Balancing the benefits of protein content and the risks of trace metal toxicity exposure from Skipjack tuna (*Katsuwonus pelamis*) consumption in Sri Lanka

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Introduction

Fish is considered as an excellent source of protein that can provide immense health benefits to human being. Protein is the major nutrient in fish consumption and it is highly digestible and consist all the essential amino acids. However, recent claims that marine fish are contaminated with trace metals exceeding the recommended maximum allowable limits have raised concerns among consumers regarding fish consumption. This may lead to rejection of marine fish both by local and export markets (Liyanage, 2009) as fish contaminated with toxic trace metal can lead to acute and chronic effects in human being. In the present study, protein content and major toxic trace metal concentrations in skipjack tuna (*Katsuwonus pelamis*) which is a major commercial marine fish species were studied with the aim of assessing benefits and risks in consumption of skipjack tuna in Sri Lanka.

Materials and Methods

Samples of skipjack tuna fish (n = 44) were collected to represent all fish landing site areas around Sri Lanka during April-July, 2014. Concentrations of toxic trace metals Hg, Cd, Pb and As were analysed individually for all the samples while the protein content analysis was carried out for composite samples that were prepared based on gender and standard length of each fish. Crude protein content was analysed according to 928.08, AOAC 2000 standard method. Crude protein content was determined using UDK 132 (VELP Scientifica, Usmate, Italy) semi-automated Kjeltec system. All composite samples were analysed in triplicates. Hg, Cd, Pb and As trace metal concentrations were analysed by Atomic Absorption Spectrophotometer (AAS; Varian240 FS, Varian Inc., Australia) following the standard method in AOAC 1998. All analyses were strictly adhered with quality control procedures. Protein content of skipjack tuna was assessed in terms of benefits with reference to its Recommended Dietary Allowance (RDA) value 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. Average consumption of skipjack tuna flesh in Sri Lanka was considered as 2.8 g/person/day (MFARD, 2013) and the average body weight of a Sri Lankan adult person was assumed as 55 kg. In addition, resulted mean toxic trace metal concentrations were compared with the established maximum allowable limits for toxic trace metals in Sri Lanka and European Union standards for skipjack tuna.

Results and Discussion

In order to determine the recovery percentage in crude protein analysis, spiked samples with $(NH4)_2SO_4$ were used and the recovery values were maintained within the acceptable range of 90-110%. The method of trace metal analysis was evaluated for its suitability in terms of their respective Limit Of Detection (LOD) and recovery levels using spiked samples and certified quality control materials. Calculated recovery values for all the trace metals were within the expected recovery range of 80%-120%.

The mean standard length of the analysed skipjack tuna fish was 47.4±3.9 cm and the range was 36-56 cm whereas the mean total weight was 2.2±0.5 kg and it had a variation of 1.1 - 4.2 kg. Among the analysed specimens 24 were males and 20 were females.

Table 1: Protein content (%) of the flesh of skipjack tuna and other major tuna species*

	Skipjack tuna [a]	Yellowfin tuna [b]	Bigeye tuna [b]
Crude protein	24.13±2.01	23.52±0.61	23.72±0.16

* Data are expressed as mean±SD on a fresh weight basis

[a] The present study

[b] Peng *et al*., 2013

As per the results obtained, skipjack tuna is a good source of protein (Table 1). The resulted percentage value for protein content of skipjack tuna was compared with the values recorded by Peng *et al*., 2013 for other major commercially important tuna species; yellowfin and bigeye tuna (Table 1). This shows that skipjack tuna is similar in terms of protein content; the major targeted nutrient in fish, with yellowfin and bigeye tuna. The resulted percentage value in this study for crude protein content in skipjack tuna slightly differs with the results of certain previous studies. This could be due to the variation of protein content in fish according to the seasonal changes as described by Clucas and Ward, 1996. Although skipjack tuna is a rich source of protein, the obtained value for the contribution for RDA value was lower (1.2%). The major reason to gain this lower value is the average skipjack tuna consumption in Sri Lanka is still a lower value (2.8 g/person/day).

Table 2: Provisional Tolerable Weekly Intake (PTWI) and Probable Weekly Intake (PWI) values of Hg, Cd, Pb and As

Toxic trace metal	PTWI *(mg/kg of body weight)	Provisional Tolerable Weekly Intake (mg)	Probable Weekly Intake (mg)
Hg	0.005	0.275	0.0025
Cd	0.007	0.385	0.0003
Pb	0.025	1.375	0.0001
As	0.015	0.825	0.0180

* WHO/FAO Joint Expert Committee on Food Additives and Contaminants

According to the results of the present study, all the recorded mean values for toxic trace metal concentrations were lower (0.13±0.06 Hg, 0.02±0.01 Cd, 0.01±0.01 Pb and 0.92±1.12 As in mg/kg). All the recorded mean values were well below the established maximum allowable limits for toxic trace metals in Sri Lanka and European Union standards in terms of seafood safety. The resulting of lower concentrations for all the toxic trace metals could be due to the reason that skipjack tuna is a

short lived animal which has a less potential for bioaccumulation. All the calculated PWI values were well below the estimated PTWI values (Table 2). This indicates that skipjack tuna does not contain a health risk on human due to trace metal toxicity.

In recent past several researchers have claimed that most of the major and popular marine food fish such as yellowfin tuna, bigeye tuna, sward and certain marlin fish have an increased risk o f trace metal toxicity (Kojadinovic *et al.*, 2007; Jinadasa *et al.*, 2014). In addition, the market values of these major marine food fish are very high with compare to skipjack tuna (MFARD, 2014). As per the results of this study, skipjack tuna is a good source of protein which does not contain any health risk due to trace metal toxicity and can be accessed by consumers for a cheaper price.

Conclusion

Skipjack tuna is a good protein source as same as the majorly attracted other tuna species such as yellowfin and bigeye tuna by the fish consumers. Skipjack tuna does not pose any health risk due to trace metal toxicity by Hg, Cd, Pb and As.

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