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Research Article

Estimation of fluoride in freshwater fish and marine water fish

Pramada Prabhakar[1,*], **Vijaya Hegde**[2]

[1] *Post Graduate Student, Department of Public Health Dentistry - A.J Institute of Dental Sciences, Karnataka, India*
[2] *Professor and Head of the Department, Department of Public, Health Dentistry - A.J Institute of Dental Sciences, Karnataka, India*

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* *Corresponding author.*
Pramada Prabhakar
pramadaprabhakar@gmail.com

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ABSTRACT

Aim: The aim of the study is to estimate the amount of fluoride in the flesh of freshwater fish and marine water fish. **Material and methods:** Fish samples were collected from a local market. Commonly consumed different species of fish (eight types are included in the study). The flesh, bones and skin were separated from individual fish. Samples of flesh, bones and skin were homogenized separately, dried and the pH of the processed samples was adjusted to neutral pH 7.2. Fluoride was determined using spectrometer. **Result:** Concentrations of fluoride in fishes ranged from 1.05-4.75 ppm. For river water fish the highest fluoride was seen in Rohu (*Labeo rohita*) and among the marine water fish highest fluoride content was seen in Indian Sardine (*Sardinella Longiceps*). **Conclusion :** The amount of fluoride present in the fish is directly proportional to the severity of fluorosis among the fish consuming population. Hence these values would give us the information about recommended daily allowance strategy for the public health of the people residing in the coastal areas

Keywords: Fluorides; fresh water fish; marine water fish; recommended daily allowance

1 INTRODUCTION

Fluoride is a naturally occurring compound derived from fluorine. It is present in almost all foods and beverages including water, but the fluoride levels vary in each.[(1)] Inorganic and organic fluorides are present in soils and water, in the plants and animals consumed by humans for food. Apart from the emissions from the industries, the largest environmental source of fluorides is through fluoridated water supplies.[(2)] Fluoridation is the addition of fluoride compounds into drinking water, to adjust concentrations to levels between 0.8 and 1.0 mg/Lt for the beneficial effect of tooth decay prevention.[(1)]

Almost 70 % of fluoride sources to the human population is available in drinking water, the remainder from various food items, drinks, tea, and supplemented dentifrices, the latter including mouthwashes and medicaments. The amount of fluoride available in vegetables, fruits, and meat is, however, less.[(3)]

Fishes have been a traditional food in the coastal areas. While small amounts of fluoride in food have been shown to help prevent tooth decay, too much fluoride in the diet or long-term excessive intake of fluoride can result in macular teeth. In some coastal areas, the amount of fluoride levels are high and can result in adverse manifestations which may range from mild dental fluorosis appearing as mottled enamel and white spots to brownish discolouration and to crippling skeletal fluorosis, as the level and period of exposure increases. There are reports that excessive fluoride consumption promotes cancer, has detrimental neurological effects, and causes hip fracture leading to stillbirth or birth defects.[(4)]

Fish living in marine waters are more adversely affected by fluoride pollution than those living in the fresh water because the bioavailability of fluoride ions is reduced with increasing water hardness. Fluoride tends to be accumulated in the bone tissues of fishes. The toxic action of fluorides is that the fluoride ions acts as enzymatic poisons, inhibiting enzyme activity and ultimately interrupting glycolysis and synthesis of proteins. Fluoride toxicity increases with increase in fluoride concentration, exposure time and water temperature

and decreases with body size and water content of calcium and chloride. In fresh water there is low ionic content as low as 0.5mgF/l and can adversely affect the fish. Safe level below this concentration are recommended in order to protect the freshwater fish from fluoride pollution. [5]

However there are no adequate literature to show the comparison between the fluoride concentration in the freshwater fish and marine water fish.

Although there are currently reports available on the fluoride content of fish, it should be noted that not only bone therein but also the flesh meat content, which are, in general, higher fluoride. [6]

Hence the aim of the study was to assess and compare the amount of fluorides present in the flesh of freshwater fish and marine water fishes

2 SUBJECTS AND METHODS

The fishes were purchased from the local fish market and were brought to the laboratory. Eight different fishes were brought out of which 4 were marine water fishes and 4 were freshwater fishes.

The marine water fishes were: (i) Mackarel (*Rastrelliger kanagurta*) (ii) Big Eye fish (*Priacanthus macracanthus*) (iii) Sardine (*Sardinella longiceps*) (iv) Sole fish (Cynoglossus Spp.)

The freshwater fishes were: (i) Croakerfish (*Micropogonias undulates*) (ii) Mullet (*Mugil cephalus*) (iii) Rohu (*Labeo rohita*) (iv) Green Chromide (*Etroplus suratenesis*)

Four species of each fish from both the source was selected based on the commonly consumed fish in the research area of interest.

4 Samples of each species of fish in each group were present

The skin was peeled and the flesh was separated from the bone. 2 grams of each sample were placed in a 70 ml Nickel crucible and 5 ml volume of 8 M NaOH solution was added to it. To dry the crucible it was placed on a hot plate for evaporation. Following which the crucible was closed with a lid and was later placed in the muffle furnace for 3 hours at 525 ^{0} C.

The crucible was then cooled to ambient temperature. 10-15ml distilled water was added to the solution and heated on a hot plate for dissolution , which gave the sample solution required for the further process. After 2 hours the sample was neutralized by adding 10ml of distilled water and 2 ml of concentrated HCl to reduce the ph value from pH 12-13 to the pH 7.2 – 7.5. Later the neutralised sample solutions were transferred to a 50ml volumetric flask and made up to the mark by using deionised water and then stored in an air tight container until fluoride estimation was carried out. The sample solutions were centrifuged for 15 minutes to clear the turbid solutions.

2.1 Estimation of fluoride

The concentration of fluoride in the samples was determined using Fluoride Ion Selective Electrode. The sample solutions were separately placed in 8 different test tubes Figure 1. 5 ml of sample was taken to which 2 ml of TISAB II (Total Ionic Strength Adjustment Buffer) was added. To this 1 microspoon of reagent powder was added and shaken vigorously until the reagent is completely dissolved. After 5 minutes the samples were placed into a 10 mm cell and the fluoride was estimated using spectrophotometer Figure 2.

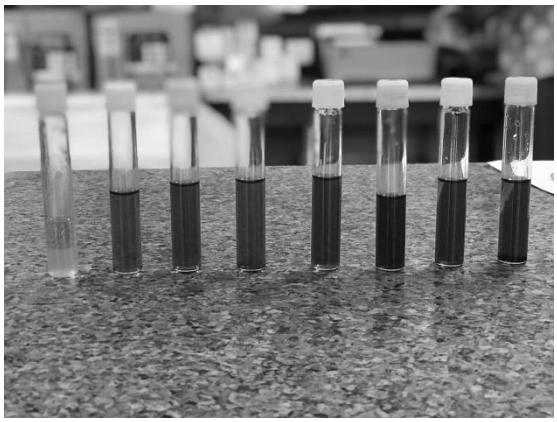

Fig. 1: 1 – Solution placed in different test tubes

Fig. 2: 2 – Fluoride analysis using spectrophotometer

3 RESULTS

Table 1 shows the amount of fluoride content in the flesh of freshwater fish and Table 2 shows the amount of fluoride in marine water fish.

Fluorine concentration was expressed in parts per million (ppm). Four fish species per variety were analysed using standard spectrophotometer and the mean value was considered.

Table 3 shows that there was no significant difference between the freshwater and marine water fish.

The range of fluoride content in the flesh of the fish samples ranged from 1.5-4.5 ppm.

Rohu fish had the highest amount of fluoride among the freshwater fish (4.32 ppm) and among the marine water fish, Indian Sardine has the highest amount of fluoride (3.66 ppm).

Table 1: Showing the amount of fluoridecontent in the flesh of freshwater fish

Freshwater fish	Initial pH	pH after adding HCl	Fluoride content (in ppm)
Rohu (*Labeo rohita*)	9.8	7.32	4.32
Croaker fish (*Micropogonias undulates*)	9.2	7.18	2.32
Mullet (*Mugil cephalus*)	10.05	7.26	2.90
Green Chromide (*Etroplus suratenesis*)	10.25	7.12	2.01

Table 2: Showing the amount of fluoride in marine water fish

Marine-water fish	Initial pH	pH after adding HCl	Fluoride content (in ppm)
Sardine (*Sardinella longiceps*)	9.7	7.36	3.66
Mackerel (*Rastrelliger kanagurta*)	10.02	7.20	3.08
Sole Fish (*Cynoglossus* Spp.)	9.73	7.22	2.74
Bigeye Fish (*Priacanthus macracanthus*)	10.45	7.13	1.98

Table 3: Showing the mean fluoride concentration in marine water fish and fresh water fish

	Fish	Mean Rank	Sum of Ranks	P value*
Initial pH	Freshwater	4.50	18.00	
	marine water	4.50	18.00	1.000 (N.S)
	Total			
Final pH	Freshwater	4.25	17.00	
	marine water	4.75	19.00	.773 (N.S)
	Total			
Fluoride Content	Freshwater	4.50	18.00	
	marine water	4.50	18.00	1.000 (N.S)
	Total			
		Mean	Std. Deviation	
Initial pH		9.8963	.38578	
Final pH		7.2238	.08551	
Fluoride Content		2.8763	.81261	
Fish		1.50	.535	

*mann whitney test, N.S – non significant

4 DISCUSSION

The present study was conducted to estimate the amount of fluoride content in freshwater fish and marine water fish. The study showed that Rohu fish had the highest amount of fluoride among the freshwater fish and Indian Sardine among the marine water fish.

The matter of concern is that the prevalence and severity of dental fluorosis is increasing with increase in consumption of fluoride through various sources. It is difficult to determine the total fluoride intake from the diet because of the variation of content of fluoride in different food materials. Fish such as Rohu and Sardine contains high levels of fluoride. The flesh of these fish has a fluoride content of the range 1.98-4.32 mg / kg. [6]

There are controversies in the accumulation of fluoride in tissues of the fish. It accumulates primarily in bone, skin, gill followed by liver, gut and muscles. However the fluoride concentration in water dictates the level of accumulation in the body of the fish. [7] The increased concentration of fluoride in freshwater fish is because the freshwater gets contaminated with fluoride due to running of filed water or garden water during monsoon where pesticides containing fluorides is used. [3].

The increase in concentration of fluoride in marine water fish is due to increased fluoride content of sea water because of increase in the availability of fluoride by leaching of the parent fluoride containing minerals with which this water is in contact.

According to a study conducted by Chowdhury et all showed similar results that Rohu fish has the highest amount of fluoride among the freshwater fish [3].

A study by Yusuf et al showed that Indian Sardine has more fluoride content when compared to other marine water fish [4].

Hence care should be taken to prevent running of field water to nearby water bodies. This not only affects the humans but also alters the metabolic activity of fish by poisoning their enzyme activity

The limitation of the study could be small sample size of the fish. The role of diet and other sources of fluoride were not recorded but consumption of water is the major factor for fluorosis. However, consumption of fishes with

high fluoride content over a period of time could lead to fluorosis. Further research and long term studies are needed to assess the fluoride levels in the skin, muscle and bone tissues of the fishes using other methods of fluoride analysis.

REFERENCES

1) Rao CS. Determination of water quality of some rural areas of Guntur District, Andhra Pradesh, India. 2013. Available from: https://shodhganga.inflibnet.ac.in/handle/10603/8242.
2) WHO Regional Office for Europe, Copenhagen, Denmark. Fluorides. In: Air Quality Guidelines. 2000. Available from: https://www.euro.who.int/__data/assets/pdf_file/0018/123075/AQG2ndEd_6_5Fluorides.PDF.
3) Chowdhury C, Khijmatgar S, Kumari D, Chowdhury A, Grootveld M, Hegde C, et al. Fluoride in fish flesh, fish bone and regular diet in south-coastal area of Karnataka state of India. *Indian Journal of Dental Research*. 2018;29(4):414–417. Available from: https://dx.doi.org/10.4103/ijdr.ijdr_653_16.
4) Ganta S, Yousuf A, Nagaraj A, Pareek S, Sidiq M, Singh K, et al. Evaluation of fluoride retention due to most commonly consumed estuarine fishes among fish consuming population of Andhra Pradesh as a contributing factor to dental fluorosis: a cross-sectional study. *J Clin Diagn Res*. 2015;9(6):11–15. doi:10.7860/JCDR/2015/12271.6035.
5) Camargo JA. Fluoride toxicity to aquatic organisms: a review. *Chemosphere*. 2003;50(3):251–264. Available from: https://dx.doi.org/10.1016/s0045-6535(02)00498-8.
6) Taves DR. Dietary intake of fluoride ashed (total fluoride) v. unashed (inorganic fluoride) analysis of individual foods. *British Journal of Nutrition*. 1983;49(3):295–301. Available from: https://dx.doi.org/10.1079/bjn19830038.
7) Singh N, Tripathi M. Fluoride toxicity in freshwater fishes and aquaculture: a review. *J Biosci*. 2015;4(2):115.