

Moms' Low Copper Could Harm Newborns

Researchers at ARS' Grand Forks Human Nutrition Research Center think they have unearthed a link between copper deficiency during pregnancy and neurological defects it causes in the offspring of laboratory animals. Their findings may have implications for people in industrialized nations, says Tom Johnson, who heads cell membrane biochemistry research at the North Dakota center.

An inherited disorder that leads to low copper concentrations in infants' brains severely retards neurological development. While U.S. and other western-type diets contain enough copper to prevent such a serious deficiency, he says, their copper level is still less than desirable. That's because oysters, liver, and whole grains—foods that are not mainstays in the U.S. diet—are among the best sources of copper.

"We don't know how consumption of relatively low-copper, western diets during pregnancy and nursing affects brain development in infants," says Johnson.

The brain has several copper-containing enzymes that would suffer from a shortage of copper, he says. Copper deficiency also reduces the activity of several enzymes that don't contain copper. One of those enzymes is protein kinase C (PKC), as Johnson discovered in earlier experiments with blood platelets. Three forms of PKC show up in the brain just after birth and are involved in development of the nervous system.

So Johnson and his assistants Anne Thomas and Amy Lozano looked at PKC levels in the brains of rat pups whose mothers were fed diets lacking adequate copper throughout pregnancy and for a few weeks after delivery. One group got only 1 microgram (mcg) of copper per gram of diet daily—one-sixth the level recommended for pregnant rats. The second group got 2 mcg per gram of diet, or one-third the recommended level. And a control group got all the copper they needed.

All three forms of PKC increased in all the pups' brains during the 3 weeks after birth, says Johnson. But the increase was half as much in the group whose moms got only 1 mcg of copper per gram of diet.

"We saw a 25 percent drop, even at 2 mcg," he adds, noting that one form of PKC was off by 50 percent in the cerebellum—the part of the brain that controls motor function. That's significant, says Johnson, because a well-known symptom of copper deficiency in baby animals is poor muscle coordination. "These changes in PKC expression occur during a period of increasing complexity in the central nervous system."

The lesson for human mothers is that an adequate copper intake during pregnancy may be critical. The Reference Daily Intake (RDI) is 2 milligrams.—By **Judy McBride**, ARS.

W. Thomas Johnson is at the USDA-ARS Grand Forks Human Nutrition Research Center, P.O. Box 9034, University Station, Grand Forks, ND 58202-9034; phone (701) 795-8411, fax (701) 795-8395, e-mail tjohnson@gfhnrc.ars.usda.gov. ♦



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Bacterial-feeding nematodes, *Operculorhabditis* sp. LKC10, frozen in liquid nitrogen. Magnified about 30x.

Nitao has analyzed these secretions and is isolating the compounds that inhibit hatching. Next, he will test these compounds in the greenhouse to determine their commercial control potential.

In another approach, Chitwood and other ARS scientists are trying to develop new control methods for parasitic nematodes by studying their biochemistry and that of their host plants.

Chitwood is an expert on the biochemistry of the steroids and fats, or lipids, of nematodes. Steroids are important components of nematode membranes and biochemical precursors of their hormones. Lipids are used as food reserves and as communication molecules between and within their cells. Chitwood is working on methods of disrupting the nematode's life cycle by interfering with its steroid and fat biochemistry.

One of the most unusual tactics for attacking nematodes is that of ARS cytologist William P. Wergin. He wants to kill the nematodes using dry ice, which is solid carbon dioxide that has a temperature below -78.5°C. A nonpolluting material, the dry ice can be applied to the soil before planting to lower soil temperature enough to either kill nematodes or reduce their infection and reproduction on plants.

"Results indicate that this treatment reduced by several hundredfold the number of nematode eggs that could be found on mature plant roots," says Wergin. "Although further studies are needed to optimize and economize this procedure, the dry ice treatment may provide some farmers with an environmentally safe and effective means to control certain types of these plant parasites."—By **Hank Becker**, ARS.

This research is part of Methyl Bromide Alternatives, an ARS National Program described on the World Wide Web at <http://www.nps.ars.usda.gov/programs/308s2.htm>.

Scientists mentioned in this story can be reached at the USDA-ARS Nematology Laboratory, Bldg. 011A, 10300 Baltimore Ave, Beltsville, MD 20705-2350; phone (301) 504-5660, fax (301) 504-5589, e-mail dchitwoo@asrr.arsusda.gov wwergin@ggpl.arsusda.gov smeyer@asrr.arsusda.gov jnitao@asrr.arsusda.gov askantar@asrr.arsusda.gov. ♦