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Distribution of Iodine in Marine and Fresh Water Fishes from Sindh Regions of Pakistan

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Abstract: Iodine content in muscles of fresh and marine fish collected from different coastal parts and fresh water resources were analyzed by selective ion electrode method. It was found that fresh fish were rich in iodine content (mean of 23-10 μg kg^{-1} on dry weight basis). Also the iodine content of marine fish, *Epinephalus malbaricus* (17 μg kg^{-1}) and *Johnius belangeri* (19 μg kg^{-1}) on dry weight basis, was higher than that of other marine fish. Significant regional differences were noted in the iodine content of marine fish as compared to fresh water fish.

Key words: Iodine, marine and fresh water fishes, regional difference

INTRODUCTION

Iodine is an essential trace element of great importance in human nutrition. The element is an integral part of the thyroid hormones and iodine deficiency leads to endemic goiter (enlarged thyroid) and other iodine deficiency disorders. The main iodine supply occurs via nutrition and marine seafood is the only natural source containing relatively large amounts of iodine (FEEDAP, 2005). However, the iodine content of marine fish depends on the species and can vary considerably. Julshamn *et al.* (2001) measured the iodine content in various fish species off the coast of Norway and from the North Sea. They found a great variation between different individuals of the same species as well as between different fish species (Varo *et al.*, 1982). Eckhoff and Maage (1997) reported high iodine concentrations in the skin of East African fishes, they also reported that iodine content of the skin can be more than ten times of the muscle tissue. They also measured the iodine content in sea water fish, fresh water fish and different foods of plant origin commonly consumed in East Africa in order to evaluate dietary iodine sources for the population in the selected areas. The results of the collected samples showed that the iodine concentration in fillet of salt water fish was 5 to 10 times higher than those of fresh water fish, with highest value of 920 μg I kg^{-1} wet weight, The lowest iodine concentration in fillet was found in barbus from Lake Awasa with only 5-8 μg I kg^{-1} wet weight. The iodine concentration in skin was higher than in fillets and the iodine concentration in fillets seemed to increase with fish size. Yasushi and Kimura (2005) reported a rapid method for determining the Iodine Value (IV) and Saponification Value (SV) of fish oils by developed using near-infrared (NIR) spectroscopy.

The purpose of this study was to measure the iodine contents in seawater fish and fresh water fish in order to evaluate dietary iodine sources for the population in the Sindh Regions of Pakistan.

MATERIALS AND METHODS

Thirteen marine water species from Ireland Manora, west wharf and fisheries Karachi and Thirteen fresh water fishes from Halay Jee Lake and other market of Sindh were collected and selected for monitoring the iodine content. Fresh water fishes were identified as *Scatophagus argus*, *Pomadasys argyeus*, *Ctenopharpngodon idella*, *Cyprinus carpio*, *Ophiocephalus marulius*, *Liza dussumieri*, *Ilisa elongate*, *Opisthopterus tardoore*, *Nematalosa nasus*, *Gonialosa manminna*, *Xenentodon cancila*, *Chatoessus chacunda* and *Tilapia mossambica* whereas *Chaetodon punctuates*, *Equula splendens*, *Epinephalus malbaricus*, *Johnius belangeri*, *Protonibea dicanthus*, *Otolithus rubber*, *Otolithus argenteusm*, *Pomadasys olivaceus*, *Thynnus tonggol*, *Nemipterus japonicus*, *Aurius thalassinus*, *Sphyraena langsar*, *Liza subviridis* and *Mugil cephalus* as a marine water fish. Five to ten sample of each fish were analyzed. The total weight and length were measured (Azmat *et al.*, 2007).

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Equal weights of all fishes were put into crucibles (using 0.2 g dry mass and a dilution factor of 50). The crucibles were placed in the oven for 2 h at 135°C. After that the samples were mineralized at 400°C in the chemical oven for 24 h then 2 mL of nitric acid was added and sampled were dehydrated at 450°C. To each sample 10 mL of hydrochloric acid was added and then make up to 50 mL with double distilled water. The detection of iodine as a iodide was carried out in various fishes by low analyzer WTW IA 5210 West Germany by using ion selective electrode made by SENTEK, Platinized by black Platinum Chloride, California USA.

RESULTS AND DISCUSSION

The results of averaged values of iodine reported in the Table 1 and 2 showed variation between different fish species as well as between individuals within a species. There were great variation in weight and length of fish with iodine contents. No relation in between weight and length with iodine content showed that accumulation of iodine in fish muscle of same and different specie is related with climate temperature and other aquatic factors/composition or it may be seasonally changed. The results of the collected samples showed that the iodine concentration in fresh water fish was 5 to 10 times higher than those of seawater fish; with highest value of 23 μg kg^{-1} dry weight for *Nematalosa nasus* from Halay Jee lake where as it was highest for *Johnius belangeri* 19 μg kg^{-1} for marine water fish. *Thynnus tonggol* marine water fish contain lowest iodine content 09 μg kg^{-1} and *Tilapia mossambica* from fresh water reservoirs contain 10 μg kg^{-1} of iodine contents. *Chaetodon punctuates* and *Liza subviridis* are marine water fish having iodine content of 16 μg kg^{-1} (Table 1) while *Chatoessus chacunda* fresh water fish with same iodine content 16 μg kg^{-1} (Table 2). Results reported in Table 2 reflect that accumulation of iodine from different aquatic resources varies specie to specie and it also depends upon the nature of specie (Larsen and Ludwigsen, 1997).

Fishmeal is a valuable concentrate not only on account of its high protein content, but also because of its calcium and phosphorus content. It may possess an additional value as a source of iodine (Rasmussen *et al*., 2001; Tokudome *et al*., 2002). The low concentration of iodine, which was obtained in marine water fish, may be attributed with the pollution of sea, which is continuously increasing day-by-day and causes serious health hazards in marine fish.

Table 1: Iodine contents in fresh water fish of Sindh

Fresh water fish	No.	Average length (inch)	Average weight (g)	Average value of Iodine (μg kg^{-1})	Literature value
Scatophagus argus	10	10.4	494.6	19±0.35	
Pomadasys argyeus	10	6.0	92.8	22±0.31	
Ctenopharpngodon idella	10	17.0	810.0	14±0.32	
Cyprinus carpio	05	17.0	2055.0	20±0.26	5-8 (Eckhoff and Maage, 1997)
Ophiocephalus marulius	05	7.6	88.0	22±0.28	
Liza dussumieri	10	7.6	83.0	18±0.27	
Ilisa elongata	07	8.0	60.5	15±0.32	
Opisthopterus tardoore	10	8.0	58.2	21±0.13	
Nematalosa nasus	05	7.5	70.8	23±1.09	
Gonialosa manminna	08	7.8	46.7	21±0.707	
Xenentodon cancila	10	12.0	51.7	11±0.707	
Chatoessus chacunda	10	12.0	230.6	16±0.158	
Tilapia mossambica	10	10.0	581.0	10±1.50	

Table 2: Iodine contents in marine water fish of Sindh

Marine fishes	No.	Average length (inch)	Average weight (g)	Average value of Iodine (μg kg^{-1})	Literature values
Chaetodon punctates	05			16±0.13	
Equula splendens	10	9.0	210.8	17±0.13	
Epinephalus malbaricus	06	10.5	233.0	17±0.35	
Johnius belangeri	10	8.2	531.5	19±0.31	
Protonibea dicanthus	10	9.0	577.0	14±0.94	
Otolithus ruber	08	10.0	350.0	13±0.941	920 μg kg^{-1} (Eckhoff and Maage, 1997)
Otolithus argenteus	07	9.0	176.0	15±0.29	
Pomadasys olivaceus	10	15.0	700.0	16±0.35	2.5 mg kg^{-1} in *Gadus morhua*
Thynnus tonggol	10	18.0	1200.0	09±0.94	4.95 mg g^{-1} cod muscle Julshamn *et al.* (2001)
Nemipterus japonicus	10	8.0	91.0	13±0.31	Certified value (Yasushi and Kimura, 2005)
Aurius thalassinus	10	10.5	168.0	14±0.35	
Sphyraena langsar	05	11.0	623.0	13±0.29	
Liza subviridis	10	6.0	42.2	16±0.35	
Mugil cephalus	10	11.0	450.0	09±0.25	

The iodine content of various fish species from different fishing grounds of Arabian Sea has been compared, yielding no clear indication of a relation of iodine concentration to the fishing ground. But large variations were found between samples in fishes of a single catch. Distribution within fish muscle showed an iodine gradient, decreasing from skin to the inner part of the fillet and iodine levels in the skin of marine fishes can be up to twenty fold of the content of the muscle tissue, depending on the species (Karl *et al*., 2001). No differences were observed between left and right fillets, ventral and dorsal parts and head and tail parts of cod fillets, respectively therefore an average value are reported (Yasushi and Kimura, 2005). As an iodine source, marine water fish do contribute some to the iodine intake and might be of importance, especially since other foods contain small amounts of the element. In addition, the contribution of iodine from the fresh water sampled in this investigation can be of importance. However, only fresh water fish in the diet can be regarded as a really good iodine source because iodine is a chemical element that is required for growth and survival (Hess *et al*., 2001). It is widespread in the environment, but is chiefly derived from the ocean and the soil. Iodine is typically present in relatively low concentrations in the sea and soil; because of its biological importance, iodine tends to be present in living organisms in higher concentrations (Yu *et al*., 1996). The most potent source of iodine in the human diet is marine fish and other seafood. Iodine is an essential micronutrient in the human diet (Wenlock *et al*., 1982). Its most important known function is as a component of thyroid hormones. Thyroid hormones are produced by the thyroid gland (located at the base of the neck). Thyroid hormones play a vital role in the regulation of metabolic processes such as growth and energy expenditure (Marchetti *et al*., 1997). Iodine values of fresh water fish compared with fresh water fish wet weight values obtained by Eckhoff and Maage (1997) showed that fresh water fish of Sindh region were rich in iodine contents and can be used as iodine rich dietary source whereas iodine contents of marine water fish were low as compared to earlier research which may be depend upon the nature of fish of Arabian sea but is a good iodine source.

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