Journal of
Dairy & Veterinary Sciences
ISSN: 2573-2196

Mini Review
Volume 5 Issue 1 - January 2018
DOI: 10.19080/JDVS.2018.05.555651

Dairy and Vet Sci J

Mini Review and Prospective: Using Organic Selenium-Strengthened Salt in Fish Processing to Mitigate the Toxicity of Residual Mercury

Dehong Tan*

Shenyang Agricultural University, China

Submission: November 16, 2017; **Published:** January 16, 2018

***Corresponding author:** Dehong Tan, College of Food, Shenyang Agricultural University, China, Tel: 8624-88487671; Email: tandehongsy@126.com

Abstract

This paper reviews the toxic issue of Hg residue in fish and discusses the possibility of applying selenium strengthened salt in fish process to solve the problem. Selenium is a natural antagonist to Hg, However, daily selenium supplementation for dealing fish Hg is not improper due to the possible side effects of excessive intake. It may be feasible to use less toxic organic selenium strengthened salt instead of common salt in fish processing, which may avoid of excessive intake of selenium, and reduce toxicity by changes of mercury chemical forms and bioavailability. This paper reviews the toxic issue of Hg residue in fish, and discusses the possibility of applying selenium strengthened salt in fish process to solve the problem of Mercury (Hg) residue, which is an important food safety issue.

Keywords: Heavy metal; Aquatic food; Neurotoxicity; Minamata disease

Mercury Residue in Fish is an Important Food Safety Problem

Mercury is an important global pollutant, prioritized by many international organizations for its persistence in the environment, bioaccumulation and toxicity in the food chain, especially in aquatic products. The toxicity of Hg was known since 1940s, first, deadly Hunter-Russell syndrome and then a public health disaster of Minamata Disease in Japan were reported, followed by reports from Iraq other areas. It has been estimated that annual worldwide emissions of mercury into the atmosphere at 2,200 metric tons. One-third of these emissions originate from natural sources (volcanic eruptions and decay of mercury-containing sediment), while two-thirds from man-made sources [1]. The issue of Hg gets sustained concern, in the past August 16, 2017; the "United Nations Convention on the Minamata of Hg" has entered into force worldwide, with the aim of controlling and reducing global Hg emissions.

Much of this discharged Hg settles in water, and fish is polluted. Hg exists in three basic states: elemental Hg or Hg vapor, inorganic Hg, and organic Hg. in water, elemental and inorganic Hg is converted by microorganisms into organic Hg, in which Hg is bonded to a structure containing carbon atoms (methyl, ethyl, phenyl, or similar groups), organic Hg is easily dissolved in water, it is ingested by smaller creatures, and eventually consumed by larger fish. Fish at the top of the food chain may concentrate considerable Hg in their tissues even in water with very low levels of methyl Hg [2]. Aquatic products as major organic Hg source get great attention. In the U.S, there are currently 1,782 advisories (one per body of water) issued by the U.S. Environmental Protection Agency (EPA) in 41 states in the United States restricting the consumption of any locally caught fish or shellfish due to their Hg content [2]. Food and Drug Administration (FDA), presented data warning of the consequences for fetuses of women who follow the current FDA's fish consumption advisory and eat 12 ounces of "safe" fish per week. There is no ideal method to solve the problem of Hg residues in fish.

Toxicological Mechanism of Hg and Detoxifying Effect of Selenium

Although the mechanism of Hg toxicity is still unclear, most studies agree that Hg firmly binds to thiol (-SH) and seleno (-SeH) containing macromolecules, the binding controls the movement of Hg and disrupts the biological function of various important molecules, chiefly, it unbalances the redox state, leads to free radicals overproduction, mitochondrial damage, apoptosis, finally, neuro degeneration and many other diseases [3,4]. In this sense, the exogenous addition of sulphides and selenides would be protective, and some sulphides and selenides were investigated for this purpose. In fact, the drugs currently treating Hg poisoning are mainly sulfur-containing compounds possessing metal chelation property, however, drug treatment is effective only when Hg poisoning is caused by a large amount of Hg in the short term, and has no clear effect on the chronic toxicity caused by a small quantity of Hg exceeding the general food. We found that hydrogen sulfide donor sodium hydride has a certain effect on chronic Hg toxicity in experimental animals, but there are still problems in its application to human.

Selenium and sulfur both are VIA elements, and the binding ability of selenium and Hg is stronger than that of sulfur and Hg (the complexing constants are 1045 and 1039 respectively). Selenium appears in various forms such as selenite, selenate, selenomethionine, and selenocysteine, it forms part of several important enzymes such as glutathione peroxidase and thioredoxin reductase [5]. Selenium is a natural antagonist to Hg, which was first shown experimentally by Parizek and Ostadalova in 1967 [6], later a positive correlation between Hg and Se has been commonly reported. She has been proposed to sequentially bind to Hg and selenoprotein P in the bloodstream, to form a non-toxic complex, and the formation of Hg-Se complex with selenoprotein P causes redistribution of Hg in the organism or reduces the absorption of Hg [7,8].

Selenium is an essential trace element for living organisms, the recommended intake dose is 50μg/d for people over 18 years of age, selenium deficiency in human will lead to the occurrence of various diseases such as cardio-cerebro vascular disease, liver disease, diabetes and tumor, the deadly Keshan disease which occurs in China is related to selenium deficiency. In China, nutrition intervention project with sodium selenite and iodine-strengthed salt for the population living in selenium deficiency area has been in the history of more than 30 years, which improves the selenium nutrition status of the population in the coverage area as a whole. However, due to the toxicity of inorganic sodium selenite, the project has been banned since 2012. The safety of organic selenium relative to inorganic selenium is good, at present, organic selenium fortified salt products and some other selenium supplements on the market, such as selenium-amino acids, selenium-enriched eggs, selenium-enriched vegetables, and so on, the effects of these products need to be further evaluated.

Due to the possible side effects of daily selenium supplementation, which may be manifested after ingestion only slightly higher than those nutritionally required [9]. Selenium is not currently used in the treatment of heavy metal intoxication.

Prospective: Using Organic Selenium Strengthened Salt in Fish Processing

Most fish processes including canned, pickled and cooking need salt, it may be feasible to use organic selenium strengthened salt instead of common salt in fish processing for reducing toxicity of Hg residue. First, selenium in processed fish may have good safety. Since organic selenium is less toxic, salt ingested is self-limiting and people do not eat fish every day, people are excluded from health problems of excessive intake of selenium.

Second, selenium in processed fish may reduce toxicity of Hg residue both before and after fish is ingested. The selenium in fish not only plays the role of the nutrition after being ingested, but also the direct reaction of selenium with residual Hg in fish may lead to the change of Hg chemical forms, bioavailability and neurotoxicity of Hg.

Conclusion

It may be feasible for using organic selenium-strengthened salt in fish processing to mitigate the toxicity of residual mercury, which needs further experimental data to support.

References

1. Patrick L (2002) Mercury toxicity and antioxidants: Part 1: role of glutathione and alpha-lipoic acid in the treatment of mercury toxicity. Altern Med Rev 7(6): 456-471.
2. Bernhoft RA (2012) Mercury Toxicity and Treatment: A Review of the Literature. J Environ Public Health (4096): 460508.
3. Carocci A, Rovito N, Sinicropi MS, Genchi G (2014) Mercury Toxicity and Neurodegenerative Effects. Rev Environ Contam Toxicol 229: 1-18.
4. Han J, Yang X, Chen X, Li Z, Fang M, et al. (2017) Hydrogen sulfide may attenuate methylmercury-induced neurotoxicity via mitochondrial preservation. Chem Biol Interact 263: 66-73.
5. Schrauzer GN (2000) Selenomethionine: a review of its nutritional significance, metabolism and toxicity. J Nutr 130(7): 1653-1656.
6. Pařízek, J, Ošťádalová I (1967) The protective effect of small amounts of selenite in sublimate intoxication. Experientia 23(2): 142-143.
7. Suzuki KT, Sasakura C, Yoneda S (1998) Binding sites for the (Hg-Se) complex on selenoprotein P. Biochim Biophys Acta 1429(1): 102-112.
8. Dan-Yi Y, Yu-Wei C, John M, Gunn, Nelson B (2008) Selenium and mercury in organisms: Interactions and mechanisms. Environmental Reviews 16(NA): 71-92.
9. Agarwal R, Behari JR (2007) Effect of Selenium Pretreatment in Chronic Mercury Intoxication in Rats. Bull Environ Contam Toxicol 79(3): 306-310.

How to cite this article : Dehong Tan. Mini Review and Prospective: Using Organic Selenium-Strengthened Salt in Fish Processing to Mitigate the Toxicity of Residual Mercury. Dairy and Vet Sci J. 2018; 5(1): 555651. DOI: 10.19080/JDVS.2018.05.555651.

DOI: 10.19080/JDVS.2018.05.555651

How to cite this article: Dehong Tan. Mini Review and Prospective: Using Organic Selenium-Strengthened Salt in Fish Processing to Mitigate the Toxicity of Residual Mercury. Dairy and Vet Sci J. 2018; 5(1): 555651. DOI: 10.19080/JDVS.2018.05.555651.