

- Engelhardt, H.; Gross, A. On-Line Extraction and Separation by Supercritical Fluid Chromatography with Packed Columns. *J. High Resolut. Chromatogr. Chromatogr. Commun.* 1988, 11, 38-42.
- Fattori, M.; Bulley, N. R.; Meisen, A. Fatty Acid and Phosphorus Contents of Canola Seed Extracts Obtained with Supercritical Carbon Dioxide. *J. Agric. Food Chem.* 1987, 35, 739-743.
- Friedrich, J. P.; List, G. P.; Heakin, A. J. Petroleum-Free Extraction of Oil from Soybeans with Supercritical CO₂. *JAOCS, J. Am. Oil Chemists Soc.* 1982, 59, 288-292.
- Food Safety and Inspection Service. *Chemistry Laboratory Guidebook*; FSIS-USDA: Washington, DC, 1986; p 5:1-17.
- Gmur, W.; Bosset, J. O.; Plattner, E. Löslichkeit von einigen Kaseinhaltsstoffen in überkritischem Kohlendioxid. *Lebensm. Wiss. Technol.* 1986, 19, 419-426.
- Gmur, W.; Bosset, J. O.; Plattner, E. Beitrag Zur Direkten Kopplung Fluidextraktion-Kapillarfluidchromatographie. I. Theoretische Optimierung Einiger Wichtiger Apparativer Parameter. *J. Chromatogr.* 1987, 388, 143-150.
- Hardartottir, I.; Kinsella, J. E.; Rizvi, S. S. Delipidation of Fish Muscle. Presented at the 1987 Annual IFT Meeting, Las Vegas, NV, 1987; Abstr. No. 574.
- Hawthorne, S. B.; Miller, D. J. Directly Coupled Supercritical Fluid Extraction-Gas Chromatographic Analysis of Polycyclic Aromatic Hydrocarbons and Polychlorinated Biphenyls from Environmental Solids. *J. Chromatogr.* 1987, 403, 63-76.
- Hawthorne, S. B.; Krieger, M. S.; Miller, D. J. Analysis of Flavor and Fragrance Compounds Using Supercritical Fluid Extraction Coupled with Gas Chromatography. *Anal. Chem.* 1988, 60, 472-477.
- Holden, A. V.; Marsden, K. Single-Stage Cleanup of Animal Tissue Extracts for Organochlorine Residue Analysis. *J. Chromatogr.* 1969, 44, 481-492.
- King, M. B.; Alderson, D. A.; Fallah, F. H.; Kassim, D. M.; Kassim, K. M.; Sheldon, J. R.; Mahmud, R. S. Some Vapor/Liquid and Vapor/Solid Equilibrium Measurements of Relevance for Supercritical Extraction Operations and Their Correlation. In *Chemical Engineering at Supercritical Fluid Conditions*; Paulaitis, M. E., Penninger, J. M., Gray, R. D., Jr., Davidson, P., Eds.; Ann Arbor Science: Ann Arbor, MI, 1983; Chapter 2.
- Maxwell, R. L.; Marmer, W. N.; Zubillaga, M. P.; Dalickas, G. A. Determination of Total Fat in Meat and Meat Products by a Rapid, Dry Column Method. *J. Assoc. Off. Anal. Chem.* 1988, 63, 600-603.
- Mills, P. A. Detection and Semiquantitative Estimation of Chlorinated Organic Pesticide Residues in Foods by Paper Chromatography. *J. Assoc. Off. Anal. Chem.* 1959, 42, 734-741.
- Nelson, G. J. Isolation and Purification of Lipids from Animal Tissues. In *Analysis of Lipids and Lipoproteins*; Perkins, E. G., Ed.; AOCS: Champaign, IL, 1975; Chapter 1.
- Peter, S.; Brunner, G. The Separation of Nonvolatile Substances by Means of Compressed Gases in Countercurrent Processes. *Angew. Chem., Int. Ed. Engl.* 1978, 17, 746-750.
- Quirin, K. W. Löslichkeitsverhalten von fetten Ölen in komprimiertem Kohlendioxid im Druckbereich bis 2600 bar. *Fette Seifen, Anstrichm.* 1982, 84, 460-468.
- Stahl, E. Coupling of Extraction with Supercritical Gases and Thin-Layer Chromatography. *J. Chromatogr.* 1977, 142, 15-21.
- Stahl, E.; Schultz, E.; Mangold, H. K. Extraction of Seed Oils with Liquid and Supercritical Carbon Dioxide. *J. Agric. Food Chem.* 1980, 28, 1153-1157.
- Sugiyama, K.; Saito, M.; Hondo, T.; Senda, M. New Double-Stage Separation Analysis Method. *J. Chromatogr.* 1985, 33, 107-116.
- Taniguchi, M.; Nomura, R.; Kijima, I.; Kobayashi, T. Preparation of Defatted Mustard by Extraction with Supercritical Carbon Dioxide. *Agric. Biol. Chem.* 1987, 51, 413-417.
- Unger, K. K.; Roumeliotis, P. On-Line High-Pressure Extraction-High-Performance Liquid Chromatography I. Equipment Design and Operation Variables. *J. Chromatogr.* 1983, 28, 519-526.
- Wright, B. W.; Frye, S. R.; McMinn, D. G.; Smith, R. D. On-Line Supercritical Fluid Extraction-Capillary Gas Chromatography. *Anal. Chem.* 1987, 59, 640-644.
- Yamaguchi, K.; Murakami, M.; Nakano, H.; Konosu, S.; Kokun, T.; Yamamoto, H.; Kosaka, M.; Hata, K. Supercritical Carbon Dioxide Extraction of Oils from Antarctic Krill. *J. Agric. Food Chem.* 1986, 34, 904-907.
- Zosel, K. Production of Fats and Oils from Vegetable and Animal Products. U.S. Patent 4,331,695, 1982.

Received for review November 14, 1988. Accepted April 3, 1989. The mention of firm names or trade products does not imply that they are endorsed or recommended by the U.S. Department of Agriculture over other firms or similar products not mentioned.

Determination of Total Cholesterol in Coconut Oil: A New NIST Cholesterol Standard Reference Material

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A new Standard Reference Material (SRM) consisting of coconut oil with various nutrients added has been developed at the National Institute of Standards and Technology in response to the needs of the food measurement community. SRM 1563 consists of ampules of a coconut oil with added cholesterol and selected fat-soluble vitamins and ampules of the natural coconut oil. We have measured cholesterol in this material by a modification of the definitive method based on isotope dilution mass spectrometry coupled with gas chromatography, originally developed for the measurement of cholesterol in serum. The cholesterol concentration, as total cholesterol, in the fortified oil was determined to be 64.2 ± 0.6 mg/100 g of oil. This value with its precision complies with the request of the food nutrient measurement community for a standard with an uncertainty within $\pm 5\%$ of the certified value at 95% confidence limits. The natural oil was found to contain 0.344 ± 0.014 mg/100 g of oil.

Understanding the relationship between food nutrient levels and human health requires the accurate determi-

nation of nutrient levels by laboratories making such measurements. Food matrix reference materials with accurate nutrient compositions can be useful as a means to standardize nutrient level measurements and thus make nutrient levels measured by different laboratories comparable. A workshop held at the National Institute of Standards and Technology recommended cholesterol

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