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Research Article

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Fluoride Levels in Aquatic Animals of Prakasam District, A.P.

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Abstract Fluoride has been known to cause significant effect on human health through drinking water. Excessive ingestion of fluorides not only causes dental and skeletal fluorosis but also leads to gastro intestinal disturbances. Prakasam district of Andhra Pradesh, India is having severe fluorosis. Higher concentrations of fluorides in water disturb the metabolism of animals including fish and other aquatic animals. Fish, are sensitive to environmental disturbances and in particular to any chemical change in aquatic environment. Fluoride mainly affects the level of glucose, lipid, protein, cholesterol and glycogen metabolisms, which play an important role in growth, reproduction and survival of fishes. Bioaccumulation of fluorides in aquatic animals is a serious threat to human beings because they are going to consume these aquatic animals as their food. Hence in the present study an attempt is made to know the fluoride concentration in the Fish, Prawns and crabs that were grown in the Prakasam district. The results shows that the fluoride levels in different fish and prawns were beyond the admissible limits. Potential adverse effects of fluoride in fishes and role of fluoride on aquaculture were discussed. This information is highly useful in the environmental risk assessment of freshwater fish and other aquatic organisms due to fluorides. The implications of fluoride toxicity to the fish and prawn to human beings was discussed.

Keywords Fluoride toxicity to fish, prawn and crab, Endemic fluorosis, Prakasam district

Introduction

Fluoride occurs naturally in public water systems as a result of runoff from weathering of fluoride-containing rocks such as fluorspar-CaF_2,Cryolite-Na_3AlF_6 and fluorapatite-$Ca_{10}F_2(PO_4)_6$. Lower concentrations of Fluorides are having beneficial effect on teeth by preventing and reducing the risk of tooth decay. In fact, concentrations lower than 0.5 mg/L intensify risk of tooth decay. However, higher concentration (more than 1.5-2 mg/L) fluoride becomes quite detrimental to health. Fluoride is potentially toxic at high doses or with prolonged lower-level exposure. It may cause dental fluorosis, osteomalacia, ligament calcification, hypocalcemia, arrhythmias, neurotoxicity, headaches, vertigo, thyroid dysfunction and anemia [1]. Recent studies indicate that fluoride exposure from fluoridated water correlates with increased risk of bone cancer in young boys, and hip fracture in the elderly. Major sources of internal exposure of individuals to fluorides are the diet (food, water, beverages) and fluoride-containing dental products (toothpaste, fluoride supplements). Internal exposure to fluorides also can occur from inhalation (cigarette smoke, industrial emissions). Fluorides are known to disturb enzymes and interfere with the intermediary metabolism [2]. They inhibit growth and development of animals by controlling the cellular respiration and ATP Synthesis [3].

Prakasam district of Andhra Pradesh, India is having serious endemic fluorosis [4-5]. Fluorides not only affects the human beings but also other animal population. No specific studies are there on the influence of fluorosis on aquatic animals. Accumulations of fluoride in the bone tissue reflect the contamination of the entire fish, [6]. Bio accumulation of fluorides in aquatic organisms, particularly fish which is consumed by human beings in large quantities is of special concern because a high retention of toxic substances in fish tissue may harm health of human being. The permanent pollution in aquatic environment leads to accumulation of pollutants in a fish. Hence in the present study an attempt I made to know the level of fluorides in fish and prawn in Prakasam district, A.P.

Material and Methods

Sampling Area

Prakasam District occupies an area of 17626 km2 .It is the largest in area among the coastal districts of Andhra Pradesh. This district lies between 140 50' 27.725" to 160 17' 21.168" north latitude and 780 31' 1.298" to 80 30' 22.62" east longitude. The average elevation is 10m (30ft). It has a population of above 3054940 as per 2001 census. Many areas in this district depends on ground water for drinking and other purposes.

Experimental Studies

All animals taken for the study were in the 8-12 month age group. They were identified. Control animals were collected from the Fish market of Nellore where there is no fluorosis. In the experimental group different aquatic animals that were grown in Prakasam district were collected from the fish market of Ongole and Singarayakonda towns. They were also identified. They are called aquatic animals from fluorosis area.

Flurides Estimation Procedure

Bones were extracted from the body of the fresh and dried for 24 hr at 105 °C. Fat was removed by washing the samples in acetone. Fat-free bones were homogenized and then digested with 2 Molar perchloric acid. In case of prawn and carb carapace was taken for study in leiu of bones. After perchloric acid digestion floride content was determined potentiometrically by using ion selective fluoride electrode and TISAB IV buffer.

Results

The data regarding fluoride levels in different aquatic animals were presented in table. There is a drastic increase in the fluoride levels in all aquatic animals in endemic fluoried area *i.e.* Prakasam district when compared to non endemic area. The highest accumulation was found in field crab Paratelphusa hydrodomus (+192.8%) and lowest in fish Etroplus suratensis (97.47%). All experimental group values are significant at % error (P<0.001)

Table 1: Fluoride levels in different aquatic animals.

(Values are mean of 10 observations, ± indicate standard deviation. +/- indicate percent deviation from control group. 'P'denotes the level of significance.

No	Name of the aquatic animal	Control Group (Animals from non fluorosis area) Concentration of Fluoride mg/kg	Experimental group (Animals from fluorosis area) Concentration of Fluoride mg/kg	Percent change over control
1	Cyprinus carpio (Common carp)	351±47	897±58	+155.6 P<0.001
2	Ctenopharyngodon idella (Grass carp),	351±83	780±79	+122.2 P<0.001
4	Tilapia mossambica	412±101	1120±110	+111.9 P<0.001
5	Lebio rohita	380±66	987±65	+159-7 P<0.001
6	Chenna punctatus	366±80	877±67	+140.0 P<0.001
7	Etroplus suratensis	399±49	788±59	+97.49 P<0.001
8	Heteropnustis fossilis	334±57	1110±143	+156.0 P<0.001
9	Penius monodon	387±67	855±45	+120.9 P<0.001
10	Machrobrachium malcomsoni	289±44	786±77	+178.13
11	Paratelphusa hydrodomus	279±33	834±90	+198.22 P<0.001

Discussion

In the present study all aquatic animals in the endemic fluorosis were having high Fluoride concentration .The severity of fluorosis are directly related to the alkalinity of water which may be one of the deciding factors for the high incidence of fluorosis in many cases. If this alkaline water remains in contact with the fluorite deposit for a longer period, then there is a definite possibility of progressive leaching of fluoride resulting in the increase in fluoride content. The main source of fluoride in ground water is fluoride-bearing rocks such as fluorspar, fluorite, cryolite, and fluorapatite and hydroxyl apatite. Ground water quantity is also influence fluoride concentration. Velocity of flowing water, pH, temperature, concentrations of calcium and bicarbonate ions in water. Due to strong electro negativity, fluoride is attracted to positively charged calcium in teeth and bones. Fluorides combine with hydrogen ions to form hydrogen fluoride (HF), depending on the pH of the contents of the stomach (2.4% HF at pH 5; 96% HF at pH 2). HF easily crosses the gastric epithelium, and is the major form in which fluoride is absorbed from the stomach upon entering the interstitial fluid in the mucosa where the pH approaches neutrality. HF dissociates to release fluoride and hydrogen ions which can cause tissue damage. Whether damage occurs depends on the concentrations of these ions in the tissue. Single high doses of ingested fluoride are known to elicit acute GI symptoms, such as nausea and vomiting.

Conclusion

All the fish collected from endemic fluorosis area were contained high flurried levels in the fish, prawn and crab. However highest concentration was found in crab paratelphusa hydrodomus. The study reveals that the fish that were grown in Prakasam district are not suitable for human consumption. Fluoride contamination may be prevented or minimized by using alternate water sources include surface water, rainwater and low-fluoride groundwater. Apart from this poor nutrition also plays an important role in aggravating endemic fluorosis. Defluoridation of drinking water is the only practicable option to overcome the problem of excessive fluoride in drinking water, where alternate source is not available. During the years following the discovery of fluoride as the cause of fluorosis, extensive research has been done on various methods for removal of fluoride from water. Cost effective and low maintenance Defluoridation technologies may immediately be introduced in these villages to stop further degradation.

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