Nutrition

Janet Raloff reports from New York City at the New York Academy of Sciences meeting, "Vitamin E: Biochemistry and Health Implications"

Boosting immunity in the elderly . . .

As people age, their ability to fend off disease declines. Working with mice at the Agriculture Department's Human Nutrition Research Center on Aging at Tufts University in Boston, Simin Meydani found that by countering an age-related increase in lipid-peroxide formation, she can also significantly improve several aspects of immune function. Reasoning that the same approach might help people – since their production of toxic lipid peroxides also increases with age – she initiated a human study involving vitamin E supplements. This vitamin can disarm potent oxidizing chemicals produced in the body. Results of Meydani's just-completed, double-blind clinical trial indicate elderly people not only tolerate massive doses of the vitamin but also derive substantial immunity benefits.

In the month-long study, 32 heathy men and women over age 60 moved into resort-like accommodations at her center's metabolic research unit. A pill taken before each breakfast and dinner provided either 400 international units of vitamin E (26 times the recommended daily allowance) or a placebo. Before and after the supplementation, Meydani measured *in vivo* immune response with a skin test, and several *in vitro* indices of immunity – such as the proliferation of lymphocytes (white blood cells useful in fighting infection) and levels of lymphokines (cell-growth-promoting factors produced by white blood cells). Although a few people getting the vitamin supplement did not respond to treatment, most showed notably improved signs of immune function – with increases of 10 to 50 percent in the measured indices – relative to their own pretreatment scores and to those of the placebo group.

While cautioning that her study was small and brief, Meydani says, "Certainly the data suggest that it might be possible to improve the immune response of the elderly with vitamin E supplementation." These findings are "very significant," says conference organizer William A. Pryor of Louisiana State University in Baton Rouge, because until now there have been no strong data indicating that healthy individuals on normal diets could benefit from vitamin E supplements.

. . . and in farm animals

Recognition of vitamin E's immunity-enhancing effects in animals has grown steadily over the past 20 years. Robert P. Tengerdy of Colorado State University in Fort Collins, a pioneer in this field, finds that "administration of vitamin E in rather large doses – six or more times that normally available in [farm animals'] diets – helps to prevent the incidence of infectious disease in animals, especially bacterial infections." In chickens infected with *Escherichia coli,* for example, he reduced mortality from 80 percent to 25 percent – just by raising them on a diet with six times the usual level of vitamin E.

New data also confirm a long-suspected notion – that dietary fat can affect the body's use of vitamin E. Researchers have suspected that diets high in unsaturated fats, which are extremely susceptible to oxidation, may increase one's need for this vitamin – a scavenger of oxygen radicals. Tengerdy's data now show that dietary fats also interact synergistically with vitamin E to bolster immunity. In chickens, vitamin E supplements suppressed the production of prostaglandins, increasing the chickens' ability to produce antibodies. This valuable drop in prostaglandin synthesis was roughly 30 percent in animals whose fat was the unsaturated safflower oil, and nearly 50 percent when it was beef tallow, a saturated fat.

But Tengerdy believes his most significant finding is new evidence showing that adding a megadose of vitamin E to conventionally administered vaccines can safely and dramatically enhance their potency. He points, for example, to early findings of an ongoing trial in Peru. There, sheep are routinely vaccinated against *Brucella ovis* – a bacterium responsible for testicular degeneration. Sixty percent of unvaccinated rams will die or become infertile from the disease, which is epidemic in the area. While the best available vaccine reduces losses to 40 percent, adding 1,000 international units of vitamin E to the vaccine decreases losses among exposed rams to just 22 percent, Tengerdy reports. He believes this may prove a way to boost the effectiveness of vaccines in people, such as the elderly, with compromised immune systems.

Help for stressed-out pigs – and smokers

One problem plaguing European hog producers far more than their American counterparts is a lethal susceptibility to stress – in their pigs, that is. Affected animals, thought to have a genetic weakness, succumb whenever they get excited – in crowded feedlots, in transit to market, even in the throes of mating. The condition, which costs European farmers an estimated $560 million annually, can affect up to 90 percent of the pigs in West Germany and Belgium, according to zoologist Garry G. Duthie at the Rowett Research Institute in Aberdeen, Scotland. Duthie's work now indicates that these stress attacks – characterized by a rapid heartbeat, hyperventilation, localized areas of bluishness on the skin and an ultimately fatal 1°C increase every five minutes in body temperature – result from an unusual sensitivity to oxidative reactions.

His first clue was the seemingly promising treatment European pig farmers happened onto: dietary supplements of the premier antioxidant, vitamin E. Though the pigs he studied displayed classic symptoms of severe vitamin E deficiency, the condition developed even after they consumed normal dietary levels of the vitamin and incorporated normal levels in their tissues, Duthie found.

His new research suggests the problem is in the animals' cell membranes. In affected pigs, he reports, those membranes are more susceptible to "free radicals" – reactive molecular fragments containing one or more unpaired electrons. These radicals can initiate damaging oxidative reactions.

Pigs receiving massive doses of vitamin E (235 international units per kilogram of food) incorporated it into blood plasma and muscle, Duthie found. However, only those with the stress-death susceptibility responded by leaking less pyruvate kinase and creatine kinase from their muscles into blood plasma. Blood levels of these enzymes – an indicator of cell-membrane leakiness – are one gauge of tissue damage from oxidative reactions. Duthie also found lower levels of three other key indicators of oxidative activity in vitamin-E-supplemented, stress-susceptible pigs – plasma malonaldehyde, peroxidized red blood cells and pentane.

As a further measure of the animals' susceptibility to oxidative damage, Duthie incubated samples of red blood cells with hydrogen peroxide – a chemical that exposes the cells to oxygen radicals. The blood cells from stress-susceptible pigs showed 5.5 times more oxidation than those from stress-resistant pigs – or stress-tolerant animals fed massive vitamin E supplements.

In a related pilot study, Duthie applied the same test to gauge the oxidative potential of red blood cells from 40 men: 20 smokers – who regularly subject their bodies to a large, oxidative burden – and 20 age-matched nonsmokers. For two weeks before the test, each man took either 1,000 international units of vitamin E daily or a placebo pill. Blood cells from unsupplemented smokers oxidized three times more than those of nonsmokers or vitamin-E-supplemented smokers.

Duthie and his co-workers say such data hint that by reducing oxidative damage in smokers, prolonged vitamin E supplementation might "decrease the risk of developing diseases such as coronary heart disease and cancer."