

# Cholesterol-Reducing Flavonoids Found in Citrus Peels

**T**he Florida citrus industry is best known for its orange juice—and for good reason. It's the country's top producer, with well over 150 million boxes of oranges processed into juice each year.

But all that processing leaves behind a whole lot of orange-peel waste—like about 700,000 tons of it. Most is sold for livestock feed at little or no profit to processors. So scientists at ARS's Citrus and Subtropical Products Research Laboratory in Winter Haven, Florida, have been looking for new, high-value uses for all that peel.

John A. Manthey, a chemist at the Winter Haven lab, is known for his work on citrus flavonoids in peel byproducts. His work has mainly focused on polymethoxylated flavones, or PMFs, which typically occur at very high concentrations in orange oil, especially in residues left behind after orange-oil processing. Orange-oil residues have traditionally been discarded as nonvalue wastes.

Manthey's research has shown that PMFs decrease blood serum levels of apoprotein B, the structural protein of low-density lipoprotein (LDL), which is the major cholesterol carrier in the blood. If too much LDL cholesterol circulates, it can slowly lead to atherosclerosis, or clogged arteries, and eventually cause heart attacks and strokes. These problems are accelerated by chronic, low-grade inflammation in blood vessels.

Manthey's work on PMFs began 8 years ago, when he met scientists from KGK Synergize of London, Ontario, Canada. KGK specializes in research to identify health-promoting

compounds called "nutraceuticals." Sometimes called "functional foods," nutraceuticals are natural, bioactive chemical compounds with disease-preventing or medicinal properties. They're being commercially produced by food, pharmaceutical, and herbal and dietary supplement industries.

The original collaboration between ARS and KGK Synergize involved studies of anticancer properties of citrus PMFs, but it then expanded into investigations of the compounds' abilities to lower LDL cholesterol in animals.

Subsequent ARS feeding trials with hamsters demonstrated significant cholesterol- and triglyceride-lowering actions of

PMFs: At 1 percent of the diet, PMFs lowered blood plasma levels of LDL, very-low-density lipoprotein (VLDL) cholesterol, and triglycerides by 30-40 percent.

A diet of 0.25 percent PMFs resulted in smaller decreases in LDL and VLDL cholesterol, but decreases in triglycerides were as large as those occurring at higher PMF doses.

These findings are the basis of human trials, currently being conducted by KGK, on the cholesterol-lowering properties of PMFs.

Manthey's previous research also provided evidence of anti-inflammatory actions of PMFs in animals—another mechanism by which the compounds may protect against cardiovascular disease. Products containing cardioprotective PMFs are being developed by some private companies.

Similar studies of cardioprotection have been started by Manthey and postdoctoral researcher Kanjana Mahatannahee on flavonoids and related phenols in select Florida-grown tropical fruits—such as mamey, guava, dragon fruit, and carambola. Scientists have found these to be extremely high in phenolic antioxidants.—By **Alfredo Flores**, ARS.

*This research is part of Quality and Utilization of Agricultural Products, an ARS National Program (#306) described on the World Wide Web at [www.nps.ars.usda.gov](http://www.nps.ars.usda.gov).*

*John A. Manthey is with the USDA-ARS Citrus and Subtropical Products Research Laboratory, 600 Avenue S, N.W., Winter Haven, FL 33881; phone (863) 293-4133, fax (863) 299-8678, e-mail [jmanthey@citrus.usda.gov](mailto:jmanthey@citrus.usda.gov). ★*

SCOTT BAUER (K11953-1)

