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## Farmed Salmon: Caught in a Numbers Game

In the January 9, 2004, issue of *Science*, researchers reported that farm-raised salmon contain what they called “significantly higher” levels of PCBs and organochlorine pesticides than wild salmon, and one of the authors stated on CBS-TV that “One should eat no more than one farmed salmon meal per month to avoid an increase of cancer.”

While scary pronouncements and press releases surrounding this popular and affordable food may cause some consumers to avoid farmed salmon, would the public be healthier if they followed this recommendation? I say no, for the following reasons.

In the United States, polychlorinated biphenyls were manufactured until the late 1970s for use in many electronic components. PCBs enter the environment and bioaccumulate up the food chain as a result of their persistence and lipophilic properties. The primary route of entry is the diet. Due in great part to environmental cleanup efforts and the cessation of their manufacture, levels of PCBs and banned organochlorine pesticides have declined by 90% in recent decades.

The Food and Drug Administration, which regulates fish entering interstate commerce, established a tolerance for PCB of 2,000 ppb. The average concentration of PCB reported in the *Science* study was 37 ppb in farmed salmon, compared to 5 ppb in wild salmon, both levels considerably below the FDA limit and thus very safe to eat.

The Environmental Protection Agency provides guidance procedures for states and tribes wishing to create fish consumption advisories to protect those who consume fish caught recreationally. EPA has established a Reference Dose (RfD) for PCB that is considered to be the safe limit of exposure and uses cancer as the endpoint. Applying this RfD to the *Science* study, a person consuming 8 oz of farmed salmon every week for 70 years might increase his or her risk by 0.001–0.004%. Yet the researchers did not measure the benefits of eating salmon, which could improve our health substantially.

Further compounding the confusion caused by the study's message, the World Health Organization recommends an approach based on 12 PCB congeners, six dioxin congeners, and 10 furan congeners that all share a common mechanism of action. These dioxins and dioxin-like compounds have been assigned a Toxicity Equivalent Factor (TEF) based on their ability to bind an Ah Receptor. To determine if a fish sample exceeds safe limits, each of the congeners is measured in raw tissue and multiplied by its respective TEF. These values are then summed to generate the Toxicity Equivalent Quotient (TEQ), and subsequently compared to the Tolerable Daily Intake (TDI) or Tolerable Weekly Intake (TWI). The recommended TDI is 1–4 picograms TEQ/kg body

weight/day. In the *Science* study, the TDI for farmed salmon ranged from 0.48 to 2.7 pg TEQ/60 kg body weight/day, which is within the recommended range.

So unavoidable contaminants in all salmon—farmed and wild—are within the established guidelines of FDA, EPA, and WHO. They are safe, and they are healthful.

Overlooked or ignored in the *Science* study is the fact that the farmed salmon most often consumed in the U.S. is from Chile (56%) and Canada (31%). Contaminants in fish studied from North and South America were significantly lower than in salmon from Europe, which supplies only 7% of U.S. farmed salmon. And still, most scientists—other than those who authored the *Science* study, presumably—would agree that farmed salmon from Europe is equally safe as fish from other locations.

Finally, here are the health benefits from eating salmon, farmed and wild: Salmon contains 25% protein. A 3.5-oz portion provides 90% of the Daily Value of vitamin D. Salmon

provides the antioxidant carotenoid astaxanthin and the beneficial omega-3 fatty acids eicosapentaenoic acid (C20:5) and docosahexaenoic acid (C22:6). These long-chain fatty acids are important for brain and retinal development early in life. They also protect the heart by preventing arrhythmia, decreasing platelet aggregation, decreasing plasma triacylglycerol concentration, decreasing blood pressure, reducing atherosclerosis, increasing slightly HDL cholesterol, modulating endothelial function, and decreasing pro-inflammatory eicosanoids. An 8-oz (227-g) serving provides five times the effective Adequate Intake (0.14 and 0.13 g/day, respectively) of C20:5 and C22:6 for pregnant or lactating women.

The American Heart Association recommends that healthy individuals consume two 2- to 3-oz servings of fatty fish/week and that persons diagnosed with cardiovascular disease consume 1 g of C20:5 and C22:6/day. AHA reports that 250,000 deaths occur each year due to sudden cardiac death. Increasing salmon intake to improve health and reduce sudden cardiac death mortalities far outweighs the appreciably lower risks posed by environmental pollutants.

With such a low risk from consuming farmed salmon, it is prudent that all individuals, including pregnant and nursing women, consume salmon or other low-contaminant fish frequently, at a rate of 8 oz/week. ●

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