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Almond Hulls: Harvest Leftover May Offer a Health Connection

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needed, and extensive training is not required, Pan notes.

Before this pasteurization process makes its way into the packinghouse, pilot-scale and in-the-packinghouse testing will be needed to gather the data necessary for federal review and approval. That might take anywhere from 1 to 2 years or more, Pan estimates.

Once that happens, perhaps infrared heating will become tomorrow's top-choice technology for pasteurizing America's almonds.—By **Marcia Wood,** ARS.

This research supports the USDA priority of ensuring food safety and is part of Food Safety (#108) and Quality and Utilization of Agricultural Products (#306), two ARS national programs described at www.nps.ars.usda.gov.

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Sliced almonds add flavor, crunch, and nutrients to this serving of hearty apple-maple oatmeal.

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Cross-section of an almond hull.

Besides yielding about $1 billion worth of healthful, orchard-fresh nuts, California's annual almond harvest also yields tons of leftover hulls. The hull is the tough, outermost layer that helps protect the shell—and the tasty nutmeat inside the shell—against attack by insects and disease.

Early studies by Agricultural Research Service chemist Gary R. Takeoka and colleagues have shown that hulls are a rich source of several interesting natural compounds that may have new applications for human health.

Using an array of sophisticated analytical techniques, including gas chromatography, high-performance liquid chromatography, nuclear magnetic resonance spectroscopy, and mass spectrometry, Takeoka's team provided new details about the identity and quantity of certain chemical compounds contained in the hulls. These included six kinds of acids (betulinic, chlorogenic, cryptochlorogenic, neochlorogenic, oleanolic, and ursolic) and two kinds of lipids (beta-sitosterol and stigmasterol).

Results from biomedical research that scientists elsewhere conducted—with laboratory animals or cell cultures as their research models—indicate that some of these compounds may have potential use in human health. For example, the medical research suggests that some of the chemicals may lower serum cholesterol, fight HIV and certain kinds of cancer, or suppress harmful internal inflammation—the kind associated with arthritis, for instance.

Takeoka's research about the compounds, published in peer-reviewed articles in 2000 and 2003 in the *Journal of Agricultural and Food Chemistry,* has led to commercial interest in the possibility of profitably extracting the chemicals. An international expert in natural products chemistry, Takeoka did the work with coinvestigators at the ARS Western Regional Research Center in Albany, California, near San Francisco. He's in the center's Processed Foods Research Unit.

Today, almond hulls are a low-value harvest leftover typically sold as a cattle-feed ingredient. Tomorrow, the hulls may prove to be a new and perhaps surprising source of health from America's almond orchards.—By **Marcia Wood,** ARS.

This research is part of Quality and Utilization of Agricultural Products, an ARS national program (#306) described at www.nps.ars.usda.gov.

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