Available online at www.sciencedirect.com

ScienceDirect

Procedia Food Science 6 (2016) 47 – 50

Procedia Food Science

International Conference of Sabaragamuwa University of Sri Lanka 2015 (ICSUSL 2015)

Which fish to eat: enjoying the benefits while minimizing the risks

Jogeir Toppe

Products sales and marketing service, FAO fisheries and aquaculture department, Rome, Italy

Peer-review under responsibility of International Conference of Sabaragamuwa University of Sri Lanka 2015 (ICSUSL 2015).

Keywords:

* Corresponding author.
E-mail address: jogeir.Toppe@fao.org

1. The issue

While the consumption of seafood has well-established nutritional and health benefits, some fish species can be harmful when they accumulate contaminants. The question is how to maximize the positive consequences of seafood consumption while minimizing the concurrent negative consequences.

The risks of consuming potentially contaminated foods have traditionally received greater attention than the benefits of eating them. However, there is now a growing focus on the risks of *not* consuming certain foods, and among them fish products, given their potential beneficial components. Nutritional benefits derive not only from the long-chain polyunsaturated fatty acids (LCPUFAs) – docosahexaenoic acid (DHA)and eicosapentaenoic acid (EPA) – but also from amino acids, micronutrients (vitamins, minerals) and possibly from other nutrients (e.g. taurine), all found in fish.

The fact that fish consumption helps prevent coronary heart disease (CHD) has been well known for some time. There is now an increasing focus on fish as a source of DHA and iodine, which are essential for the early development of the brain and neural system. These nutrients are almost exclusively found in foods from the aquatic environment. The role of fish in mitigating mental disorders, such as depression and dementia, is also receiving increased attention from scientists.

However, the presence of contaminants in some fish and fish products and other foods is of increasing concern to consumers. Some fish products are known to contain contaminants such as methyl mercury (mercury in its most

Peer-review under responsibility of International Conference of Sabaragamuwa University of Sri Lanka 2015 (ICSUSL 2015).
doi:10.1016/j.profoo.2016.02.009

toxic form) and dioxins (alldioxin-like compounds).

In general, it is believed that the levels of such contaminants in seafood are well below the maximum levels established for their safe intake. Nevertheless, in fish caught in polluted waters or in large, long-lived predator species, the levels of contaminants might exceed the levels regarded as safe for consumption.

It is well known that ingested mercury might have a negative impact on the development of the neural system of children and that some fish species can be the main source of mercury in many diets. Fish can also be a source of dioxins in populations that consume fish frequently. However, the occurrence of dioxins among individuals in these populations is generally not higher than in populations having low fish consumption.[1] Therefore, reducing the consumption of fish might reduce the exposure to mercury in human diets, but the exposure to dioxins will probably be the same for individuals even if they significantly reduce their consumption of fish.

When consumption of a food can be associated with both potential health risks and benefits, risk managers try to identify an intake level that minimizes risks and maximizes benefits. It is particularly important to establish such levels when consumption levels are close to levels that should not be exceeded.[2]

Advice on limiting the consumption of fish for vulnerable groups, such as children and pregnant women, is being given by many public health authorities. While the intention is only to limit consumption of products believed to have elevated levels of contaminants, the effect in some cases has been a significant reduction in seafood consumption. However, a reduction in seafood consumption could result in a diet that might not ensure an optimal intake of essential nutrients. Both children and adults run this risk. As LCPUFAs are essential in the early development of the brain and neural system in children, advice aiming to limit the consumption of contaminated fish must be couched in such terms that not all fish is given a “bad name”. Similarly, as sea food consumption reduces cardiovascular diseases among the adult population, messages intended to reduce the exposure of fish products to contaminants should go hand in hand with the promotion of safe fish products.

2. Possible solutions

Most informed observers would probably agree that the solution to this issue consists of sound, science-based advice that weighs the benefits and costs for human health of consuming fish. Although much work has been done in this field, the subject is not exhausted and conclusions reached to date have not obtained universal endorsement. Addressing this issue is a complex and resource-demanding scientific task that includes: (i) an assessment of the health risks associated with the consumption of fish and other seafood; (ii) an assessment of the health benefits associated with the consumption of fish and other seafood; and (iii) a subsequent comparison of the health risks and health benefits.

Some studies have tried to balance the positive and negative sides of consuming foods of high nutritional value but that are also a source of contaminants. However, to date, the procedures used have been controversial, and experts in this field maintain that new procedures need to be developed in order to carry out quantitative selected issues in fisheries and aquaculture assessments of the risks and benefits to human health of consuming fish and other seafood.[3] Once the methodology has been developed, the required data will need to be obtained. The new procedures should make it possible to compare nutritional benefits with the possibility of adverse effects while accounting for the uncertainties –this should be possible for all groups in the population. In addition, scientists should be able to make quantitative comparisons of the human health risks and benefits of seafood consumption.

3. Recent actions

In order to assist governments in giving advice to vulnerable population groups on the potential risks and benefits of consuming fish and seafood, the Codex Alimentarius Commission requested FAO and the WHO to hold an expert consultation on health risks associated with mercury and dioxins in fish and the health benefits of fish consumption. The Expert Consultation on the Risks and Benefits of Fish Consumption was held from 25 to 29 January 2010 at FAO Headquarters, Rome, Italy.[4] Seventeen experts’ innutrition, toxicology and risk-benefit assessment discussed the risks and benefits of fish consumption. The experts agreed that consumption of fish provides energy, protein and a range of essential nutrients, and that eating fish is part of the cultural traditions of many peoples. In some populations, fish and fishery products are a major source of food and essential nutrients, and there may be no alternative and affordable food sources for these nutrients.

Among the general adult population, consumption of fish, and in particular oilyfish, lowers the risk of CHD mortality. There is an absence of probable, or convincing, evidence of mercury causing CHD. Although there is a risk that dioxins may cause cancer, the risk is comparatively small and seems to be outweighed by reduced CHD mortality for those who eat fish. Weighing the benefits of LCPUFAs against the risks of mercury for women of childbearing age, it is established that, in most circumstances, fish in the diet lowers the risk of women giving birth to children with suboptimal development of the brain and neural system compared with women not eating fish.

At levels of maternal dioxin intake (from fish and other dietary sources) that do not exceed the established long-term tolerable intakes of dioxins, the risk of suboptimal neural development is negligible. [5] If the maternal dioxin intake (from fish and other dietary sources) exceeds the established long-term tolerable intakes of dioxins, this risk may no longer be negligible. Among infants, young children and adolescents, evidence is insufficient to derive a quantitative framework of health risks and benefits. However, healthy dietary patterns that include fish established early in life influence dietary habits and health during adult life.

To minimize risks in target populations, the Expert Consultation recommended that states should acknowledge that fish is an important food source containing energy, protein and a range of essential nutrients as well as being part of the cultural traditions of many peoples. States should therefore emphasize: (i) that fish consumption reduces CHD mortality in the adult population; and (ii) that fish consumption improves then euro development of foetuses and infants and is therefore important for women of childbearing age, pregnant women and nursing mothers. In order to provide sound advice to different population groups, it will also be important to develop, maintain and/or improve regional databases of the specific nutrients and contaminants in the fish available for consumption. Risk management and communication strategies that aim to minimize risks and maximize benefits from eating fish should be developed and evaluated.

4. Future perspectives

4.1. Mental illness

Mental illness and depression are increasing globally. Some experts predict that they will become a major burden in terms of global health, especially in the developed world.[5] In 2004, mental health overtook heart disease as the leading health problem in104 The State of World Fisheries and Aquaculture 2010Europe and was estimated to cost €386 billion a year.[6] More recent studies suggest that consumption of seafood and in particular long-chain n-3 polyunsaturated fatty acids (LC n-3 PUFAs) may also have a positive impact on dementia[7] and Alzheimer's disease, with the most promising evidence for the benefits on mood and depression.[8] However, such benefits should be considered as emerging, as they are not as well established as reductions in CHD deaths and improved early neurodevelopment.

4.2. Sustainability and alternative sources of LC n-3 PUFAs

Although there is no association between resource sustainability and health, the issue of sustainability must be considered if proven health benefits lead to greatly increased demand for seafood. With the known wide range of benefits from seafood consumption, it is pertinent to consider whether increased production is possible. For the last 20 years, global landings from capture fisheries have been stagnant at around89–93 million tonnes. Even with the widespread failure to manage fishery resources properly, which has resulted in a situation where some 28 percent of stocks are overexploited, there is general scientific agreement that significantly more cannot be produced from wild fish populations.

However, total global fish production has continued to rise, amounting to about 142 million tonnes in 2008.[9] the balance is made up by production from aquaculture, which now amounts to 52.5 million tonnes, accounting for almost 46 percent of all fish for human consumption.

Global fish consumption has gradually increased, regardless of the increasing world population, and stood at 17.0 kg of fish (live weight equivalent) per capita per year in 2008. A widespread recognition of the benefits of seafood consumption would inevitably lead to additional demand. If the recommendations of authorities in the United Kingdom of two meals of 140 g of fish per week[10] were followed, then annual per capita consumption would have to rise to 23.3 kg. This translates into an additional production of 40 million tonnes for 2008, rising to 82 million

tonnes in 2050.

Aquaculturists are optimistic that far more fish can be produced, but there are issues of nutritional quality using land-based feeds. It would be necessary to incorporate LC n-3 PUFAs into the feeds. Intensive research is required on how this could be achieved, including on production from hydrocarbons by yeast fermentation, extraction from algal sources[11] and/or genetic modification of plants to become LC n-3PUFA producers. However, for now and probably for the new decade, the source of LCn-3 PUFAs will remain marine capture fisheries.

References

1. T. Sasamoto, F. Ushio, N. Kikutani, Y. Saitoh, Y. Yamaki, T. Hashimoto, S. Horii, J. Nakagawa and A. Ibe. 2006. Estimation of 1999–2004 dietary daily intake of PCDDs, PCDFs and dioxin-like PCBs by a total diet study in metropolitan Tokyo, Japan. *Chemosphere*, 64(4): 634–641.
   A. Mazet, G. Keck and P. Berny. 2005. Concentrations of PCBs, organo chlorine pesticides and heavy metals (lead, cadmium, and copper) in fish from the Drômeriver: potential effects on otters (*Lutralutra*). *Chemosphere*, 61(6): 810–816.
2. European Food Safety Authority. 2007. *Risk-benefit analysis of foods: methods and approaches. Summary Report EFSA Scientific Colloquium 6, 13–14 July 2006 –Tabiano (Province of Parma), Italy*. Parma, Italy.
3. European Food Safety Authority. 2007. *Risk-benefit analysis of foods: methods and approaches. Summary Report EFSA Scientific Colloquium 6, 13–14 July 2006 –Tabiano (Province of Parma), Italy*. Parma, Italy.
4. FAO and World Health Organization. *Joint FAO/WHO Expert Consultation on the Risks and Benefits of Fish Consumption, Executive Summary, 25–29 January2010, Rome, Italy* (available at ftp://ftp.fao.org/FI/DOCUMENT/risk_consumption/executive_summary.pdf).
5. J.R. Hibbeln and J.M. Davis. Considerations regarding neuro psychiatric nutritional requirements for intakes of omega-3 highly unsaturated fatty acids. *Prostaglandins, Leukotrienes and Essential Fatty Acids*, 2009. 81(2): 179–186.
6. P. Andlin-Sobocki, B. Jönsson, H.-U. Wittchen and J. Olesen. Costs of disorders of the brain in Europe. *European Journal of Neurology*, 2005. 12(Suppl. 1): 1–27.
7. M.C. Morris, D.A. Evans, C.C. Tangney, J.L. Bienias and R.S. Wilson. Fish consumption and cognitive decline with age in a large community study. *Archives of Neurology*, 2005.62(12): 1849–1853.
8. M. Peet and C. Stokes. Omega-3 fatty acids in the treatment of psychiatric disorders. *Drugs*, 2005. 65(8): 1051–1059.G. Young and J. Conquer. Omega-3 fatty acids and neuropsychiatric disorders. *Reproduction Nutrition Development*, 2005. 45(1): 1–28.
9. FAO. 2009. FAOSTAT statistical database. Rome (available at faostat.fao.org/).
10. Scientific Advisory Committee on Nutrition and Committee on Toxicity. 2004. *Advice on fish consumption: benefits and risks*. Norwich, UK, The Stationery Office.
11. T.M. Mata, A.A. Martins and N.S. Caetano. Microalgae for bio diesel production and other applications: a review. *Renewable and Sustainable Energy Reviews*, 2010. 14: 217–232.
    M. Plaza, M. Herrero, A. Cifuentes and E. Ibáñez. Innovative natural functional ingredients from microalgae. *Journal of Agricultural and Food Chemistry*, 2009. 57(16): 7159–7170.