K. Nielsen**, General Meters and Controls Co., PO Box 657, Park Ridge, IL 60068.

With labor, energy, and raw material costs increasing, process management must look for tools to maintain profitability. For batch reactors, a process orientated computer is one such tool. The scope of this discussion is to present some general computerized control philosophies and configurations: (a) What can a process computer do to make your plant more profitable? (b) How does it accomplish this task? (c) How are batch problems—such as metering, mixing, heating and cooling, pressurization, change of recipes, and scheduling—handled? Some specific examples of successful computer installations will also be presented.

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AUTOMATED SYSTEMS FOR CHEMICAL PROCESS STUDIES FOR THE EDIBLE OIL INDUSTRY. **S.S. Randhava** and **S.S. Randhava**, Xytel Corporation, 59 Eisenhower Lane South, Lombard, IL 60148.

This paper reviews recent technological developments related to the design and fabrication of advanced turn-key research systems for conducting catalytic and noncatalytic kinetic studies for the edible oil industry. The authors indicate how modern miniature process components and electronics can be effectively integrated to generate highly automated configurations that are not only functional, flexible, and safe, but also provide highly accurate data for efficient scale-up. A modus operandi is suggested for using a modular approach in defining a total system featuring multi-tier safety. Strong emphasis is given to the application of solid state electronics and TTL to create a reliable scheme for closed loop process monitoring and function sequencing. Some examples are cited to illustrate techniques utilized by Xytel to overcome common problems imposed by component/hardware limitations. The concepts discussed in this paper have been used in practice for assembling a number of automated bench-scale systems. The basic approach has now also been successfully employed for designing a new and highly modular micro kinetic test facility.

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AUTOMATION IN EDIBLE OIL REFINERIES. **A.J. Duff**, Engineering Division, Unilever N.V., Vlaardingen, The Netherlands.

Examples will be presented on automation for refinery operations, including centralized computer control, programmed sequence control, in-plant product quality control, and process yield measurements. Current trends in automation and equipment design will be reviewed.

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MISCELLA REFINING. **G.C. Cavanagh**, Ranchers Cotton Oil Co., PO Box 2596, Fresno, CA 93745.

Miscella refining can be practiced as a batch process or, preferably, as a continuous process with oil concentrations through the range of about 30% by weight of oil to 70% by weight of oil. Miscella refining and processing is preferably practiced at the oilseed solvent extraction plant for the economic reason of single solvent recovery. Three immediate benefits are lower refining loss, lighter colored refined oil, and elimination of water washing. Various types of chemical conditioning, mechanical conditioning, and combinations of both are discussed for miscella refining certain oils. Blends of compatible crude oils can be advantageously miscella refined and, if desired, winterized or hydrogenated to produce oils with unique properties.

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EVALUATION OF REFINING CHARACTERISTICS OF CRUDE OILS. **Yngve Hoffmann** and **Ilona Hoffmann**, AB Pellerin/Zenith, PO Box 721, S-251 07 Helsingborg, Sweden.

It is essential to get an estimation of the expected yield and quality of refined oil before the refining procedure is started. Several analyses are available and used to define the quality level of the crude oil, e.g., free fatty acid, peroxide value, anisidine value, color, iron, phosphorus, and impurities. On finished oil, taste and keepability are normally most important. The mentioned analyses are not sufficient on crude degummed soybean oil for a distinct forecast. By introducing a UV-measurement at 235 nm, additional information of value was found. Several deliveries in 1975–76 showed a good correlation between UV 235 and taste keepability. These results were independent of refining method. It was further observed that crude soybean oil with high absorbance at UV 235 contains high degree emulsifying substances. These will increase the losses of neutral oil in normal refining.

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MECHANICAL PRESSING. **D. Bredeson**, French Oil Mill Machinery Co., Piqua, OH.

Abstract not available at press time.

102

SOLVENT EXTRACTION. **N.W. Myers**, Myers Engineers, Decatur, IL.

Abstract not available at press time.

103

MEAL DRYING AND COOLING. **L.W. Follett**, Davenport Machine and Foundry Co., Davenport, IA.

Abstract not available at press time.

104

MEAL SCREENING AND MEAL GRINDING. **G.R. Thomas**, Prater Industrial Products, Inc., Chicago, IL.

Abstract not available at press time.

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MEAL PELLETING AND PELLET COOLING. **Roy A. Robinson**, California Pellet Mill Co., 1114 E. Wabash Ave., Crawfordsville, IN 47933.

This paper will include the following: 1. Brief history of pelleting in U.S. 2. Discussion of reasons for pelleting meals. 3. Outline of theory and practice of the pelleting process. 4. Discussion of pellet sizes including theory and reasons for sizes used. 5. Scope of pelleting. 6. Discussion of meals and conditions conducive to optimum pelleting conditions. 7. Equipment required for a pelleting installation. 8. Approved flows for equipment installation.

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HISTORY AND EXPERIENCE WITH SYNTHETIC LUBRICANTS. **Robert T. Trites**, Amzoil, Inc, 701 15th St., Plano, TX 75074.

A brief history will be given of the development of man-made lubricants, with emphasis on the development of these chemicals into the performance requirements of automotive equipment. The factors leading developers into the use of these products in automotive applications are higher engine operating temperatures, improved lubricity, and a combination of low temperature flow properties and high temperature stability. Data supporting the use of synthetic engine lubricants in field service will be presented with data supporting extended drain intervals. Also included will be a presentation of what synthetic engine lubricants will do and what they will not do.

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DIESTER SYNTHETIC LUBRICANTS FOR SEVERE SERVICE AUTOMOTIVE AND DIESEL APPLICATIONS. **Ray H. Boehringer** and **Robert J. Ruebusch**, Emery Industries, Inc., 4900 Este Ave., Cincinnati, OH 45232.

This presentation will discuss the performance properties of diester synthetic lubricants and how they relate to severe service automotive and diesel applications. Limited field test data will be presented. Specific severe service conditions to be considered are cold weather, extended oil drain interval, and high temperature operations.

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A REVIEW OF SYNTHESIZED HYDROCARBON LUBRICANTS. **D.S. Taber**, Mobil Oil Corporation, 150 East 42nd St., New York, NY 10017.

This is an oral review of work done leading to the development of a line of lubricants using Synthesized Hydrocarbon Fluids (SHF) as base stocks. The individual lubricants, their performance properties, and advantages and disadvantages versus mineral oil based lubricants will be discussed. Laboratory test data and field performance will be presented in support of the performance claims for the SHF based lubricants. The advantages of SHF lubricants over mineral oil lubricants are in terms of wider temperature range of application, improved wear protection, longer oil life, lower volatility, and reduced frictional properties. The lubricants developed are for use in passenger cars, aircraft, commercial vehicles, and industrial equipment.

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METABOLISM OF BROMINATED FATTY ACIDS. **Ian J. Tinsley**, **Barbara Jones**, and **Robert R. Lowry**, Department of Agricultural Chemistry, Oregon State University, Corvallis, OR 97331.

Brominated vegetable oils are used as a food additive and there is some evidence for the presence of brominated fatty acids in marine oils (Lunde, *JAOCS* 49:44, 1972). The feeding of brominated oils to rats increases tissue levels of lipid bromine, produces liver enlargement and fatty degeneration of the heart (Gaunt et al., *Food Cosmet. Toxicol.* 9:1, 1971). The form of the lipid bromine in the tissues, however, has not been established. In this study, male rats were raised for periods of 10 and 40 days on semisynthetic rations containing either 5% corn oil or 3% corn oil plus 2% brominated olive oil. Liver enlargement but no myocardial lesions were obtained with the 40 day feeding period. Levels of brominated fatty acids in liver, heart, and adipose tissue were determined by gas chromatography after conversion of the bromo-esters to the acetate derivatives. Dibromostearate, the major brominated constituent in the brominated olive oil was the only brominated fatty acid detected in the tissue lipids. Concentrations of 61.1, 68.4, and 89.1 mg/g lipid were detected in liver, heart, and adipose tissue after the 40 day feeding period. These concentration values were compared to lipid bromine levels obtained by neutron activation analysis. No shorter chain (less than C_{18}) brominated fatty acids could be detected, suggesting that, if the dibromostearate is metabolized, debromination probably precedes β-oxidation.

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INFLUENCE OF DIET ON PLASMA CHOLESTEROL LEVELS IN WEANLING RABBITS. **M.W. Huff**, **D.C.K. Roberts**, and **K.K. Carroll**, Department of Biochemistry, University of Western Ontario, London, Ontario, Canada N6A 5C1.

In rabbits, as in other animal species, the plasma cholesterol rises during the suckling period and then decreases at weaning to normal adult levels. Plasma cholesterols also rise after birth in humans but remain elevated after weaning, so that adult human levels are higher than those in most animal species, and these high levels are thought to promote atherosclerosis. The hypercholesterolemia in suckling animals appears to be due to milk lipid, but our studies have shown that in young adult rabbits milk protein (casein) is more hypercholesterolemic than milk lipid (butter). Experiments were, therefore, carried out to investigate the relative importance of dietary fat and protein in relation to the decrease in plasma cholesterol of rabbits at weaning. Rabbits weaned at 4 weeks of age to commercial feed or to low fat, cholesterol-free, semisynthetic (SS) diets showed a rapid drop in plasma cholesterol from 250–500 mg/dl to $<$100 mg/dl. The levels remained low in rabbits weaned to commercial feed or to a soy protein SS diet, but in rabbits weaned to a casein SS diet the plasma cholesterol again increased after weaning, to approximately 200 mg/dl by 7–8 weeks of age. In rabbits weaned to a soy protein SS diet containing fat (butter, 44% w/w), equivalent to the level in rabbit milk, the plasma cholesterol decreased as before. However, when the butter was added to a casein SS diet, the plasma cholesterol decreased only to $\sim$200 mg/dl and remained at that level. A diet designed to simulate rabbit milk more closely in protein, fatty acid, and cholesterol composition, produced a similar result. Rabbits maintained on only mother's milk to 5½ weeks of age remained hypercholesterolemic. When they were weaned at this age to a low fat, casein SS diet, the plasma cholesterol decreased to only $\sim$200 mg/dl. In rabbits fed a low fat, casein SS diet from 4 weeks of age and allowed to continue suckling, the average plasma cholesterol level was still 280 mg/dl at 8 weeks of age. In contrast, when the casein was replaced by soy protein isolate, the plasma cholesterol dropped to $<$100 mg/dl by 6 weeks of age. It appears that dietary protein and dietary fat can both influence the level of plasma cholesterol in weanling rabbits. (Supported by the Ontario Heart Foundation and the Medical Research Council of Canada.)

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DI-2-ETHYLHEXYL PHTHALATE: AN INHIBITOR OF HEPATIC STEROL AND SQUALENE BIOSYNTHESIS IN THE RAT. **Frank P. Bell**, Department of Pathology, McMaster University, Hamilton, Ontario, Canada.

Di-2-ethylhexyl phthalate (DEHP), a commonly used plasticizer was found to be an inhibitor of biosynthesis of hepatic nonsaponifiable lipids in the rat. The addition of DEHP at levels of 0.5% or 1.0% to a stock diet of rats resulted in a decreased conversion of acetate-1-^{14}C and mevalonate-5-^{3}H into squalene, C_{27} sterols, and C_{30} sterols by liver minces or slices, in vitro. In studies conducted with 0.5% DEHP feeding from 2 to 11 days, the degree of inhibition was found to increase with the duration of DEHP feeding; the inhibition of mevalonate conversion to squalene and sterols developed more slowly, being reduced to approximately 70% of control values in 11 days while acetate conversion was reduced to approximately 35% of control values during the same period. DEHP was also effective in inhibiting ^{14}C-acetate incorporation into non-saponifiable lipids of liver minces from stock (control) fed rats when added directly to incubations as a sonicated dispersion. Inhibition of acetate incorporation increased with increasing levels of DEHP over the range 0.1 to 2.5 mmolar, whereas mevalonate incorporation was unaffected by additions of DEHP to the incubations. In view of the widespread use of phthalate-containing products by man, these results emphasize a need for further studies on the biochemical effects of phthalates.

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EFFECT OF CHRONIC INGESTION OF DDT ON PHYSIOLOGICAL AND BIOCHEMICAL ASPECTS OF ESSENTIAL FATTY ACID DEFICIENCY. **David A. Sampson**, Colorado State University, and **Robert E. Pitas** and **Robert G. Jensen**, Department of Nutritional Sciences, U-17, University of Connecticut, Storrs, CT 06268.

Male weanling rats were fed semipurified diets with and without essential fatty acid (EFA) and DDT (150 ppm) to determine the effects of this lipid soluable pesticide on physiological and biochemical aspects of EFA deficiency (EFAD). DDT did not affect EFAD-induced dimution of feed intake, growth rate, and adult body weight; nor did the pesticide affect EFAD-induced changes in feed efficiency or skin health. The pesticide did increase liver mass/body mass ratios, but did not interact with EFAD (which also increased this ratio) in ellciting this response. The pesticide produced complex changes in total fatty acid composition of liver and tail skin: liver levels of 18:0, 18:2, and 20:3n9 were increased, while levels of 12:0, 14:0, and 16:0 were decreased. In both tissues, DDT interacted with EFA to increase 18:2 levels. In this study, although DDT did not exacerbate physiological aspects of the EFAD, the DDT-induced changes in fatty acid composition of liver and tail skin indicate that 150 ppm DDT in the diets did affect lipid metabolism of the rats in an unclarified manner.

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BLOOD LIPIDS AND THEIR RELATION TO ATHEROSCLEROSIS IN NIGERIANS. **Peter O. Egwim**, Department of Biochemistry, University of Nigeria, Enugu Campus, Nigeria.

The pattern of the plasma lipids in adult Nigerians, belonging to different socio-economic groups, was surveyed, especially with the objective of assessing the levels of total cholesterol, triglyceride, and phospholipid and the potential of the available total cholesterol to act as an atherogenic factor. The atherolipid number (A.No.) parameter of Searcy and co-workers was adopted as an index for comparing the data from Nigerians with those from Caucasians. All comparisons were referred to the condition of type II lipoproteinemia for which hypercholesterolemia is a distinguishing feature. The results confirmed the suspected lower plasma total cholesterol levels in Nigerians in comparison to Caucasians, except that Nigerians in the high income group resembled the Caucasians in their plasma total cholesterol and phospholipid levels. The triglyceride levels were generally low and comparable among groups. Furthermore, both the total cholesterol levels and the Atherolipid Numbers exhibited a clear age-dependent increase from the second to the sixth decade of life. The total plasma cholesterol level, however, never exceeded 200 mg/100 ml of plasma. The results are discussed as the possible basis for the generally low risk of atherosclerosis and coronary among the Nigerian population.

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BIOLOGICAL EVALUATION OF CRAMBE MEALS DETOXIFIED BY WATER EXTRACTION ON A CONTINUOUS FILTER. **E.C. Baker** and **G.C. Mustakas**, Northern Regional Research Center, ARS, USDA, 1815 N. University St., Peoria, IL 61604, and **M.R. Gumbmann** and **D.H. Gould**, Western Regional Research Center, ARS, USDA.

Dehulled crambe seed was screw pressed to remove approximately two-thirds of the oil and then hexane extracted to remove the remaining oil in the presscake. The resulting meal was toasted in the presence of moisture, slurried with four parts of water, and then washed on a continuous pilot plant filter to remove 92–96% of the glucosinolates. The latter are sources of toxic compounds and must be either inactivated or removed if crambe meal is to be fed to nonruminants. Protein efficiency ratios (PER) for the meal were equal to or higher than the casein control indicating that the water washing produced a palatable, nontoxic meal. In a 4 week chick feeding study, crambe was fed at 20% of the total diet. The diets containing crambe had somewhat lower gains (83–87%) and feed efficiency compared to the basal control group. Livers and kidneys appeared normal for all groups. There was some very slight gizzard erosion in the crambe-fed group. In a 90 day rat feeding study, crambe was fed at 30% of the total diet, and body and organ weights were determined. Growth was slightly less than with the 30% soy control. There were no significant differences among relative organ weights for all groups.

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AN UPDATE ON GLASS AND PLASTIC PACKAGING OF SALAD OIL WITH METAL AND PLASTIC CLOSURES. R. LONGSETT and D.E. PARSON, Kerr Glass Manufacturing Corp.

Abstract not available at press time.

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COMPOSITE CANS—YOUR PRODUCTS' PARTNER. JACK PRICER and SHELDON SABATH, Boise Cascade Composite Can Division, 13300 Interstate Dr., Hazelwood, MO 63042.

The versatile composite can has become the package choice for many food products. The increasingly sophisticated materials and construction techniques have expanded the industry's capabilities of engineering a specific container for a specific end-use. This efficient utilization of materials has increased the cost effectiveness of this unique packaging form. During the presentation, specific examples and case histories will be illustrated emphasizing the performance capabilities of composite cans. The conclusion will focus on expectations for the future, including sizes, styles, and features.

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PACKAGING IN THE MARGARINE INDUSTRY. A.F. FOELL, JR., and R.D. HOUT, CrownZellerbach, Rigid Plastics Division, GPO Box 708, Kansas City, MO 64141.

Margarine can be divided into two major classes—retail and institutional—with retail sales accounting for about 92% of the total. There are four basic forms of retail margarine: conventional (solid), soft, whipped, and liquid. Federal and state laws regulate package size and weight for colored margarine, limiting the maximum package size to 1 lb, and making the industry one of the most regulated in the country. These and other pertinent topics will be discussed.

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AEROSOL PACKAGING OF FOODS. M.A. JOHNSON, Peterson Puritan, Inc., IL.

Abstract not available at press time.

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CHARACTERISTICS OF THE PROTEIN SOLIDS FROM HIGH AND LOW TEMPERATURE RENDERINGS. GENE MATERN, South Chicago Packing, 944 W. 38th St., Chicago, IL 60609.

The purpose of this paper is to describe the nutritional characteristics of the protein solids derived from high and low temperature edible rendering systems. The following data will demonstrate differences that occur between raw materials containing *lean trimmings* and "normal" fat, and tissue that has been fortified by the addition of deboned meat to raw fats before separation of the oil from the solids phase.

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COMPARISON OF PROCEDURES FOR EXTRACTION OF LIPIDS FROM SOYBEAN PROTEIN MATERIAL. RICHARD M. MOYERS, SHARON L. MELTON, and CYNTHIA G. PLAYFORD, University of Tennessee, Department of Food Technology and Science, PO Box 1071, Knoxville, TN 37901.

Lipids in soybean defatted meal, concentrate, and isolate were extracted by four procedures: (1) a Soxhlet extraction with chloroform-methanol, (2) a Soxhlet extraction with benzene-ethanol, (3) a cold extraction with chloroform-methanol, and (4) a cold extraction with hexane-ethanol. The Soxhlet procedures extracted more lipid than procedure 3 from the meal only and more lipid than procedure 4 from all products. Procedure 3 extracted more lipid than procedure 4 from all products. Percent lipid on dry matter basis ranged for the meal, 1.51 to 4.52; concentrate, 0.90 to 1.44; and isolate, 0.28 to 0.96. Lipids extracted from each product by procedure 3 and 4 were eluted on a silicic acid column by three solvents: (I) chloroform:methanol 20:1 v/v, (II) chloroform:methanol 1:1 v/v, and (III) methanol. For the extracts of each product from procedure 3 and 4, the percent total lipid eluted by each solvent was determined; the fatty acid (C_{12}-C_{20}) content of each eluate was determined by gas liquid chromatography, and attempts were made to identify lipids in each eluate by thin layer chromatography. *Differences in percent* total lipid eluted were found among the three solvents for each product extracted by procedure 3 or 4. The larger amount of total lipid for any product extracted by either procedure was eluted by solvent I. Linoleic acid was the most abundant acid found in any eluate. For any one product, differences were found between procedures 3 and 4 for percent palmitic, oleic, and linoleic acids in lipids eluted by solvent I, II, or III. A number of lipids were eluted by solvent I and II, but the major lipid eluted by methanol was lecithin.

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CHOLESTEROL REMOVAL FROM EDIBLE BEEF FAT FRACTIONS. FRANCIS E. LUDDY, JAMES W. HAMPSON, PAUL MAGIDMAN, and HERBERT L. ROTHBART, Eastern Regional Research Center, ARS, USDA, 600 East Mermaid Lane, Philadelphia, PA 19118.

Research at ERRC on the solvent fractionation of edible tallow has produced tallow fractions of unique properties. One, a semisolid fraction, is being considered as a replacement fat for cocoa butter. Another is a light, bright oil or high oxidative stability which should be a superior salad and cooking oil. The favorable properties of these fractions should greatly increase the use of tallow in foods. However, the recent trend in food advertising suggesting that cholesterol might be a factor in cardiovascular diseases has been of concern to producers of animal fats. Although conclusive evidence is lacking about the specific role of cholesterol in these diseases, an unfavorable climate has been created towards the use of animal fats in foods. Beef fat contains only about 130 mg of cholesterol per 100 g of fat. A study of the cholesterol distribution in the fractions of solvent fractionated beef fat indicated that the solid and semisolid glyceride fractions each contained about 4.5 mg of cholesterol per 100 g, the oil fraction about 120 mg of cholesterol per 100 g. An additional one-step crystallization of each fraction was found to lower the cholesterol content of the solid and semisolid fractions to about 1 mg of cholesterol per 100 g and the cholesterol content of the oil fraction to <6 mg per 100 g. Cholesterol analysis of the fractions was obtained by a modified Liebermann-Burchard method in which the intensity of the color developed was measured spectrophotometrically. Analyses by this method were in agreement with the more specific determination of cholesterol by gas liquid chromatography.

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OXYGENATED FATTY ACID CONSTITUENTS OF SOYBEAN PHOSPHATIDYL CHOLINES. D.J. SESSA, H.W. GARDNER, R. KLEIMAN, and D. WEISLEDER, Northern Regional Research Center, ARS, USDA, 1815 N. University St., Peoria, IL 61604.

Bitter-tasting phosphatidyl cholines isolated from hexane-defatted soybean flakes contain 32% oxygenated fatty acids in addition to palmitic, stearic, oleic, linoleic, and linolenic. Identification of these oxygenated acids was based on spectral characteristics of methyl ester derivatives which were separated and purified by column and thin layer chromatography. The fatty acid methyl esters identified were 15,16-epoxy-9,12-octadecadienoate, 12,13-epoxy-9-octadecenoate, both with double bonds and epoxide groups predominantly of *cis* configuration; 13-oxo-9,11- and 9-oxo-10,12-octadecadienoates; 13-hydroxy-9,11- and 9-hydroxy-10,12-octadecadienoates; 9,10,13-trihydroxy-11- and 9,12,13-trihydroxy-10-octadecenoates. In addition to these, trace amounts of 11-hydroxy-9,10-epoxy-12- and 11-hydroxy-12,13-epoxy-9-octadecenoates; 13-oxo-9-hydroxy-10- and 9-oxo-13-hydroxy-11-octadecenoates; 9,10-dihydroxy-12- and 12,13-dihydroxy-9-octadecenoates; and 9,12,13-dihydroxyethoxy-10- and 9,10,13-dihydroxyethoxy-11-octadecenoates were indicated by mass spectrometry. The latter two probably arise during the extraction of the phosphatidyl cholines from defatted flakes with 80% ethanol. Except for the first two epoxy compounds, the oxygenated fatty acids are similar to the products formed by homolytic decomposition of linoleic acid hydroperoxide. The first two compounds with predominantly *cis* configuration are thought to arise by action of fatty acid hydroperoxides on unsaturated fatty acid.

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VACCENIC ACID CONTENT IN EDIBLE FATS AND OILS. E. WASOWICZ and F.W. HOUGEN, Department of Plant Science, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2.

Kramer et al. (*Lipids* 10:511, 1975) have suggested that $\omega7$ fatty acids may be implicated as a factor causing myocardial lesions in weanling male rats fed a diet high in rapeseed oil. This prompted us to compare rapeseed oil with other edible oils and fats with regard to their contents of $\omega7$ fatty acids. Gas chromatography with open tubular columns was used. The following amounts of vaccenic acid (18:1ω7) were found (as percent of the total fatty acids): low erucic rapeseed oil, 3.1%; olive oil, 3.1; lard, 3.1; high erucic rapeseed oil, 1.6; soybean oil, 1.5; sesame seed oil, 1.1; corn oil, 0.8; palm oil, 0.8; peanut oil, 0.6; beef tallow, 0.6; sunflower seed oil, 0.5; and coconut oil, 0.3. Rapeseed oil thus contained no more vaccenic acid than olive oil or lard. Furthermore, it has been reported that almost no myocardial lesions occur with diets containing olive oil or lard. This indicates that vaccenic acid is of little importance as a possible contributing factor in causing cardiovascular lesions.

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FATTY ACID COMPOSITION OF FINFISH, SHELLFISH, AND SOME OTHER AQUATIC ANIMALS. JACOB EXLER and JOHN L. WEIHRAUCH, Consumer and Food Economics Institute, ARS, USDA, Federal Building, Rm. 370, Hyattsville, MD 20782.

Recent data (since 1960) on the total lipid content and fatty acid composition of finfish, shellfish, and some other aquatic animals have been collated for use in the preparation of tables of nutrient composition of foods. Some of the factors which affect the variability in the data are discussed. A comparison is made of the different methods used to convert analytical data as methyl ester weight percent to grams fatty acid/100 g food for food composition tables. Fatty acid composition tables for finfish, shellfish, and some other aquatic animals are presented and discussed. A measure of the relative degree of polyunsaturation in lipids of these species is also tabulated.

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HYDROGENATION AND ISOMERIZATION OF METHYL OLEATE, METHYL ELAIDATE, AND COTTONSEED OIL. SAVE STEFANOVIC, Food and Drug Administration, ROBERT H. PRICE, University of Cincinnati, and LYLE F. ALBRIGHT, School of Chemical Engineering, Purdue University, West Lafayette, IN 47007.

Cottonseed oil, methyl oleate, and methyl elaidate were partially hydrogenated at operating conditions in the range of industrial interest. The supported nickel catalyst employed was in each case either new (fresh) or had been used in a previous hydrogenation run. Iodine values, geomertical and positional isomer contents, pseudo reaction rate constant, and induction period were determined for each batch run conducted in all cases at high levels of agitation. Both the rate constants and induction periods for hydrogenations with new catalysts decreased in the following order: methyl elaidate, methyl oleate, and cottonseed oils. With used catalysts, the induction periods were small if not completely eliminated, and the rate constants were the same as those with new catalysts. Increases in pressure resulted in higher levels of both types of isomerization. Changes in the catalyst concentration had little effect on isomerizations. Increased temperature caused significantly higher levels of positional isomerization, but geometrical isomerization was less affected. The results of this investigation clarify significantly factors affecting the interdependence of both positional and geometrical isomerizations and also the kinetics of hydrogenation.

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EFFECT OF THE UNSATURATED ACYL POSITION IN TRIGLYCERIDES ON THE HYDROGENATION RATE. BRONISLAW DROZDOWSKI, Gdansk Technical University, Institute of Organic and Food Chemistry and Technology, Gdansk, Poland.

The triglycerides of soybean, rapeseed, and cod liver oils, and the triglycerides randomized by undirected interesterification have been hydrogenated in the presence of nickel catalysts. The samples of partly hydrogenated triglycerides were subjected to enzymatic hydrolysis using pancreatic lipase, and the fatty acid content was determined in the internal and external positions. The curves illustrating the variations of the content of the particular fatty acid for the defined positions as the function of hydrogenation time were also traced. It was concluded that the hydrogenation rate of unsaturated acyls in the external position is higher than in the internal position.

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HYDROGENATION OF RAPESEED OIL. P.S. Puri and J.M. deMan, Department of Food Science, University of Guelph, Guelph, Ontario, Canada.

The effects of some process conditions on the overall reaction rate and on *trans* isomer formation during hydrogenation of low erucic acid rapeseed oil with a commercial nickel catalyst were studied. Experimental data were correlated by an empirical equation which could be used to predict the reaction rate constants for any given process conditions. Temperature had a major effect on rate and *trans* isomer formation. Pressure and catalyst concentrations, however, had only minor effects. It is suggested that apart from these factors, the extent of *trans* isomers formed is also controlled by the nature and amount of unsaturation of the oil and by the overall reaction rate. A new parameter, specific isomerization index, was introduced to represent the formation of *trans* isomers during the hydrogenation reaction. The effects of the solvents n-hexane and 2-propanol on the reaction rate and *trans* isomer formation were determined.

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EFFECT OF THE CONCENTRATION OF SOME NICKEL CATALYST POISONS IN OILS ON THE HYDROGENATION COURSE. Bronislaw Drozdowski and Maria Zajac, Gdansk Technical University, Institute of Organic and Food Chemistry and Technology, Gdansk, Poland.

The hydrogenation has been carried out in a "dead-end" type reactor with the automatic recording of hydrogen absorption using various types of nickel catalysts. The oils with varying concentrations of sulfur and phosphorus compounds, fatty acids and their salts, as well as the oils partly oxidized have been hydrogenated. The analysis of kinetic curves shows that they have a characteristic run for each catalyst type and for each inhibitor. The increase in poison concentration in the reaction system results in the lengthening of the induction period apart from the decrease in contact activity. No distinct changes in the selectivity and *cis-trans* isomerization were observed as the result of the partial poisoning of nickel contacts.

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HIGH-SPEED HYDROGENATION OF FATS AND FATTY ACIDS IN CONTINUOUS FLOW REACTORS. K. Ilsemann and K.D. Mukherjee, Bundesanstalt für Fettforschung, Piusallee 68, D-44 Münster, Germany.

In current industrial practice, fats and fatty acids are hydrogenated mostly by batch processes in which they are agitated with the suspended catalyst under hydrogen at elevated temperatures and pressures till the desired degree of hydrogenation is attained. During this process, which extends generally over a considerable period of time, several undesirable side reactions are known to occur extensively apart from saturation of the olefinic bonds. These side reactions include geometrical isomerization and migration of double bonds which lead to the destruction of essential fatty acids, development of unpleasant "hardening flavor," and formation of lipid-soluble metallic compounds resulting from metal catalyst which impair the oxidation stability of hydrogenated products. The aim of the present study was to elucidate whether the time of reaction could be greatly reduced and, consequently, the extent of side reactions minimized if fats and fatty acids are hydrogenated in continuous flow reactors. Soybean oil, low erucic rapeseed oils, and technical fatty acids were hydrogenated partially or completely in a continuous manner using suspended catalysts in a vertical flow reactor packed with Raschig rings at various temperatures, hydrogen pressures, catalyst concentrations, and flow rates of the liquid reactant. High rates of hydrogenation and short residence times of the liquid reactant in the reactor were found to be the unique features of hydrogenation in a continuous flow reactor. The effects of reaction parameters on the rate of hydrogenation and selectivity in "high-speed hydrogenation" were studied using commercial nickel and copper catalysts. Moreover, the effect of a short reaction period on side reactions accompanying catalytic hydrogenation were systematically investigated.

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LABORATORY SCALE CONTINUOUS HYDROGENATION. Janet M. Snyder, H.J. Dutton, and C.R. Scholfield, Northern Regional Research Center, ARS, USDA, 1815 N. University St., Peoria, IL 61604.

Data required for modeling and simulation of continuous hydrogenation kinetics have been obtained in an isothermal, cocurrent flow-type reactor. A preheated suspension of catalyst in oil, mixed with hydrogen, is passed cocurrently through 10 m length of 0.12 cm ID Teflon tubing at flow rates varying from 2 to 4 ml/min, gas flow rates from 100 to 700 ml/min, and temperatures from 160 to 180 C. The hydrogenations are run using nickel catalyst at outlet pressures of 1 atmosphere. Samples are removed at equal intervals along the length of the reactor and analyzed by gas chromatography. The kinetics of the continuous reactor are satisfactorily modeled by the simple scheme Ln → Lo → 01 → S using first order kinetics. Reaction rates, calculated by a digital computer, are shown to be related to temperature by the Arrhenius equation. *trans* Content and degree of hydrogenation are increased with temperature and are decreased as oil flow increases. Hydrogen flow rate has little or no effect over the range studied.

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RELATIONSHIP BETWEEN COMPOSITION AND ODOR IN COPPER HYDROGENATED OILS. P.Y. Vigneron, LeSieur-Cotelle & Associés, 122, Avenue Gal Leclerc, 92103 Boulogne-s/Seine, France.

Reduction of the linolenic content in soybean oil by selective hydrogenation lowers fishy responses, but characteristic disagreeable odors still develop when the oil is heated to frying temperatures. Retention of the so-called hydrogenation odor suggests that the precursor(s) might be isolated roughly by fractionating the oil. Such precursor(s) should be in fraction(s) having the hydrogenated odor only at frying temperatures. In this way it has been established that the precursor(s) were in fractions containing triglycerides with more than four double bonds, some being isomerized. Comparative studies on hydrogenation of oils with or without linolenic acid demonstrate that the precursors are in fractions containing isomers formed by hydrogenation of linolenic. Analytical studies by conventional means and glass capillary gas chromatography point out the complexity of this fraction. Therefore, it is presently difficult to know if a relationship can be established between room odor scores and content of these compounds.

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APPLICATION OF CHRONIC ACIDCELITE COLUMN TO LIPID MICROANALYSES. Daniel P. Schwartz, Eastern Regional Research Center, ARS, USDA, 600 E. Mermaid Lane, Philadelphia, PA 19118.

In a convenient procedure for locating double bond position in a series of methyl octadecenoates, submicro- or microgram amounts of substrate dissolved in CS_2 are brought in contact with a very small column of aqueous chronic acid on Analytical Grade Celite. The oxidation products (carboxylic acids) are eluted after 15 min, converted to methyl esters, and resolved by gas liquid chromatography. Beside the acids resulting from scission of the double bond, acids containing one less carbon atom arise from oxidation of the allylic carbons on both sides of the double bond so that pairs of peaks appear on the chromatogram. All positions from $\Delta 3$ through $\Delta 17$ are located successfully. The $\Delta 2$ position fails to oxidize. In another application under similar conditions, aqueous chromic acid on Celite 545 is used to oxidize submicrogram to micromole amounts of unsaturated and saturated primary fatty alcohols to the corresponding aldehyde. Double bonds are not oxidized, isomerized, or shifted, and the aldehyde is obtained in 70–80% yield. The two procedures demonstrate the dramatic effect that the type of support has on the reactivity of chromic acid.

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APPARATUS FOR MICRO-OZONOLYSIS AND HYDROGENATION. Nicholas Pelick and V. Mahadevan, Supelco, Inc., Supelco Park, Bellefonte, PA 16823.

Literature on the chemistry of ozone and its uses is quite extensive. Lipid chemists are particularly interested in the ozonolysis of olefins and unsaturated fatty acids to determine the positions of unsaturation in these molecules. Even small amounts of a component unsaturated fatty acid can be isolated by preparative gas chromatography. After isolation of an unsaturated acid, it can be chemically split at double bonds by (a) reductive ozonolysis to alcohols, (b) reductive ozonolysis to aldehydes using chemical reducing agents or by catalytic hydrogenation, and (c) oxidative ozonolysis. Supelco has designed a micro-ozone generator (Micro-ozonizer) for this purpose. Examples illustrating the determination of structures of unsaturated fatty acids by this method will be presented. Ozonolysis has been used for structure determination of various other biologically important compounds, such as pheromones. The pheromones are present in very minute quantities, and ozonolysis has been particularly suited for double bond location in these compounds. It is difficult to exaggerate the importance of the catalytic hydrogenation process in both industry and the analytical laboratory. Selectivity and geometrical isomer formation are naturally influenced by operating varibles in the hydrogenation process such as temperature, hydrogen pressure, agitation, catalyst concentration, and the nature of the catalyst. Emphasis will be placed more on the analytical aspects of the technique. Hydrogenation followed by gas liquid chromatographic (GLC) analysis is often used in studies in the fatty acid composition of natural lipids. As pointed out in the first part, reductive ozonolysis is a popular method of analysis of unsaturated fatty acids, and catalytic hydrogenation offers a rapid and simple method of preparing the aldehydes and aldehyde esters which can be analyzed by GLC. Supelco's micro-hydrogenator for these purposes will be outlined.

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A DERIVITIZATION METHOD FOR DETERMINATION OF BROMINATED FATTY ACIDS. Robert R. Lowry and Ian J. Tinsley, Department of Agricultural Chemistry, Oregon State University, Corvallis, OR 97331.

Brominated fatty acids (BFA) appear in the dietary food intake from at least two sources, one synthetic and one natural. In order to more easily follow the metabolic fate of these compounds, certain derivatives have been formed and studied, since the bromo compounds decompose when subjected to gas chromatography. Reaction of these compounds with sodium methoxide to form the methoxy derivatives has not proven to be satisfactory due to the formation of multiple derivatives with a resultant degree of uncertainty concerning the parent molecules. The chemical substitution of acetate for the bromine on the BFA using silver acetate in acetic acid/acetic anhydride gives stable compounds for gas chromatography. These acetates offer the advantage of primarily forming a single compound of defined structure using mild reaction conditions. Optimum conditions for the formation of the acetates and their subsequent analysis will be described, together with suggestions for their isolation (by thin layer chromatography) from other lipids present in samples from animal tissues.

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SYNTHESIS OF SPECIFICALLY DIDEUTERATED OCTADECANOATES AND OXOOCTADECANOATES. A.P. Tulloch, Prairie Regional Laboratory, National Research Council of Canada, Saskatoon, Saskatchewan, Canada S7N 0W9.

The sixteen methyl dideuterooctadecanoates containing a CD_2 group at positions 2- to 17- and the seven oxo esters, 5-D_2-8-oxo, 8-D_2-11-oxo, 9-D_2-12-oxo, 10-D_2-7-oxo, 11-D_2-8-oxo, 14-D_2-11-oxo, and 16-D_2-13-oxo octadecanoates, have been synthesized. Two principal methods of converting CH_2 to CD_2 were used: preparation of 2-D_2 acids by exchange with D_2O followed by chain extension giving the D_2 oxo esters, which were then reduced as tosylhydrazones with sodium cyanoborohydride; and stepwise introduction by reduction of C_{18} oxo esters with sodium borodeuteride, formation of tosylate or mesylate, reduction with lithium aluminum deuteride to di D_2 alcohol, and reoxidation to *D_2 acid*.

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SYNTHESIS OF 1-^{14}C LABELED *trans*-OCTADECENOIC ACIDS. Anthony J. Valicenti, Frederick J. Pusch, and Ralph T. Holman, The Hormel Institute, University of Minnesota, 801 16th Ave. N.E., Austin, MN 55912.

The synthesis of a series of positional isomers of labeled *trans*-octadecenoic acids was achieved by modifications of unpublished procedures. In general, an ω-halotetrahydropyranyl ether (or ω-acetylenotetrahydropyranyl ether) was condensed with an alkyl halide (or terminal acetylene) to furnish, upon hydrolysis, a heptadecynol. The alcohol was then partially reduced to a *trans*-heptadecenol, mesylated, extended with $K^{14}CN$, and hydrolyzed to afford a C_{18} *trans* acid in good yield of high geometrical and positional purity.

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A MICROSCOPIC METHOD FOR THE ESTIMATION OF FRAGILITY, SIZE, AND NUMBERS OF GOSSYPOL PIGMENT GLANDS IN GLANDED COTTONSEED. Charles W. Monagle, Grady J. Glenn, and James T. Lawhon, Food Protein Research and Development Center, Texas A&M University, 216 Teague Building, College Station, TX 77840.

With the increased potential for use of cottonseed in human foods, it becomes imperative that processors be able to assess the different varieties for suitability in food use. The susceptibility of the gossypol pigment gland to rupture during processing would be of major importance in any assessment. A method was developed for rapid estimation of pigment gland fragility that was very sensitive to differences in variety and moisture content of kernels. Although not part of the original objective, the method appeared to be equally useful for the rapid estimation of gland numbers and size. The procedure consisted of mixing weighed samples (ca. 0.1 g), taken from cottonseed kernels passed through a pin mill, with a drop of vegetable oil; spreading the mixture over a marked area (2.25 cm^2) on a microscope slide; and counting and sizing the pigment glands in a microscopic field, falling within the grid area (2.5 mm^2) of an eyepiece micrometer. One hundred sixty-eight samples from four glanded varieties of cottonseed, predried to a constant moisture content, showed mean gland rupture during milling in the range of 6.0–15.3%. The mean standard deviation within replicates was 1.2%, and the same ranking accrued for samples from different growing locations. As expected, moisture adjusted samples above 2.5% water showed sharp increases in gland rupture. The method appears to have utility both in quality control and as a research tool for the correlation of pigment gland parameters, the gossypol content of cottonseed products, and the condition and types of cottonseed.

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AN ANALYSIS OF WATER BINDING TO PHOSPHATIDYL CHOLINES. G.L. Jendrasiak, Biophysics Division and Program in Bioengineering, University of Illinois, Urbana, IL 61801, and J.H. Hasty, Kendall Research Center, Barrington, IL 60010.

The water adsorption isotherms have been obtained for the phosphatidyl cholines in their various forms: lyso, unsaturated diacyl, and saturated diacyl above and below the phase transition temperature. Complexation with cholesterol was also studied. In all cases, type IV isotherms, according to the Brunauer, Emmett, and Teller (BET) scheme, were obtained. This type of isotherm can be described by a BET equation from which the monolayer coverage values for water and a BET constant can be obtained. The BET constant is related to the strength of the water binding. The amount of water adsorbed at various relative humidities can be explained by a model based on the size of the polar head-group region. This region, in turn, depends on the hydrocarbon chain configuration. The results are consistent with monolayer results obtained by Shah and Shulman. The BET constant, however, does not seem to bear a simple relationship to the amount of water bound. It may be related to the head-group orientation, but for phosphatidyl choline complexed to cholesterol and for hydrocarbon chains containing more than one double bond, the results are more complex. Electrical conductivity studies show that it is the most tightly bound water which has the greatest effect on phospholipid electrical conductivity.

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FATS AND OILS IN THE 1980S. Jon L. Heimann, Emery Industries, Inc., 1300 Carew Tower, Cincinnati, OH 45202.

The major thrust of this talk is a discussion of the fats and oils available during the 1980s. A brief history of world fats and oils production, a description of the world situation today concerning fats and oils, and a profile of the constituent items in the general term "fats and oils" are also covered. More important than production is export availability, past and present trends. Which oils will be produced and from which countries will there be excess supply over domestic needs are two questions that are also discussed. Future trends in fats and oils production (changes in supply, availability, etc., of major oils), the expected impact, if any, of developing oils (such as Babassu), and synthetic items on the total profile of fats and oils are considered.

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SYMMETRICAL ETHERS AND ETHERS-ESTERS OF GLYCEROL. G.F. Cegla and H.K. Mangold, Food Protein Research and Development Center, Texas A&M University, 216 Teague Building, College Station, TX 77843.

Synthetic alkoxylipids, especially those containing alkyl moieties, are finding wide application as model substances in systems where lipids containing ester bonds cannot be used because of their relative instability. Of special interest are symmetrical ether and ether-esters of glycerol which do not occur in natural sources. Saturated 2-alkylglycerols with even-numbered and odd-numbered alkyl chains having 10–20 carbon atoms were synthesized in 80–95% yield by alkylation of 1.3-benzylideneglycerol with alkyl methanesulfonates followed by hydrolytic removal of the protecting group. Monounsaturated and polyunsaturated 2-alkylglycerols were prepared similarly. Saturated 1.3-dialkylglycerols with even-numbered and odd-numbered alkyl chains having 10–20 carbon atoms were synthesized in 20% yield by reacting 1.3-dichloropropanol with potassium alcoholates. Monounsaturated and diunsaturated 1.3-dialkylglycerols were prepared similarly. Acylation of various 2-alkylglycerols and 1.3-dialkylglycerols with acyl chlorides led to 2-alkyl-1.3-diacylglycerols and 1.3-dialkyl-2-acylglycerols, respectively. Trialkylglycerols were synthesized by peralkylation of 2-alkylglycerols and 1.3-dialkylglycerols. The compounds synthesized were characterized by their infrared spectra melting points, critical solution temperatures with nitromethane, and by mass spectrometry. [1'-^{14}C]-Labeled esters of 1.2-dialkylglycerols and 1.3-dialkylglycerols were used in studying the substrate specificity of various lipases, and trialkylglycerols were utilized as "nonfattening fats" in nutritional studies with rats.

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PERFORMANCE CHARACTERISTICS OF PEANUT OIL PRODUCTS. R.O. Feuge, M.S. Gray, and J.L. White, Sr., Southern Regional Research Center, ARS, USDA, PO Box 19687, New Orleans, LA 70179.

Fat products made entirely from peanut oil have been relatively unknown in the United States. Now Government-owned peanut oil is being processed into a number of such products, and the preparation of other products is being proposed. Several all-peanut oil products have been examined. Among these were a general purpose shortening and an experimental mayonnaise. The latter was found to perform well at both room and refrigerator temperatures but was not equal to standard mayonnaise in its resistance to emulsion breakage at freezing temperatures. An all-peanut oil shortening, contrary to expectations, exhibited excellent resistance to becoming grainy on temperature cycling and storage. In this characteristic, as well as in others, it surpassed standard commercial shortenings. The winterization of peanut oil to produce a salad oil has been attempted, and the possibility of producing a salad oil will be discussed. The suitability of peanut oil in other fat products will be surveyed.

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ZERO *trans* MARGARINES: PREPARATION, STRUCTURE, AND PROPERTIES OF INTERESTERIFIED SOYBEAN OIL-SOY TRISATURATE BLENDS. G.R. List, E.A. Emken, W.F. Kwolek, T.D. Simpson, and H.J. Dutton, Northern Regional Research Center, ARS, USDA, 1815 N. University St., Peoria, IL 61604.

The sodium methoxide-catalyzed random interesterification of liquid soybean oil-soy trisaturate blends was explored as a possible route to zero *trans* margarine oils. Parameters necessary for the random interesterification reaction were established along with methods to determine the glyceride structure of randomized fats. Despite a variety of reaction conditions including catalyst and oil preparation, catalyst concentration, and time, some 6–8% diglycerides were detected in the interesterified fats. These results will be presented and discussed. Organoleptic evaluation showed that randomization of the glyceride structure had no adverse effects on flavor and oxidative stability. Flavor evaluations made against a commercially hardened tub margarine oil showed that interesterified oil had comparable initial and aged flavor scores. X-ray diffraction studies demonstrated that corandomized soybean oil-soy trisaturate blends possess the beta-prime crystal structure desirable for margarine manufacture. Dilatometric data indicate that random interesterification of 15–20% by weight of soy trisaturate into the glyceride structure of soybean oil provides enough solid fat for soft tub margarine manufacture.

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CONFECTIONERY FATS FROM PALMITIC-OLEIC-LINOLEIC ACID OILS. R.O. Feuge, Southern Regional Research Center, ARS, USDA, PO Box 19687, New Orleans, LA 70179.

At one time virtually all hard butters for use in chocolate-type and other confections were based on lauric acid oils, even though these oils are inherently incompatible with cocoa butter and present other problems. While palmitic-oleic-linoleic oils and some of their fractions can be converted into high quality hard butters, the processing is relatively expensive and involved. Nevertheless, the volume of confectionery fats made from palmitic-oleic-linoleic acid oils is increasing. The technical and economic problems involved in the production of hard butters from such oils are discussed and performance characteristics are described.

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ON COCOA BUTTER SUBSTITUTE TECHNOLOGY. M.D. Baijal, Chemical Consulting, Painesville, OH 44077.

This discussion will deal with cocoa butter, hard butters, and with the development of product alternates. Specialty fats for utilization in confectionery products are normally evaluated for chemical, physical, and functional attributes. These attributes can be essentially defined in terms of structure-property, processing-restructurization, and subjective-objective performance aspects. For a proper understanding of these products, attention should also be focused on nonideal behavior, physical-bulk structure and molecular engineering, diluent level and phase separation, as well as on "band response" considerations. A product/process catalog should be constructed both as an audit instrument and as a vehicle for speculation.

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PRODUCT DESIGNING IN SPECIALTY FATS. M.D. Baijal, Chemical Consulting, Painesville, OH 44077.

An attempt is made here to provide an understanding of the design elements that are needed in the development of specialty fat products. For product development and/or improvement, a "concept to commercialization" strategy is suggested for favorable benefit/cost ratio. Basically, this design strategy is defined in terms of p^4 (properties • processing • performance • pricing) criteria. Utilization of these factors is illustrated through model products for B-C-D (bakery-confectionery-dairy) system. Transportation and implementation of ideas in the G-S-G (generalized-specific-generalized) domain is suggested as a logical base for the development of specialty fats for consumer and industrial markets. A reference chart for input functions is proposed for product management.

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HYDROGENATION OF FOOD FATS. Robert R. Allen, W. L. Clayton Research Center, Anderson Clayton Foods, Richardson, TX 75080.

The hydrogenation of food fats is the major chemical reaction operation of the fats and oil industry. This reaction has had a major effect on the agricultural economy of the world since it made possible the use of vegetable oils as semisolid fats for baking, frying, and table spreads as well as stabilizing the fats against oxidative rancidity and polymerization. The process of heterogenous catalytic hydrogenation of vegetable oils causes some positional and geometrical isomerism of the double bonds as well as saturation. This isomerization is believed to be due to a partial hydrogenation-dehydrogenation of the double bonds. The analyses of typical hydrogenated vegetable oils show considerable *cis* and *trans* forms of the positional isomers of oleic glycerides.

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INHIBITION OF CELLULAR GROWTH AND METABOLISM BY ISOMERIC *trans*-OCTADECENOATES. WILLIAM E.M. LANDS, Department of Biological Chemistry, The University of Michigan, Ann Arbor, MI 48109.

Microbial mutants that are unable to synthesize unsaturated fatty acids provide useful models to examine the effect that a given acyl chain may have upon prokaryotic and eukaryotic cells. A variety of acyl structures can serve in place of the naturally occurring *cis*-ethylenic derivatives. When *trans*-isomers were provided, they formed cellular lipids but were not very effective promoters of cell growth. Growth of mutants on oleate (*cis*-9-octadecenoate) was not impaired by additional *trans*-acids in the case of the prokaryotic mutant tested, but the eukaryotic yeast, *S. cerevisiae*, was inhibited by the presence of some *trans*-fatty acids. In particular, the 4, 6, 7, 11, 12, and 13 isomers were fairly toxic, whereas the 8 and 10 isomers had little effect on the growth. When division of the eukaryotic cell was impaired by added *trans*-acid, some control point was altered in phospholipid biosynthesis and triacylglycerols accumulated. The effects of the different acyl chains appear to not be directly related to the melting points of the nonesterified acids, and the sharp differences noted among the isomers suggest that some selective interaction, beyond a nonselective fluidity phenomenon, may be occurring with some of these isomers.

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DISTRIBUTION OF POSITIONAL AND CONFIGURATIONAL MONOENE ISOMERS IN LIPID CLASSES OF LIVER AND HEPATOMA. RANDALL WOOD and F. CHUMBLER, Lipid Laboratory, Department of Biochemistry and Biophysics, Texas A&M University, College Station, Tx 77843.

Groups of male weanling rats were placed on one of three diets consisting of a fat-free diet supplemented with either 0.5% safflower oil (Diet A), 15% safflower oil (Diet B), or 15% partially hydrogenated safflower oil free fatty acids (Diet C). The animals on Diet B and one group of animals on Diet C were inoculated with minimal deviation hepatoma 7288CTC. After 4 weeks the animals were sacrificed, hepatomas and livers removed, and the lipids extracted and fractionated into individual lipid classes. The C-18 monoene fractions from the partially hydrogenated safflower oil fatty acids, steryl esters, triglycerides, phosphatidyl cholines, and phosphatidyl ethanolamines were analyzed quantitatively for geometrical and positional isomers. The 18:1 fraction from Diet D contained 66% *trans* and 33% *cis*, and positional isomers ranged from Δ8 to Δ14 in both geometrical isomer fractions. Individual lipid classes from liver of animals fed Diet D contained different quantities of *trans* isomers, but all the lipid classes of the hepatoma contained the same approximate *trans* isomer content. Lipid classes of liver, and to a lesser extent hepatoma, exhibited characteristic specificity for positional isomers. The distribution of the positional monoene isomers at each position of glycerol for triglycerides, phosphatidyl cholines, and phosphatidyl ethanolamines is being determined and will be presented. (This work was supported by USPH Grant CA 12973 from the National Cancer Institute. A portion of this work was carried out at the University of Missouri.)

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SOME NUTRITIONAL ASPECTS OF PARTIALLY HYDROGENATED OILS. J.L. BEARE-ROGERS and E.A. NERA, Health Protection Branch, Health and Welfare, Ottawa, Ontario, Canada K1A 0L2.

Partial hydrogenation of an edible oil produces both beneficial and questionable changes in nutritional quality. When rats were fed rapeseed oil (*Brassica campestris*, cultivar Span), the incidence of cardiac lesions was lower with the partially hydrogenated oil than with the liquid oil which had been treated in various ways. Another rapeseed oil (*B. napus*, cultivar Tower) was similarly improved when hydrogenated to an iodine value of 77, but not when the iodine value was 97. The production of *trans* fatty acids during hydrogenation and their prevalence in the diet are associated with their occurrence in human milk. Concentrations of 6–18% of the total fatty acids have been found, but the nutritional significance has yet to be ascertained.

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CHANGES IN THE ALK-1-ENYL AND ACYL GROUP COMPOSITION IN CARDIAC PHOSPHOLIPIDS OF BOARS FED CORN OR RAPESEED OIL. JOHN K.G. KRAMER, and HOWARD W. HULAN, Animal Research Institute, Research Branch, Agriculture Canada, Ottawa, Ontario, Canada, K1A 0C6.

The 1 and 2 positions of alk-1-enyl acyl and diacyl phosphatidyl ethanolamine and phosphatidyl choline of the cardiac lipids of pigs fed corn oil or rapeseed oil were investigated. The alk-1-enyl group composition was significantly affected by dietary fatty acids as well as acyl composition. Erucic acid was preferentially incorporated into the 2 position of both phospholipids; the highest concentration of erucic acid was found in the 2 position of the ethanolamine plasmalogen.

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PROTEIN-WATER INTERACTION AND FUNCTIONAL PROPERTIES. DAVID CHOU and CHARLES V. MORR, Ralston Purina Company, 900 Checkerboard Square, St. Louis, MO 63188.

Proteins are not generally functional in the absence of a liquid water phase. Thus, the protein hydration process is the first and most crucial step toward proper functional performance of a protein. Furthermore, the ability of a protein to bind or hold water is itself one of the most important functional properties in food applications. In this paper, the following will be discussed: (a) the physical chemical nature of protein hydration, (b) factors governing or affecting the protein-water interaction, (c) methods of measuring protein-water interaction in model and food systems, and (d) the effect of protein-water interaction on other functional properties. The current literature on water binding (and/or holding) capacity and other related properties will be summarized and evaluated in terms of physical chemical nature of protein-water interactions.

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RHEOLOGY OF FOOD PROTEINS. EDWIN W. MEYER, Central Soya Co., 1825 N. Laramie Ave., Chicago, IL 60639.

The functional properties of food proteins are fundamental factors in the formation, structure, and structural behaviorism of both traditional and new foods. These factors involve many facets of rheology, including viscosity of dispersions or sols, the deformation and elasticity of gels, and plastic flow of proteins, among others. With the advent of the so-called engineered or fabricated foods, increasing attention has been focused on the rheological characteristics of the newer protein ingredients for food. This review is concerned with a characterization of some rheological properties of selected protein products for food, with emphasis on novel or new protein resources. The changing character of these properties as related to protein source and processing has been noted, but is little understood as to the fundamental alteration in protein structure or conformation which prompts such changes. This is understandable in view of the macroheterogeneity of the new food proteins. Some speculation as to gross alterations in protein structure which affect selected rheological properties is presented. The structural and conformational changes involve the whole range of inter- and intra-actional forces, including ionic, hydrogen, hydrophobic, and covalent bonding. The relationship of certain rheological properties of selected food proteins, especially as evidenced in model systems, to function in processed foods is critically evaluated.

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TEXTURIZATION: PHYSICOCHEMICAL ASPECTS. JEROME SHEN, DAVID CHOU, and CHARLES V. MORR, Ralston Purina Company, 900 Checkerboard Square, St. Louis, MO 63188.

The modification of proteins to produce fibrous or fiber-like textured products is a subject of unique importance and interest. Unfortunately, very little is known about the physicochemical properties of texturized "fibers," the mechanisms that produce them, or the forces that hold the molecules in a given structure. The following topics will be covered: (a) Methods for characterizing the physicochemical properties of textured protein products will be illustrated; particular emphasis will be given to those methods that can give useful information without undue expenditures of effort. (b) The structures of naturally occurring fibrous proteins and fibrous synthetic polypeptides will be discussed insofar as they might be models for texturized "fibers." (c) The current understanding of the mechanisms and the forces that are required to form and stabilize protein structures will be outlined. (d) A brief and generalized survery of the presently available "fiber" forming processes and of the physicochemical properties of these "fibers" will be given. (e) The information discussed in topics b and c will be used to postulate reaction mechanisms for the above processes.

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PROTEINS AS EMULSIFIERS. CHARLES J. CANTE and ROGER W. FRANZEN, General Foods Corporation, Pet Food Division, and FOUAD Z. SALEEB, General Foods Corporation, Central Research Department, Kankakee, IL.

The role of various proteins as emulsifiers or coemulsifiers is considered. Surface and colloidal chemical methodologies, needed to obtain information on protein-oil and protein-cosurfactant interactions to explain the protein's function, are presented. Particular attention is given to film balance (single film and duplex film) and tensiolaminometric (double film) techniques for establishing the mechanism of action of the protein at the oil/water interface. Electrokinetic techniques are also employed to explain the effect of charged interfaces, pH, and ionic strength on the protein's emulsification character. Correlation of surface and colloidal chemical properties and performance in actual emulsions will be offered. Applications to food emulsions such as salad dressings and whippable emulsions for toppings will be discussed.

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PRETREATMENT OF EDIBLE OIL REFINERY WASTE.

Abstract not available at press time.

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JOINT TREATMENT OF EDIBLE OIL REFINERY WASTE.

Abstract not available at press time.

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LOOK AT THIS CITY SEWER SERVICE BILL. G.N. MCDERMOTT, The Procter & Gamble Company, Hillcrest Tower, 7162 Reading Rd., Cincinnati, OH 45222.

A major increase in the sewer or wastewater service bill of many industries has or will shortly be felt. The causes are the requirements in federal law for increased wastewater treatment effectiveness of joint treatment systems together with specifications in the law concerning the industrial user sharing in the costs of the publicly owned systems. Cases of bills going up tenfold can be found. The EPA regulations must be properly interpreted and rational principles used to arrive at a fair charge for industry. The revenue program must recognize all uses and benefits of the community system to be fair. Such benefits include community use for storm water, infiltration flow, unbilled institutional use, reserve capacity for the future, and uncollected accounts. Charges that are logically borne equally per customer, such as for billings, should be so dealt with. EPA regulations require the repayment, interest free, of the federal construction grant funds used for industry's share of the facilities. Domestic users do not have any such repayment regulations. Therefore, industry's costs will rise even more than the homeowner's. The revenue requirements to run the system must be generated, and any reduction in industry's share will cause an increase in another's share; the issue is thus sensitive politically.

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NEGOTIATIONS: SEWER CONTRACTS WITH MUNICIPALITIES.

Abstract not available at press time.

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STUDIES ON GLYCERIDE COMPOSITION AND SYNTHESIS IN RAT HEART AFTER FEEDING HIGH AND LOW ERUCIC ACID RAPESEED OILS. S. HUNG, B.J. HOLUB, M.K. BHATNAGAR, T. UMEMURA, and S.J. SLINGER, Department of Nutrition, University of Guelph, Guelph, Ontario, Canada N1G 2W1.

In view of the known effects of high erucic acid rapeseed oils in causing early cardiac lipidosis, there is considerable interest in assessing the potential effects of the low erucic acid oils. With the availability of rapeseed oil (c.v. Tower) containing less than 1% erucate, a series of comparative experiments were conducted with Target rapeseed oil (34% erucate) and corn oil. These two fully refined rapeseed oils and corn oil were fed to male Sprague-Dawley rats at a level of 20% by weight in the diet for up to 16 weeks. As early as 3–7 days, the mean concentrations of fatty acids in triglyceride in the Target groups were 21.5–30.1 mg/g heart and drastically greater than those found in the corn oil (1.8–4.2 mg/g heart) or Tower (1.8–3.9 mg/g heart) groups. Mean concentrations of fatty acids in total phospholipid at corresponding intervals were 8.8–11.0 mg/g heart regardless of dietary treatment. Compositional analyses revealed a preferential association of certain fatty acids among the triglycerides and phospholipids which was a function of the dietary oil. These latter findings may be due to an effect of the dietary oils on specific metabolic pathways in heart. The present studies suggest that triglyceride accumulation in heart which results from the feeding of high erucate rapeseed oil does not occur with the Tower rapeseed oil. The results from histopathological examination of cardiac tissue from these animals will also be presented. (Supported by the Rapeseed Association of Canada, the National Research Council of Canada, and the Ontario Ministry of Agriculture and Food.)

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METABOLISM OF LINOLEATE VS. LINOELAIDATE IN THE LAYING HEN. Alan C. Lanser, T.L. Mounts, and E.A. Emken, Northern Regional Research Center, ARS, USDA, 1815 N. University St., Peoria, IL 61604.

The metabolic fate of the *trans,trans*-geometric isomer of methyl linoleate has been compared to that of the naturally occurring *cis,cis* isomer in the laying hen. Dual-labeled radioactive mixtures composed of one isomer having a 12(13)-^{3}H label and the other a 1-^{14}C label were orally administered to three laying hens in two separate experiments. A control feeding of tritium and carbon-14 labeled methyl linoleates was run in order to detect possible tritium isotope effects and also to confirm the biological stability of the tritium label on the double bond. The ^{3}H/^{14}C ratios of both the neutral lipid and phospholipid fractions from the egg yolks and of the isolated acids from these fractions were compared to that of the administered mixture. No variation in both the neutral lipid and phospholipid dienoic ^{3}H/^{14}C ratios from the administered ratio indicates that the hen does not discriminate between these two geometric isomers during incorporation of dienes into these fractions. The arachidonate of the phospholipid, however, contained only the radioactive label associated with the *cis,cis* isomer. Both carbon-14 and tritium labels were found in the cholesterol and cholesterol ester fractions of the neutral lipid, indicating catabolism of both fatty acid isomers and anabolism of the fragments.

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METABOLIC PROPERTIES OF HYDROGENATED FATS. F.A. Kummerow, S. Cho, W. Huang, and L. Lawson, The Burnsides Research Laboratory, University of Illinois, Urbana, IL 61801, H. Imai, Albany Medical School, and A. Kamio, Harlan E. Moore Heart Research Foundation, Champaign, IL 61820.

The metabolic properties of hydrogenated fats were studied with the arterial tissue from swine of various age groups and with heart mitochondria from weanling rats. The lipid content of the arteries and the degree of atherosclerotic involvement in weanling swine fed for 6 months a hydrogenated soybean oil, which had an iodine value of 68 and contained 63% *trans* fatty acids, was *not* significantly different from those fed beef tallow. Supplementation with vitamin D_3 increased the percentage of degenerative smooth muscle cells in the aorta of 3 and 6 month old swine, and age was also a factor in the development of atherosclerosis. The incorporation of ^{14}C-labeled oleic and elaidic acids into various lipid classes by heart subcellular preparations in vitro indicated that both readily incorporated into phospholipid. Oleic acid appeared to be a preferred substrate for cholesterol esterification. Utilization of elaidic acid was several times less than that of oleic acid by both microsomal and mitochondrial fractions. Incorporation of oleic acid into triglyceride was sightly higher than that of elaidic acid. However, regardless of fatty acid tested, the incorporation of fatty acid into lipids was consistently in the order of phospholipid > cholesteryl ester > triglyceride. A decreased capacity to oxidize substrate by heart mitochondria which had been isolated from the hearts of weanling rats fed rapeseed or hydrogenated soybean oil as compared to those fed corn oil as a sole source of dietary fat seemed related to their lipid composition. As heart mitochondria contain an even higher proportion of highly unsaturated fatty acids than liver mitochondria, heart mitochondria may be more sensitive to an influx of unnatural, unsaturated fatty acids. However, the rapidity at which the rat adjusts to their presence in the plasma lipoprotein indicated that the linoleic acid in the adipose tissue may have been mobilized and replaced the unnatural fatty acids in the phospholipids in the heart mitochondria. The presence of a dietary source of linoleic acid hastens this process so that at the end of 6 weeks the heart mitochondria oxidized substrate at a normal level. The relationship between the composition of heart mitochondria and dietary fat deserves further study.

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INFLUENCE OF DIETARY UNSATURATED *cis* AND *trans* AND SATURATED FATTY ACIDS ON TISSUE LIPIDS OF SWINE. Charles E. Elson, Department of Nutritional Sciences, 1270 Linden Dr., University of Wisconsin, Madison, WI 53706, N.J. Benevenga, Department of Meat, Animal, and Nutrition Science, University of Wisconsin, D.J. Canty, Department of Nutritional Science, University of Wisconsin, R.H. Grummer, Department of Meat and Animal Science, University of Wisconsin, A.E. Johnston, Northern Regional Research Center, USDA, University of Wisconsin, J.J. Lalich, Department of Pathology, University of Wisconsin, J.W. Portor, Department of Physiological Chemistry, University of Wisconsin, and E.S. Shrago, Department of Medicine and Nutritional Science, University of Wisconsin.

The interplay of dietary unsaturated *cis* and *trans* and saturated fatty acids that might be contributory to an abnormal lipid metabolism leading to intimal lipoidosis was studied in swine. Seventy weanling crossbred barrows and gilts of similar genetic origin were fed a diet providing 15% protein and 19% fat. Seven fats, constant in *cis cis* diene but in which the *trans* fatty acids varied from 0 to 50%, the saturates from 20 to 70%, and the *cis* monoene from 20 to 80% provided 90% of the dietary fat; the remaining 10% by corn. A configurational analysis of the dietary fatty acids will be presented. Weight gain, feed consumption, and plasma lipids were determined routinely during the 10 month feeding period. Tissues were analyzed for lipid content and composition and liver for fatty acid synthetase, hydroxymethylglutaryl coenzyme A reductase, cholesterol 7α hydroxylase, and adenine nucleotide translocase activities. Gross and microscopic examinations of the aortas were done independently by pathologists at the University of Wisconsin and the Bowman Gray Schools of Medicine. The data, analyzed by Student's t test for differences between group means, do not reveal any differences that can be attributed to a dietary fat influence. A more rigorous regression analysis is being employed to explore any effects arising from the interplay between the various fatty acid components of the diets.

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NUTRITIONAL EVALUATION OF *trans* FATTY ACIDS. Roslyn B. Alfin-Slater, Lilla Aftergood, and Terry Whitten, University of California, School of Public Health, Center for Health Sciences, Los Angeles, CA 90024.

Male and female rats were fed from weaning diets containing 15% of six different fats with varying levels of transmonounsaturated (1–45%) and transdiunsaturated fatty acids (0–6%). Females were bred at 13 weeks of age, and their progeny were continued on the same diets. No significant differences were observed in either weight gains or liver weights of animals of all groups. On reaching maturity, progeny were bred and killed thereafter. Fatty acid analyses of lipid fractions from plasma, liver, adrenals, kidney, testes, heart, and red blood cells revealed the presence of rather high amounts of *trans* fatty acids in the tissues of rats ingesting diets containing these acids. The extent of the incorporation of these acids varied with the lipid fraction and the tissue examined. Analyses of cholesterol were done in plasma, heart, liver, and adrenals. Plasma cholesterol levels were not significantly affected by the type of composition of the dietary fat, although some differences in cholesterol content were evident in other tissues.

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METABOLISM OF LINOELAIDIC ACID IN RAT LIVER AND BRAIN. R. Karney, Division of Environmental and Nutritional Sciences, UCLA School of Public Health, Los Angeles, CA 90024, G.A. Dhopeshwarkar, UCLA Department of Nuclear Medicine and Radiation Biology, and R.B. Alfin-Slater, UCLA School of Public Health.

In the course of hydrogenation of vegetable oils to produce margarine, *trans* isomers of the various unsaturated fatty acids are formed. Although a complete nutritional evaluation of these *trans*-fatty acids is not available, studies have been done which indicate that the metabolism of *trans*-polyunsaturated fatty acids differ from that of the naturally occurring *cis*-isomers, especially as far as concerns their utilization by the brain. As a result, this investigation was undertaken to elucidate the possible incorporation and subsequent metabolism of the *trans* linoleic acid isomer, linoelaidic acid (t-L), into the brain and liver of rats. Two groups of rats, one 10–12 days old (Group A) and the other 2–3 months old (Group B), were injected intraperitoneally with C^{14}-linoelaidic acid and killed 8 hr later. Brain and liver were removed and analyzed by gas liquid chromatography, thin layer chromatography, ozonolysis, and scintillation counting techniques to measure the incorporation of the labeled *trans*-isomer into lipids, the percent distribution of radioactivity in various lipid and fatty acid fractions, and the possibility of isomeric interconversion. In general, in both A and B there was a rather high incorporation of the t-L in the liver and a much lower uptake by the brain. However, uptake of t-L by brain in Group A was 3 times that of Group B. This could be due to the fact that there is an incompletely developed blood-brain-barrier system in the young rat or to a relatively slower metabolic turnover of brain lipids in mature animals. Further examination showed that the t-L was incorporated into the phospholipids, the predominant fraction being phosphatidyl choline. In addition, it appeared that t-L was metabolized to acetate which was subsequently used in the biosynthesis of cholesterol. Analysis of liver fatty acids showed that the acetate was also used for the de novo synthesis of palmitate as indicated by the relative distribution of radioactivity in the carboxyl group as compared to the whole. Studies also showed that t-L was not directly elongated and desaturated to arachidonate, but rather was oxidized to acetate; this was thereafter used in the elongation of linoleate to arachidonate. Further studies to elucidate the role of dietary *trans*-fatty acids in the metabolism of the developing brain are in progress.

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FOAMING PROPERTIES OF PROTEINS. Victor Moreno, FBI Foods, Ltd., 1610 de Beauharnois, Montreal, Quebec, Canada H4N 1J5.

The study of the foaming properties of proteins is the study of the ability of protein solutions to create films capable of enclosing air. Therefore, the study aims at identifying the film forming capacity of protein solutions, the factors affecting the stability of such films, and the behavior of proteins at air-water interphases. Proteins, as any surfactant, have the capacity of lowering the air-water interfacial tension. However, they do not exhibit a clear critical micelle concentration, and, although they are thought to be oriented at the interphase in a manner similar to surfactants, they exhibit different properties. The methodology for measuring the foaming properties of protein solutions ranges from the sophisticated to the crude. The properties of protein films are studied generally in a Langmuir surface balance, where a protein film is formed and then compressed and decompressed and where the relationship between the protein surface concentration and the decrease in surface tension is studied. However, all the methods available gave either properties of films or colligative properties of foam. Recently a new method, called Tensiolaminometry, was developed and could give information on film forming capacity and stability of the films. This methodology revealed that very low protein concentrations could depress the surface tension of an air-water interphase substantially and could form large but unstable films. High protein concentration reduced the film forming capacity of proteins but increased their stability. It is therefore thought that proteins initially form a monolayer at the water-air interphase and this monolayer is further stabilized by a number of sublayers. This system must be highly organized and creates an energy barrier which opposes surface reduction and the thinning of the foam lamella.

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DOUGH FORMING PROPERTIES. R. Carl Hoseney, Department of Grain Science and Industry, Kansas State University, Shellenberger Hall, Manhattan, KS 66506.

The gluten proteins of wheat are unique in their ability to form a dough that will retain the gas produced during panary fermentation. Thus, those proteins are basically responsible for the light baked products with which we are all familiar. The reason for the gluten protein's uniqueness is not clearly understood. However, the high level of glutamic acid (35%), proline (14%), and amide groups (95% of the acids) together with the relatively low levels of basic amino acids results in very low charge on the proteins. That low charge is conducive to high levels of hydrogen bonding and hydrophobic bonding. The changes in protein configuration as a result of dough mixing will be discussed. The contribution of the nongluten proteins, particularly the glycoproteins, in bread and other baked systems will be evaluated. Basic differences between the role of proteins in yeast leavened doughs and chemical leavened systems will be noted. A discussion of the role or function of foreign (nonwheat) protein in baked products, including their interaction with lipids and surfactant, will be included.

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COMPARISON OF FUNCTIONAL PROPERTIES OF DIFFERENT OILSEED PROTEINS. Dale W. Johnson, Food Ingredients Inc., 1150 Willis Ave., Wheeling, IL 60090.

Due to the chemical nature and configuration of oilseed proteins, one would expect differences in functionality of vegetable proteins from different oilseed sources. From a given vegetable protein source, the degree and method of processing to produce products in a given product category, processing to remove certain nonprotein substances to increase protein content, processing to make an isolated vegetable protein, presence of fat, fiber, and possibly other constituents, will influence functionality in given food systems. Care should be taken in evaluating functionality of a given protein in comparison to another type of protein using single laboratory tests for functionality comparisons, since more than one functionality characteristic may be important in determining what may actually happen in a given food system.

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YEAST PROTEIN: FUNCTIONAL PROPERTIES. P.G. Schnell, J.H. Pearce, and C. Akin, Amoco Foods Company, PO Box 400, Naperville, IL 60540.

Food ingredients are used in processed foods for functionality as well as nutrition and flavor. Although yeast products have long been used in foods, little has been published about their functional properties. These properties have now been studied with a new food yeast, Torutein, torula yeast grown on ethanol. Torutein contains 52% protein, of which 6.6% is lysine. The dried yeast is readily dispersible in oil or water and has some soluble components which act as flavorants. Torutein also contains vitamins, minerals, fats, and carbohydrates. The fat is 80% lecithin and cephalin and contains essential unsaturated fatty acids. The functional properties include water retention (2/1), fat retention (0.36/1) and emulsification (84 ml/g). These provide yield increases in meat products and allow use of Torutein in fat-water or water-fat emulsions. Torutein-94, a specially processed torula yeast, can functionally replace 25–40% of the egg yolk in pourable and spoonable dressings. Objective and subjective measurements correlated that the viscosity of the test dressing was equal to that of control. Torutein-94 in bakery products incorporates a flaky texture and reduces the hard fat mouthfeel while replacing egg in puffed pastries. In cereal based snack products and wafers, Torutein increases crispness.

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QUALITY CHARACTERISTICS OF GROUND BEEF PATTIES EXTENDED WITH MOIST-HEATED AND UNHEATED DEFATTED OILSEED MEALS. Kay H. McWatters and E.K. Heaton, Department of Food Science, University of Georgia College of Agriculture Experiment Stations, Georgia Station, Experiment, GA 30212.

Four defatted meals (peanut, soybean, pecan, and field pea) were compared at a 5% level of substitution in ground beef patties. Protein content levels (dry weight basis) in the four meals were 54.88, 50.57, 42.06, and 24.18%, respectively. Proximate analyses data were obtained for both the uncooked and cooked patties. Beef patties containing moist-heated (100 C for 30 min) and unheated meals were compared. The beef patties with and without added meal were examined for differences in cooking losses, texture compression and shear, color reflectance, and sensory ratings. Addition of oilseed meals reduced cooking losses, indicating an increased oil and/or water binding capacity. There were no differences between heated and unheated peanut, soybean, and pecan meals with regard to cooking losses. Unheated field pea meal exhibited better binding qualities than its heated counterpart or the other oilseed meals. Patties containing oilseed meals required less force for compression and shear, indicating more tenderness than the all-beef control. Uncooked patties containing moist-heated pecan meal were substantially lower in redness (a) and lightness (L) than the control patties or patties containing peanut, soybean, and field pea meals. Improvement in aroma and flavor of the oilseed meals resulting from moist-heat treatment was evident in sensory quality ratings of the patties.

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MIXING SCALEUP IN THE OIL PROCESSING INDUSTRY. James Y. Oldshue, Mixing Equipment Co., Inc., PO Box 1370, Rochester, NY 14603.

Mixing scaleup involves determination of the controlling factors in a particular process, and then properly extrapolating the controlling factors to full scale equipment. Variables include power input, impeller and tank geometry, impeller pumping capacity, and fluid shear rates. Examples will be discussed in five basic areas: liquid-solid, gas-liquid, liquid-liquid, miscible liquids, and fluid motion. Specific consideration will be given to such processes as low viscosity blending, steam stripping, hydrogenation, and heat transfer.

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AUTOMATIC BATCH WEIGHING SYSTEMS: USES AND ADVANTAGES. F. William Spencer, H. J. Fuller & Sons, Inc., 1212 Chesapeake Ave., Columbus, OH 43212.

This paper will describe automatic weighing systems, including design considerations, equipment required, operation, and advantages. Also included in the discussion will be a review of an automatic weighing system related to the edible oil industry.

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FLOWMETERS OLD AND NEW. Peter Elliott, Elliott Automation Company, Inc., PO Box 31227, Cincinnati, OH 45231.

Flowmeters have changed greatly over the past few years, and new flowmeters are available that can apparently displace flowmeters of an earlier technology. The truth of this will be explored. Advantages and disadvantages of each flowmeter type will be compared. Old technology will include orifice flowmeters, target flowmeters, rotameters, metering pumps, positive displacement flowmeters. New technology will include ultrasonic flowmeters, vortex shedding flowmeters, fluidic flowmeters, magnetic resonance flowmeters, magnetic flowmeters, and turbine flowmeters. For best accuracy flow measurements should be compensated for fluid volume changes due to variations in temperature and pressure. Density compensation of flow measurements is also feasible, enabling the measurement to be in units of mass. Some new densitometers will be described, as will instruments for temperature and pressure compensation. Digital instrumentation is superceding much analog instrumentation; some reasons for this change will be explained as well as its impact on the selection of flowmeters. A slide presentation will accompany the paper, and questions will be answered if time permits.

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FLOAT ACTUATED LEVEL GAUGING IN GENERAL AND AS APPLICABLE TO EDIBLE OILS. John P. Cummings, Varec, Inc., 3915 W. 103rd. St., Chicago, IL 60655.

Discourse will include a brief history of float type level gauges; an outline of current standard bill-of-materials; and, as interest justifies, notation of bill-of-materials suitable for special services. Following above, attention will be turned to auxiliary devices/systems available for use with the float type gauges, such as: hi-lo level limit switches and associated alarm annunciator and others in accordance with interest.

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PROPERTIES OF BLEACHING CLAYS. Louis L. Richardson, Filtrol Corporation, 5959 W. Century Blvd., Los Angeles, CA 90045.

Bleaching clays are usually identified in the trade by the manufacturers' name and characterized by bleaching efficiency. Occasionally, users will request modification of certain properties to benefit a special situation. This paper examines the physical, chemical, and bleaching properties of commercial bleaching clays from the manufacturers' viewpoint. Examples are given of how variations in moisture content, residual acidity, particle sizing, and activation affect product performance and cost.

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TILTING FILTER: ITS POSSIBLE USES. Ned Brinkmeyer, North American Filtration, PO Box 722, Wheaton, IL.

This paper describes a pressure leaf filter designed to accomplish the normal operations of filtration and subsequent cleaning of the removed solids in a completely automatic fashion. A particular application describing the manufacture of a biocide using the filter is discussed. In this case the product is precipitated in chloroform and then recovered on the horizontal filter plates. After the primary separation, the cakes are washed with fresh chloroform to remove a toxic by-product. The undesired by-product is reduced $< 0.20\%$ and the cake further dried to remove residual "moisture." The washed, dried cake is then automatically discharged from the filter to a hopper feeding a special closed-circuit dryer for total removal of chloroform before packaging. These several operations are accomplished without exposure of the product or the environment.

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APPLICATIONS OF INDUSTRIAL GASES IN THE PROCESSING AND PRODUCTION OF OIL AND OIL BY-PRODUCTS. James H. Love, Airco Industrial Gases Division, Airco, Inc., 3909 Woodland Ave., Western Springs, IL 60558.

Several of the industrial gases are used in a wide area of production and processing of oil and oil by-products. These applications include edible and inedible products and vegetable as well as animal fat derived products. Some of these products and applications are: hydrogen—for hydrogenation; nitrogen—for pressure transferring, for purging and blanketing, for sparging and fluffing, for gas packaging; carbon dioxide—for pressure transferring, for product chilling, for pH control. Since the late 1950s, the demand for these products and related products derived from air separation have multiplied a hundredfold bring about the construction of a large number of regional production facilities with capacities of hundreds and even thousands of tons of product per day. This growth has made possible the distribution of cylinder and bulk quantities of these products throughout the U.S. at costs justified by the benefits derived from their use.

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PROCESSING IN RELATION TO PERFORMANCE. M.D. Baijal, Chemical Consulting, Painesville, OH.

Fats and oils undergo a series of processing operations prior to being useful as consumer and industrial products. These operations, which are primary and secondary in scope, lead to products which have limited and versatile applications. Compositional and structural integrity is retained (to a larger extent) in primary products. Both sharper property profile and performance-response are the key characteristics of secondary products. These and other considerations such as by-products, altered geometry, process variables and production volume (including controlled and disturbed experiments), and quality will be discussed in linking processing to product performance. Because of their versatile nature, fats and oils offer good opportunities for designing of tailor-made end-products.

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HEXANAL AS A MEASURE OF OXIDATIVE DETERIORATION OF FOOD PRODUCTS. Carl W. Fritsch and Julia A. Gale, General Mills, Inc., James Ford Bell Technical Center, 9000 Plymouth Ave. North, Minneapolis, MN 55427.

For some low moisture food products, particularly processed cereals, the gas chromatographic determination of n-hexanal in the vapors of foods suspended in boiling water was found to be the simplest, yet, most reliable method for measuring oxidative lipid deterioration. With the use of an internal standard, good precision was obtained when the method was used as a routine analytical tool. The time required for one hexanal determination was 10 min. Antioxidants were found to minimize the hexanal formation during storage of some cereal products. For some cereal products, but not for others, the rate of hexanal formation was found to be proportional to storage temperatures up to 60 C. Excellent correlation between sensory evaluations and hexanal value was obtained with foods whose primary deterioration was due to lipid oxidation.

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OXIDATIVE CHANGES IN COMMERCIAL FATS DURING FRYING. W.W. **NAWAR**, Department of Food Science and Nutrition, University of Massachusetts, Amherst, MA 01002.

The length of time for which a batch of shortening is used in commercial frying varies from a few days to several months. Other variables include type of shortening, geometry of frying vats, temperature, type and number of foods fried, antioxidants, etc. The present work is part of an effort designed to study the relation between operating parameters and chemical changes and to develop practical tests to determine the extent of use or abuse of shortenings. With the aid of the Massachusetts Food and Drug Administration, a number of samples of shortening oils, has been randomly collected from western Massachusetts at various stages of their use. These were analyzed by gas chromatography-mass spectrometry as well as chemical tests. In addition, a controlled study is being conducted using the University dining kitchens. The commercial samples varied considerably in color, viscosity, and in certain quantitative aspects of the volatile spectrum. Striking qualitative similarities, however, were evident between samples of significantly different history. Typical gas chromatograms of the volatile patterns will be shown. The question of whether or not a single test based on analysis of volatiles can be sufficient as an "index of abuse" for shortenings will be discussed.

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FORMATION AND CHARACTERISTICS OF FLAVOR COMPONENTS DERIVED FROM FOOD LIPIDS. P.S. **DIMICK**, 116 Borland Laboratory, The Pennsylvania State University, University Park, PA 16802.

Lipids, whether natural or added to the food product, play a major role in total flavor acceptance by the consumer. The flavor and aroma may be derived or modified directly by the lipid components themselves or may be a result of the volatile breakdown products through chemical and biochemical reactions where lipids are the primary precursors. The importance of understanding the origin of flavor is obvious. Only by studying the lipid substrates, products, and mechanisms involved in flavor and aroma development can we furnish a basis for determining ways to control possible factor which may influence the final flavor, whether they be beneficial or detrimental to the product.

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REACTION OF HISTIDINE WITH METHYL LINOLEATE: CHARACTERIZATION OF THE HISTIDINE DEGRADATION PRODUCTS. **SAMUEL** H. **YONG** and **MARCUS KAREL**, Rm. 56–117, Massachusetts Institute of Technology, Cambridge, MA 02139.

Efforts have been made to characterize the products resulting from the interactions of L-histidine (free base) and peroxidizing methyl linoleate (ML) in a model system consisting of reactants dispersed on a filter paper. Imidazole lactic acid and imidazole acetic acid are identified as the major breakdown products when histidine is incubated with ML, methyl linoleate hydroperoxide (MLHPO), or n-hexanal over a period of 3 weeks. Two other major reaction products are found to give back histidine upon acid hydrolysis. These products are thought to be Schiff's base compounds which result from the condensation of the histidyl α-amino group and carbonyl groups of reactive aldehydes formed during ML peroxidation. Most of the detectable reaction products have the imidazole moiety intact, indicating the high relative reactivity of the functional groups, especially the amino group, associated with the α-carbon. Such high reactivity provides an explanation for the low concentrations of ninhydrin-positive free amino compounds that they are, at the best, barely detectable on thin layer chromatography. Preliminary toxicological experiments, using human lymphoblasts in buffered suspensions, indicate that a relatively high toxicity, similar to that of peroxidized oil, is associated with the ethereal extract of a reaction system consisting of ML and histidine on a filter paper while the aqueous extract is nontoxic at 1 mg/ml level.

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ANALYSIS OF AUTOXIDIZED FATS BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY: METHYL OLEATE AND LINOLEATE. E.N. **FRANKEL**, W.E. **NEFF**, and W.K. **ROHWEDDER**, Northern Research Center, ARS, USDA, 1815 N. University St., Peoria, IL 61604, and B.P.S. **KHAMBAY** and B.C.L. **WEEDON**, University of London.

Gas chromatography-mass spectrometry (GC-MS) of trimethylsilyl (TMS) ethers of unsaturated fatty esters has been used in a number of structural investigations of autoxidation products. However, studies now carried out for the first time with authentic samples of isomeric hydroxystearates indicate that misleading results can be easily obtained in this way. There is partial separation of isomeric hydroxy esters by GC, and manual scanning of peaks by MS can cause serious errors in the quantitative analyses. This problem was overcome by careful summation of mass spectra by computer. The quantitative reliability of this computer summation approach was demonstrated with known mixtures of synthetic 8+9+10+11-hydroxystearates for autoxidized oleate and of 9+13-hydroxystearates for autoxidized linoleate.

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DETERMINATION OF HYDROPEROXIDES OF METHYL OLEATE AND LINOLEATE IN OXIDIZED METHYL ESTER MIXTURES. **WING-SUM DOMINIC WONG** and E.G. **HAMMOND**, Department of Food Technology, Iowa State University, Ames, IA 50011.

The hydroperoxides in oxidized mixtures of methyl oleate and linoleate were reduced to the corresponding hydroxy methyl esters with iodide. The hydroxy esters were separated from unoxidized esters by thin layer chromatography (TLC) on silica gel. The hydroxy esters recovered from the TLC plate were converted to trimethylsilyl ethers and separated by gas chromatography on OV 225. Results for methyl oleate and linoleate oxidized in various ratios agree reasonably well with theoretical expectations, but there is more oleate hydroperoxide than might be expected.

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OAT OIL REFINING AND STABILITY TESTS. A. **KALBASI-ASHTARI**, E.G. **HAMMOND**, and K.J. **FREY**, Department of Food Technology, Iowa State University, Ames, IA 50011.

Oil obtained by petroleum ether extraction of oats (Dal variety) was refined by conventional methods. Degumming losses were minimized by centrifuging at 5,860 g in 42% by volume of hexane and partial neutralization with sodium hydroxide. Under the best conditions the loss was still 15%. Free fatty acids were 6–8% and the alkali refining loss was 25–30%. The oil was bleached with charcoal and deodorized. The stability of the oil was compared with that of soybean oil at 25 and 55 C by peroxide values and organoleptic tests. The stability of oat oil was increased by citric acid, and it was significantly more stable than soybean oil with added citric acid, especially at 25 C. Oat oil contained significant amounts of α-tocopherol. Ferulic and caffeic acids, which have been shown to be important antioxidants in oats, were removed during extraction of the oil.

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LIPID HYDROPEROXIDE DEGRADATION BY A MODEL SYSTEM. H.W. **GARDNER**, R. **KLEIMAN**, and D. **WEISLEDER**, Northern Regional Research Center, ARS, USDA, 1815 N. University St., Peoria, IL 61604.

The degradation of linoleic acid hydroperoxide by ionic iron and cysteine is a model that mimics lipid hydroperoxide degradation in many biological systems. Of the nine oxygenated fatty acids previously identified from the model reaction, eight have been found by others as products of linoleic acid hydroperoxide degradation by various plant extracts or enzymes. A specific isomer of the hydroperoxide, 13-hydroperoxy-*cis*-9, *trans*-11-octadecadienoic acid, was degraded by the model in specific ways depending on the presence of absence of oxygen. In the absence of oxygen the products were mostly oxooctadecadienoic acid and addition compounds with cysteine, 9-S-cysteine-13-hydroxy-10-ethoxy-*trans*-11-octadecenoic acid, and 9-S-cysteine-10,13-dihydroxy-*trans*-11-octadecenoic acid. In the presence of oxygen the yield of cysteine addition products was dramatically reduced, and oxooctadecadienoic acid, as well as at least eight other oxygenated fatty acids, were produced. Oxygen was absorbed by the model reaction and was dependent on both the concentration of linoleic acid hydroperoxide and cysteine. In the presence of oxygen one of the major products from the model, 9-oxo-*trans*-12,13-epoxy-*trans*-11-octadecenoic acid, previously has not been observed in biological systems. Testing our hypothesis, that soy homogenates behave like the model, we introduced linoleic acid hydroperoxide or linoleic acid into soy homogenates in the presence of excess oxygen. Oxoepoxyoctadecenoic acid was isolated from the reaction. Possible reaction mechanisms will be discussed and related to biological systems.