# How fish oil fights inflammation

Omega-3 fatty acids, such as those found in fish oils, are known to be effective in treating conditions associated with insulin resistance and chronic inflammation, such as diabetes. Now, thanks to new research from Jerrold Olefsky of the University of California, San Diego School of Medicine and colleagues, the mechanisms underlying these anti-inflammatory properties is somewhat better understood. Their results could lead to the development of a dietary supplement to treat the inflammation that characterizes obesity and other conditions.

Inflammation is part of the body's immune response to perceived threats. It is caused by cytokines secreted by specialized white blood cells called macrophages. Obese fat tissue contains numerous macrophages, producing relatively large quantities of cytokines. Overexposure to cytokines may cause chronic inflammation and insulin resistance in neighboring cells. In insulin resistance, insulin loses its effectiveness at controlling the level of blood sugar in the body; this can create various health problems, including type 2 diabetes mellitus.

Brian Jackson

Olefsky and his group identified a key receptor expressed by macrophages in obese body fat. This receptor, called GPR120, has inflammatory effects when it is turned off. But when it is exposed to omega-3 fatty acids, it becomes activated and has strong anti-inflammatory effects (*Cell* **142**, 687–698; 2010). "It's just an incredibly potent effect. The omega-3 fatty acids switch on the receptor, killing the inflammatory response," stated Olefsky in a press release.

The researchers studied the effects of the omega-3 fatty acids docosahexaenoic acid and eicosapentaenoic acid (the main ingredients in fish oil) on inflammation and insulin resistance in wild-type mice and in mice genetically engineered to lack the GPR120 receptor. All of the mice were fed a high-fat diet, and some of each genotype were given omega-3 fatty acid supplements. Both wild-type and GPR120-knockout mice became obese when fed the high-fat diet. The fatty acid supplements inhibited inflammation and enhanced insulin sensitivity in wild-type obese mice but not in GPR120-knockout mice.

Olefsky noted that the study's result "…suggests a possible way to treating the serious problems of inflammation in obesity and in conditions like diabetes, cancer and cardiovascular disease through simple dietary supplementation." Further research will be needed to identify a safe, effective dose. Consumption of large quantities of fish oil has been linked to increased risk of bleeding and stroke in some people. Furthermore, it is not known whether dietary supplements or fatty fish supply enough omega-3 fatty acids to activate GPR120.

**Monica Harrington**

## MICRONEEDLES OFFER VACCINATION ALTERNATIVE

In an effort to simplify influenza vaccine administration and improve vaccine immunogenicity, Mark Prausnitz of the Georgia Institute of Technology in Atlanta and colleagues have developed polymer microneedle patches containing inactivated influenza virus. Results from a study in mice suggest that similar dissolving patches could be used for safer and simpler vaccination in humans and could help increase vaccine uptake rates (*Nat. Med.* **16**, 915–920; 2010).

The research team designed polymer microneedle patches so that the devices would encapsulate the influenza virus without disrupting its antigenicity, would insert into the skin and would rapidly dissolve into safe products. Each patch encapsulates 3 µg of inactivated flu virus and consists of an array of needles that are just hundreds of micrometers in length.

The researchers administered a single, 6-µg dose of inactivated flu virus vaccine to 11 female mice using microneedle patches and to 11 female mice using intramuscular immunization. To intradermally administer the 6-µg dose to a mouse, the researchers applied two microneedle patches to the mouse's skin for 15 minutes and then removed the patches. A month later, the researchers exposed six mice from each group to a lethal dose of flu. All of the mice that had received the vaccine through either the patches or intramuscular injection lost less than 5% of their body weight and survived this challenge dose. A group of six mice that had not received vaccination lost more than 25% of their body weight within a week of the challenge.

Three months after immunization, the research team exposed mice to flu particles, allowing the animals to inhale the flu particles. Four days after this exposure, the mice that had received the microneedle vaccination had cleared about 1,000 times more viral particles from their lungs than had the mice that had received intramuscular vaccination. These results highlight the potential benefits of immunizations that target the skin, which is an active immune organ with ample antigen-presenting cells.

In their paper, Prausnitz and colleagues note that "the effectiveness of influenza vaccination is limited by the quality and breadth of the immune response and the time required for vaccine delivery." Additionally, some people are afraid of the needles used to administer vaccines intramuscularly, and intramuscular injections create biohazardous waste, the authors note. The research team concludes that these microneedle patches provide an alternative tool for flu vaccine administration that is simpler and safer and results in higher immunogenicity.

**Kirsten Dorans**