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ARTICLE

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TINY GANGETIC TITANS: INVESTIGATING TRACE ELEMENTS PROFILES IN SMALL INDIGENOUS FISHES

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Ganga river is rich in fish diversity, and consumers have wide choice for daily fish consumption. However, the micronutrient dense, small indigenous fishes (SIFs) are still not fully utilized but consumed regularly and are mostly part of fishermen's meals. In this context, trace element profiles (Zinc and Selenium) were analyzed by ICP-MS of ten SIFs collected from different stretches of river Ganga. The analysis revealed that among the SIFs studied, Eleotris fusca *was rich in both Zn and Se.*

Introduction

Fish is important for human nutrition, being rich in dietary essential nutrients like proteins, omega-3 (ω-3) polyunsaturated fatty acids, micronutrients like minerals and vitamins[1]. Among the fish, mainly the micronutrient dense, small indigenous fishes (SIFs) can be a key player in providing a balanced diet for human nutrition and eradicating micronutrient deficiency diseases, most common in the developing countries[2]. Some minerals are more commonly available in the aquatic organisms than in the mammalian flesh or plants like vitamin D especially in the oily fish or minerals like selenium, iodine, magnesium, calcium and also zinc. From a nutritional perspective, SIFs contribute many minerals in far higher concentrations than larger fish because they are consumed whole, including the bones and head. Ganga river is a crucial river system in India in terms of cultural, economic, and historical worth. In India, Ganga is the fifth largest river in the world as well as the longest that covers a long-distance of 2525 km starting from the Gangotri in the upper stretch and Gangasagar in the lower stretch. It is also used for navigation and communication. The variety of fish that the river supports is essential to the daily lives of thousands of people. It is thought to be the foundation of riverine fisheries in India. Beginning in the western part of the Himalayas, the Ganga River traverses eight Indian states, covering a total area of 1,051,540 km^2, before draining into the Bay of Bengal. This enables the river to nurture a diverse range of fish, including both warm- and cold-water species, throughout its entire course. Considering, only the freshwater portion of the Ganga river, earlier researchers documented the geographic distribution as well as comprehensive descriptions of one forty three fish (including seventy two taxa and thirty two families) that stretch from Gangotri (Uttarakhand) to Hooghly (West Bengal)[3].

Trace elements are the minerals that are present in smaller quantities in the living tissues. They can be further categorized to essential and non-essential trace elements. As the name indicates, essential trace elements are crucial for physiological functions in living beings and non-essential are not actively involved in any important biological functions. Iron, manganese, zinc, selenium etc. are some of the trace elements that are essential for maintaining normal homeostasis of the human body[4].

In this backdrop, the present study evaluated the trace element concentration (Zine, Zn and Selenium, Se) of ten small indigenous fishes (SIFs) (Fig. 1) from the Ganga river.

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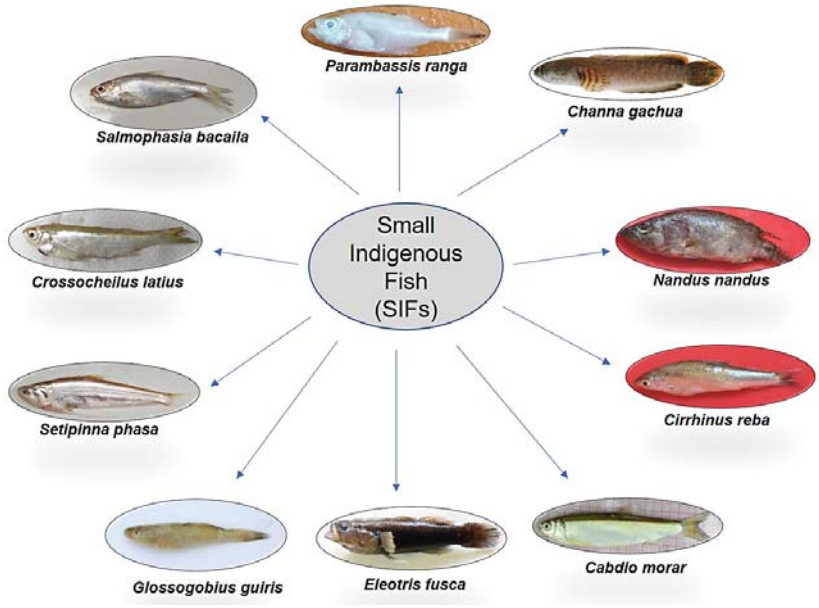

Fig. 1 Small Indigenous fishes (SIFs) collected from river Ganga (*Setipinna phasa*, *Channa gachua*, *Nandus nandus*, *Cirrhinus reba*, *Parambassis ranga*, *Salmophasia bacaila*, *Glossogobius guiris*, *Crossocheilus latius*, *Cabdio morar*, *Eleotris fusca*).

Methodology

Sample Preparation and Trace Element Analysis by ICP-MS: A total of ten distinct types of SIFs were collected from different landing stations along the river Ganga (Table 1). The length (in cm) as well as weight (in g) of all the fish were noted. After segregation, fish were cleaned in running tap water before further processing to remove dust and debris. The SIFs are generally eaten as whole fish so the entire fish was cleaned, descaled, and degutted, and then samples were pooled, minced, dried, and kept in zipper pouches. The trace elements Zn and Se were analyzed by ICP-MS (Inductively coupled plasma mass spectroscopy, NexION 1000, PerkinElmer, USA). At first, the dried fish sample (1g) was taken, and after the addition of Tri-acid (HNO_3:$HClO_4$:H_2SO_4) in the ratio of 10:4:1, the samples were then digested using a hot plate. After cooling, a final volume of 50ml was made using distilled water. A Meinhart nebulizer along with a cyclonic spray chamber were used in conjugation with an ICP-MS to analyse the trace elements[5].

A standard curve was prepared each time prior analysis. To optimise the result's accuracy and reliability, samples were injected in triplicate into ICP-MS, and the mean value was taken as the final concentration of the metals. Linearity (r^2) ranged between 0.996 and 0.999 for both Zn and Se. For calculating the recovery percentage of the method, spiked concentrations were used, which ranged between 85.40 and 112.74% with RSD < 12.50%. The LOD (limit of detection) and LOQ (limit of quantification) in µg/L were 0.017 and 0.216 for Zn and 1.729 and 5.240 for Se, respectively.

Statistical Analysis: MS Excel was used for data analysis and the data is expressed in mean ± standard deviation.

Observations

The micronutrient Zn is a necessary element, but in trace amounts, concentrations beyond the minimum acceptable concentration (MAC value) i.e. 50 mg/kg can cause major health problems like nausea, vomiting, and diarrhea[6]. Zn is an essential part of several enzymes

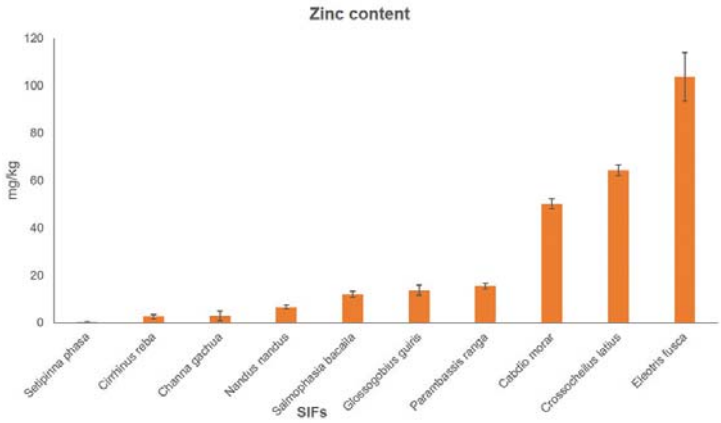

Fig. 2: Zinc content (mg/kg) in ten SIFs from the river Ganga. Among the fish analysed, Zn content was found to be highest in *Eleotris fusca* followed by *Crossocheilus latius* and *Cabdio morar*

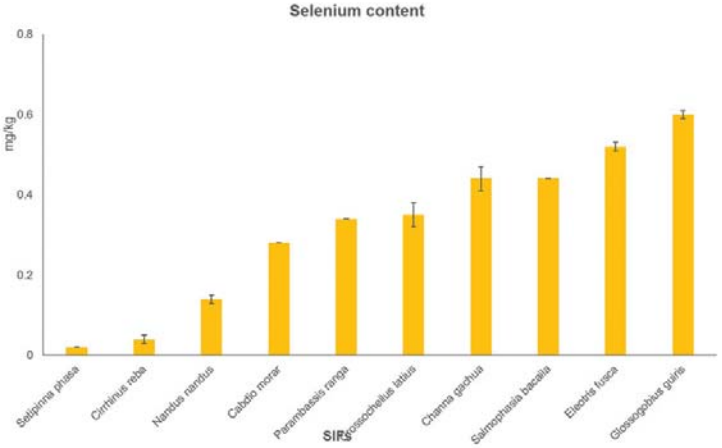

Fig. 3: Selenium content (mg/kg) in ten SIFs from the river Ganga. Among the fish analysed, Se content was highest in *Glossogobius guiris* followed by *Eleotris fusca* and *Salmophasia bacaila.*

that are associated in the metabolism of biomolecules like proteins, lipids, carbohydrates, nucleic acids, and other micronutrients. Zn contributes to maintaining cellular integrity by stabilizing the membrane's molecular structure and other biological components. Polynucleotide transcription, a stage in the expression of the genetic material, also requires zinc. All living things require zinc, which is probably because it is essential for these basic processes[7]. Trace element concentration analysis by ICP-MS revealed that among the SIFs studied, Zn content was found to be highest in *Eleotris fusca* (103.71 mg/kg), then *Crossocheilus latius* (64.24 mg/kg) and *Cabdio morar* (50.20 mg/kg) (Fig. 2).

Table 1: SIFs collected from different landing stations of river Ganga along with their common names

Sl no.	Fish species	Common name
1.	*Setipinna phasa*	Phasa
2.	*Channa gachua*	Gachua
3.	*Nandus nandus*	Nadosh
4.	*Cirrhinus reba*	Reba bata
5.	*Parambassis ranga*	Lal chanda
6.	*Salmophasia bacaila*	Chele
7.	*Glossogobius guiris*	Bele
8.	*Cabdio morar*	Pioly
9.	*Crossocheilus latius*	Kala bata
10.	*Eleotris fusca*	Bhut bele

Se is an essential trace mineral and is crucial for human health. Being a part of selenoproteins, it has both structural as well as enzymatic roles, and best known for its antioxidant properties and catalytic activity for the active thyroid hormone production[8]. The Se content was found to be highest in *Glossogobius guiris* (0.60 mg/kg), followed *Eleotris fusca* (0.52 mg/kg) and *Salmophasia bacaila* (0.44 mg/kg) (Fig. 3).

Conclusion

SIFs are rich in minerals and vitamins and the present study revealed that the SIFs may be used as natural dietary supplements to meet Zn and Se requirements of the human body. The SIFs which are mostly not preferred for daily consumption should be included as a part of a balanced diet and should also be brought into aquaculture owing to their nutritional richness.

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