FLUORIDE IN SKIN AND MUSCLE OF TWO COMMERCIAL SPECIES OF FISH HARVESTED OFF THE BUSHEHR SHORES OF THE PERSIAN GULF

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SUMMARY: This study reports measurement of the fluoride (F) content of the skin and muscle tissues of Indo-Pacific king mackerel (*Scomberomorus guttatus*) and tiger tooth croaker fish (*Otolithes ruber*) harvested commercially off the Bushehr shores of the Persian Gulf. By a standard diffusion procedure, the mean F concentration in the soft tissues of these two species of fish was determined to range from 5.56 to 6.09 mg/kg wet weight in the skin and 5.78 to 6.14 mg/kg wet weight in the muscles. At these concentrations, the total F intake among consumers of the skin and muscle tissue of these fish is appreciably increased. Possibly contributing to these soft tissue levels, the mean F concentration of the water in this part of the Persian Gulf was measured at 1.97 mg/L.

Keywords: Bushehr shores; Fluoride in fish skin and muscle; Persian Gulf fish.

INTRODUCTION

Various studies in Iran have reported the fluoride (F) content of drinking water, air, and tea and also the removal of high F from water.[1-8] As is well known, high F levels are often found in bone meal and gelatin and in some brands and forms of tea. In a recent study,[9] we determined the trace heavy metal Cd, Cu, Ni, and Pb content of the skin and muscle tissues of two commercially important species of fish, Indo-Pacific king mackerel (*Scomberomorus guttatus*) and tiger tooth croaker (*Otolithes ruber*), that are harvested off the Bushehr shores of the Persian Gulf and commonly consumed in Bushehr Province of Iran. In this study we report the F content of the skin and muscle tissues of these fish.

MATERIALS AND METHODS

Bushehr Province is located in the southwest part of Iran on the shore of the Persian Gulf (see Figure).

Figure. Location of Bushehr Province in Iran.

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Two species of fish, namely, Indo-Pacific king mackerel and tiger tooth croaker, harvested near the Bushehr port shore, were purchased during April–July 2010 from a Bushehr fish market. The fish were brought to the laboratory and dissected with clean stainless steel instruments. Muscle and skin were dried, homogenized and ground first with a meat grinder and later with a mortar and pestle to a fine powder. For the F determinations, essentially the procedure of Jackson et al.[10] was used, followed by measurement of the F content of the samples with an ion selective electrode (Methrom Co., Switzerland).

Weighed one-gram samples of dry skin and muscle powder were placed in plastic Petri dishes and deionized water was added to bring the final sample volume up to 3 mL. A sodium hydroxide (0.05N) trap solution (50 µL) was placed on the inside cover of each Petri dish, Vaseline® was placed on the inside rim of the Petri dish cover, and the dishes were sealed. After making a small hole with a soldering iron in the top of each Petri dish, 1 mL of 3N sulphuric acid saturated with HMDSO (hexamethyldisiloxane) was added. The dishes were then immediately resealed with Vaseline®, and HF was allowed to diffuse out of the sample into the NaOH trap overnight. The NaOH in the trap was neutralized with 25 µL of 0.1N perchloric acid and brought to a volume of 100 µL with TISAB II (Total Ionic Strength Adjustment Buffer solution). After calibration of the F ion selective electrode with a standard solutions of NaF of known and exact F concentration, the F contents of the samples were measured directly. The calibration curve of the ISE was linear with $R^2 = 0.99$. The accuracy of the measurements was verified by spiking five of the samples with the addition of three known quantities of F (as NaF), providing an average recovery of 98.6%.

The standard SPADNS method was used for analysis of F in the seawater (DR/5000s Spectrophotometer).

RESULTS AND DISCUSSION

As seen in Table 1, the mean concentration of F in the skin and muscle tissue samples of either the Indo-Pacific king mackerel (*Scomberomorus guttatus*) or the tiger tooth croaker fish (*Otolithes ruber*) was not appreciably different.

Table 1. Mean and range of skin and muscle F concentration (mg/kg/wet weight; values are mean±SD)

Fish species	N	Skin	Muscle
Indo-Pacific king mackerel	7	5.56 ± 1.89 (3.21 – 7.81)	5.77 ± 1.80 (3.65 – 7.9)
Tiger tooth croaker	7	6.09 ± 1.55 (3.89 – 8.10)	6.14 ± 1.4 (3.9 – 8.05)

Various previous studies[11-14] have reported the F content of skeletal bone and muscle in fish (Table 2), but the present study was confined to determining the F level in the skin and muscle tissues because most people in Iran consume these parts of fish as food but not the bones. Although the F concentration in unpolluted

sea waters generally range from 1.2 to 1.5 mg F/L,[15-16] we found the F content in the Persian Gulf waters where the fish in this study were harvested to be higher with 1.97±0.152 mg/L (SD with six samples). It is likely that this higher F content in this part of the Persian Gulf contributes to the elevated F content of the fish skin and muscle. In agreement with this view, Hemens and Warwick,[17] have observed that fish in certain environments can accumulate relatively large amounts of F.

Table 2. Fluoride content (mg F/kg wet weight) of fish in some previous studies

Fish species	Aquatic medium	Skeletal bone	Muscle	Reference
Chaenoce phallus aceratus	Seawater	1143	1.8	11
Notothenia neglecta	Seawater	865	3.7	11
Notothenia rossii	Seawater	964	2.2	11
Notothenia gibberifons	Seawater	1156	1.3	11
Micromesistius australis	Seawater	1207	1.4	11
Mugil labrosus	Seawater	52-940	1.5-15.3	12
Mugil cephalus	Seawater	45-630	1.3-26	12
Mugil auratus	Seawater	105-140	2.8-3.3	12
Oreochromis leucostictus	Freshwater	210.6	1.97	13
Oncorhynchus mykiss	Freshwater	450	2.9	14
Cyprinus carpio	Freshwater	1100	20.8	14

In Bushehr Province, people have a high consumption of the two species of fish studied here (at least twice a week in their diet). The resulting substantial increase in F intake is augmented by the high concentration of F in drinking water in certain parts of the province,[1] along with the extensive consumption of tea with a mostly modest F level.[7] Consequently, the use of low-F bottled drinking water[3] and a hybrid sorbent resin for removal of F from drinking water with high F levels[8] in this region is recommended.

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