Conflict of nutritional benefits vs. biochemical toxicity of skipjack tuna (*Katsuwonus pelamis*) in Sri Lanka

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Abstract

The present study was carried out to assess the health benefits vs. risks of consuming commercially important fish skipjack tuna (*Katsuwonus pelamis*) in Sri Lanka. Skipjack tuna samples (n=44) collected from fish landing sites around Sri Lanka were analysed for proximate composition by AOAC, 2000 standard methods: Fatty acids composition, histamine and trace metal concentrations were analysed by Gas Chromatography, High Performance Liquid Chromatography and Atomic Absorption Spectroscopy, respectively. All the nutrients were assessed in terms of benefits, referring to their respective Recommended Dietary Allowance (RDA) values whereas the toxicity of each trace metal was assessed by the stipulated Provisional Tolerable Weekly Intake (PTWI) with the Probable Weekly Intake (PWI) values. Histamine levels were compared with the recommended European Union and Sri Lankan regulations. The results demonstrate that skipjack tuna is a good source of nutrients, and that it comprises of 24.13±2.01% crude protein and 0.41±0.56% crude fat. From the total fatty acids content, 49.4% were Poly Unsaturated Fatty Acids (PUFAs) of which ω-3 was found to be 41.67%. Skipjack tuna is rich in essential trace minerals; Fe, Zn and Cu, with the mean values of 24.05±4.81, 6.89±3.42, 5.04±7.35 mg kg^{-1}, respectively. In addition, skipjack tuna does not pose any health risks due to trace metal toxicity, since all the PWI values (0.0025 Hg, 0.0003 Cd, 0.0001 Pb and 0.0180 As in mg/kg of bw/week) were well below the PTWI values (0.275 Hg, 0.385 Cd, 1.375 Pb and 0.825 in mg/kg of bw/week). Although the results of the mean histamine content (9.79±20.67 mg kg^{-1}) was below the recommended guidelines, in order to come to a conclusion, a broader investigation along the market chain of skipjack tuna is required.

Keywords: Skipjack tuna (*Katsuwonus pelamis*), Nutritional benefits, Toxicity risks, Assessment

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Introduction

Fish provide an excellent source of nutrients, which provide health benefits to humans. However, some toxic compounds in fish such as histamine and toxic trace metals can generate certain negative consequences. Analysis of potential benefits and risks of fish

consumption is required to establish appropriate dietary recommendations for public health as well as to obtain scientific information (Verbeke*et al.*, 2004). Being a frequently available and popular marine food fish in Sri Lankan fish markets, skipjack tuna (*Katsuwonus pelamis*)is required to be assessed for its positive and negative implications. Hence, the present study was accomplished to analyse the nutrient contents and major toxic compound concentrations, with the aim of assessing benefits and risks of consuming skipjack tuna in Sri Lanka.

Materials and methods

Skipjack tuna fish samples (n=44) were collected from representative fish landing sites around Sri Lanka during April-July in 2014. An aliquot (500 g) of homogenized flesh part from one whole side of the body of each sampled fish was taken for analysis. The trace metal and histamine concentrations were analysed individually for all the samples whereas other analyses were carried out for composite samples that were prepared on gender and standard length basis of each fish. Fatty acid profile was analysed according to Bligh and Dyer, 1959 method of extraction followed by Fatty Acid Methyl Ester (FAME) generation and using Gas Chromatography (GC; GC2014 Shimadzu, Kyoto, Japan). Histamine concentrations were analysed by AOAC, 1995 method using High Performance Liquid Chromatography (HPLC; LC20AD Shimadzu, Kyoto, Japan) whereas all trace metal concentrations were analysed by Atomic Absorption Spectrophotometry (AAS; Varian240 FS, Varian Inc., Australia). The crude protein, fat, moisture and ash contents were analysed by AOAC, 2000 standard methods. All the analytical methods were strictly adhered with quality control procedures. All the nutrients were assessed in terms of benefits with reference to their respective Recommended Dietary Allowance (RDA) values whereas the toxicity of each trace metal was assessed based on the stipulated Provisional Tolerable Weekly Intake (PTWI) with the Probable Weekly Intake (PWI) values. Histamine levels were compared with the recommended European Union and Sri Lankan regulations which the maximum allowable limit has been stipulated as 100 mg of histamine/kg of fish.

Results and Discussion

Skipjack tuna contains 24.13±2.01% crude protein, 0.41±0.56% crude fat, 73.28±0.89% moisture, 1.43±0.22% total ash. The percentage values for proximate components of skipjack tuna were compared with the values recorded by Peng *et al.*, 2013, for other major commercially important tuna species; yellowfin and bigeye tuna. In skipjack tuna, the fat content is slightly lower than the other two major tuna species while all the other components are more or less similar in percentage values. This

shows that skipjack tuna is similar in terms of protein content; the major targeted nutrient in fish, with yellow fin and big eye tuna.

According to the fatty acid profile of skipjack tuna, 49.4% comprised PUFAs; of which 41.6% were ω-3, followed by 36.25% Saturated Fatty Acids (SFAs) as well as 14.67% Mono Unsaturated Fatty Acids (MUFAs). These values are contradictory with certain previously recorded values for skipjack tuna. As explained by the Ackman, 1989, the levels of each type of fatty acid vary with the diet of the fish. Further, skipjack tuna is rich in essential trace minerals; Fe, Zn and Cu, where the resulted mean values were 24.05±4.81, 6.89±3.42 and 5.04±7.35 mg kg^{-1}, respectively. The resulted higher concentrations could be explained by their specific structural and functional roles in the fish body.

However, all the calculated percentage values for the contribution of skipjack tuna for the RDA value of all the nutrients were very low (< 2%). These low values could be due to the low average consumption of skipjack tuna (2.8 g/person/day) in Sri Lanka which was used for the calculation.

According to the results of the present study, all the recorded mean values for toxic trace metals were lower (0.13±0.06 Hg, 0.02±0.01 Cd, 0.01±0.02 Pb and 0.92±1.12 in mg kg^{-1}). The low concentrations for all the toxic trace metals could be due to the fact that skipjack tuna is a short lived animal and thus there is less potential for bioaccumulation. In addition, all the calculated PWI values (0.0025 Hg, 0.0003 Cd, 0.0001 Pb and 0.0180 in mg/kg of bw/week) were well below the estimated PTWI values (0.275 Hg, 0.385 Cd, 1.375 Pb and 0.825 in mg/kgof bw/week). This indicates that skipjack tuna does not pose a health risk to humans in terms of trace metal toxicity.

The values for histamine content (mean±SD= 9.79±20.67 mg kg^{-1}, median= 2.63 mg kg^{-1}, range = 0.17-85.67 mg kg^{-1}) were low, and below the recommended European Union and Sri Lankan maximum allowable limits (100 mg of histamine/kg of fish). However, in order to come to a conclusion, a broader investigation along the market chain of skipjack tuna is required since the level of histamine content highly depends with its storage temperature and time.

Conclusion

Skipjack tuna is a good source of nutrients, and in terms of protein content it is similar to yellow fin and big eye tuna. Skipjack tuna does not pose a health risk due to trace metal toxicity.

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