Getting the Good Stuff

With Supercritical Fluid Extraction

The road to producing more nutritious foods for health-conscious Americans may be paved by ARS scientists using an environmentally safe processing method known as supercritical fluid extraction (SFE).

After decades of using SFE, researchers at the National Center for Agricultural Utilization Research (NCAUR), in Peoria, Illinois, have expanded its application far beyond decaffeinating coffee and extracting hops for beer flavoring. They have used SFE to extract and enrich nutritionally beneficial compounds called nutraceuticals from rice bran, corn fiber or bran, and soybeans. The goals are to provide alternative sources of nutraceuticals and to find value-added uses for byproducts of the oilseed and milling industries.

KEITH WELLER (K9553-8)

Margarine-based products marketed to lower cholesterol.

Plant-derived oils contain nutraceuticals that have recently been shown to enhance human health. For example, rice bran, soybean, and corn fiber oils all contain significant levels of compounds called phytosterols, according to ARS chemist Jerry W. King, who is with NCAUR. Touted for their cholesterol-lowering properties, phytosterols are found in commercially prepared margarines and spreads.

SFE is both an environmentally and consumer-safe way to extract such compounds because it uses carbon dioxide that's been heated and compressed to a semiliquid state. Previous articles described the use of SFE to replace organic solvents in laboratory analyses or to remove fat from meats. (See *Agricultural Research*, "Supercritical Fluid Fat Extraction," March 1995, p. 18, and "Cutting Use of Laboratory Solvents," March 1993, p. 12.)

King and Scott L. Taylor, also at NCAUR, have combined this benign method with solvents generally recognized as safe, such as ethanol and water, to selectively extract and enrich target nutraceuticals from vegetable oils. Using these natural and food-consumable solvents, they have created an extract containing 14.5 percent ferulate-phytosterol esters—compounds that other ARS researchers have found will lower cholesterol in humans.

More recent SFE-related projects by Taylor have yielded phospholipids from soybean oil. He combined two steps that occur during processing—extraction and chromatography—which also use only carbon dioxide, ethanol, or water as solvents. These are the only processing agents that are in contact with the soybean oil and meal. The isolated phospholipid concentrates are purported to provide such health benefits as improving cognitive function.

Former research associate Nurhan T. Dunford took supercritical fluid technology one step beyond the extraction stage. With engineering technician Jeff Teel's assistance, she built a fractionating column—similar to ones that produce distillates for the petroleum industry—to obtain and enrich the desired nutraceutical component without using chemical extraction solvents. This continuous system is called supercritical fluid fractionation (SFF), which yields phytosterol-enriched fractions from crude vegetable oils.

"SFF is feasible for industry to use, since they currently use a costly and complicated process to extract nutraceuticals from oils and then add them back into the product," says Dunford. She's now examining rice bran oil for enriching oryzanol, a compound that is known to lower the cholesterol levels in humans.

Another NCAUR scientist, Gary List, collaborating with King, has used a hydrogenation reaction in the presence of carbon dioxide to produce a product with reduced trans fatty

acid content that could be used in margarine formulations.—By **Linda McGraw,** ARS.

This research is part of Food Safety, an ARS National Program (#108) described on the World Wide Web at http://www.nps.ars.usda.gov.

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KEITH WELLER (K9550-3)

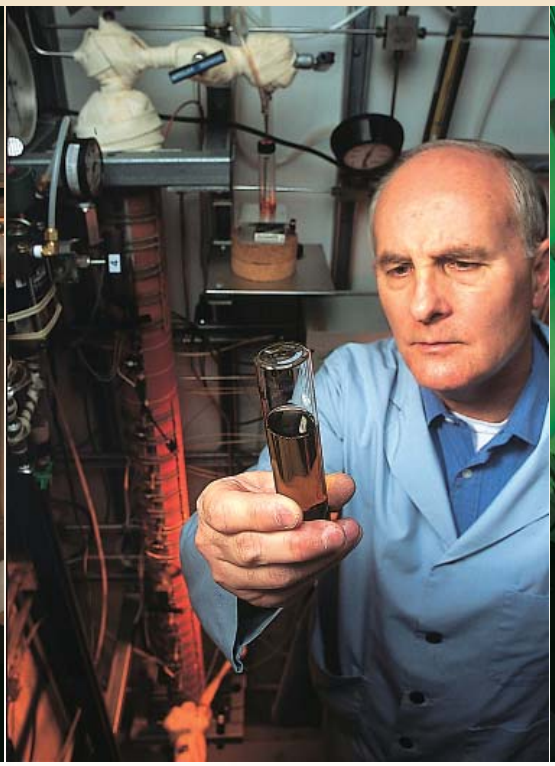
Extracts from oil fractionations performed on rice bran. Each has different properties and nutritive values.

KEITH WELLER (K9552-1)

To produce margarine that is low in trans fatty acids, chemist Gary List uses high-pressure hydrogenation in stirred reactors.

KEITH WELLER (K9549-1)

Chemist Jerry King removes rice bran oil extract from a high-pressure fractionating column. The extract contains an enriched level of phytosterols.



KEITH WELLER (K9551-1)

Supercritical fluid extraction is an environmentally safe method to extract nutraceuticals from brans. Here, chemist Scott Taylor examines corn bran oil processed by SFE.