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Comparative Study of Three Heavy Metals in the Muscle of Three Edible Fishes

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Abstract: ***This study aims to know the concentration of heavy metals in the muscle of three species of edible fish collected from Ramnagar market of Hyderabad city and to assess the possible health risks associated with its consumption. In this study, we used Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) to estimate cadmium (Cd), lead (Pb), and mercury (Hg) in different types of fishes, such as Rohu (Labeo rohita), Roopchand (Piaractus brachypomus) and MilkFish (Chanos chanos). The concentration range of heavy metals in this study is cadmium ranges from 0.04-0.05mg/kg, while lead is between 0.04-0.07mg/kg and mercury is 0.05mg/kg. The permissible limit for cadmium is 0.3mg/kg, lead is 1.5mg/kg and mercury is 0.5mg/kg given by FAO/WHO. By comparing the values obtained in the present study with those of permissible limit values, we can conclude that the consumption of these three fishes from the Ramnagar area does not cause any health risk to humans.***
Keywords: Heavy metals, cadmium, lead, mercury, edible fishes

I. INTRODUCTION

Heavy metals are metals with chemical elements, each of which has a relatively high density of atomic numbers and atomic masses of > 50 carbon units. Examples: cadmium (Cd), lead (Pb), arsenic (As), mercury (Hg), copper (Cu), zinc (Zn), nickel (Ni), etc., (Spiegel,2002). Among them, Zn, CU, and Ni are essential metals and have normal physiological regulatory functions. The non-essential heavy metals are Cd, Pb, As, and Hg as they are not necessary for metabolic activity. According to the properties of heavy metals Dmitri Mendeleev arranged them in p and d blocks in the periodic table [1]. Worldwide, heavy metal pollution in fish has become a major problem due to heavy consumption of fish by humans because of its nutritional benefits, high protein supply & omega fatty acids without knowing the fish polluted [2], [3]. Cadmium (Cd) is the 7th most toxic heavy metal as per ATSDR (Agency for Toxic Substance and Disease Registry) ranking [4] . Among non-essential heavy metals, Cadmium (Cd) is highly toxic and well recognized for its adverse influence on an enzymatic system of cells & oxidative stress. In the mammalian system, metallothionein plays a major role in determining the metabolism of Cadmium. Cadmium interferes with zinc in the enzyme system. A small dose of Cadmium may inhibit mitochondrial oxidative phosphorylation (Miller, W.J.1971). Lead is a highly toxic metal. It enters the body through ingestion or inhalation. Lead metal cause toxicity in living cells by ionic mechanism and oxidative stress [5]. The mechanism of lead toxicity occurs due to its ionic nature which replaces the bivalent cation like Ca^{+2}, Mg^{+2}, $Fe^{+2,}$ and monovalent cations like Na^{+1} which disturbs the biological mechanism of the cell. Lead can substitute Calcium [Ca] [5] which inhibits calcium-dependent events such as Protein- kinase –C [6]. Mercury is a heavy metal belonging to the transition element series of periodic tables [7]. Mercury exists in three forms i.e metallic elements, inorganic salts, and organic compounds (Transande et. al,2005). In human blood, mercury vapor oxidizes to mercuric ions. The ionic mercury is then circulated in the blood, bound mostly to plasma proteins [8]. The molecular mechanism of mercury toxicity is based on chemical activity and oxidative stress. In the cell both mercury and methylmercury form covalent bonds with cysteine residue protein.

The study aims to compare the concentration of the three heavy metals cadmium (Cd), lead (Pb) & mercury (Hg) in the muscle tissue of edible fishes namely Rohu (Labeo rohita), Roopchand (Piaractus brachypomus) and MilkFish (Chanos chanos).

II. METHODOLOGY

Edible fish samples of three different species of fish were collected from Ramnagar Market, Hyderabad, Telangana. The samples were collected in polythene bags and sealed and stored in an ice box and then taken to the laboratory for further analysis.

The procedure followed for the estimation of three heavy metals cadmium (Cd), lead (Pb) & Mercury (Hg) in the muscle of three edible fishes namely Rohu (Labeo rohita), Roopchand (Piaractus brachypomus) & Milkfish (Chanos Chanos) with the help of an Inductively Coupled Plasma Optical Emission Spectroscopy(ICP-OES) machine of the model of AVI0 200. 5gm of muscle tissue from each fish is taken for the estimation of three heavy metals. 5gm of sample digested with super pure nitric acid using 7ml of HNO_3^{+3} ml of H_20 after digestion made up to 25ml. Finally aspirated into ICP-OES against standard references.

Table 1: Scientific, common & local names of fishes

Scientific name	Common name	Local name
Labeo rohita	Rohu	Sheelavathi
Piaractus brachypomus	Pacu	Roopchand
Chanos chanos	Milk fish	Pala Bontha

III. RESULTS

The concentration of three heavy metals Cadmium, Lead & Mercury in the muscle of three edible fishes Rohu (Labeo rohita), Roopchand (Piaractus brachypomus) & Milkfish (Chanos chanos) are tabulated as below

Table 2: Concentration of heavy metals in fish samples

S. No	Scientific name	Cadmium (Cd) mg/kg	Lead (Pb) mg/kg	Mercury (Hg) mg/kg	Permissible limit (FAO/WHO:1984, 1989) mg/kg
1	Labeo rohita (Rohu)	0.04	0.05	0.05	0.3
2	Piaractus brachypomus(Roopchand)	0.05	0.07	0.05	1.5
3	Chanos chanos (Milk fish)	0.05	0.04	0.04	0.5

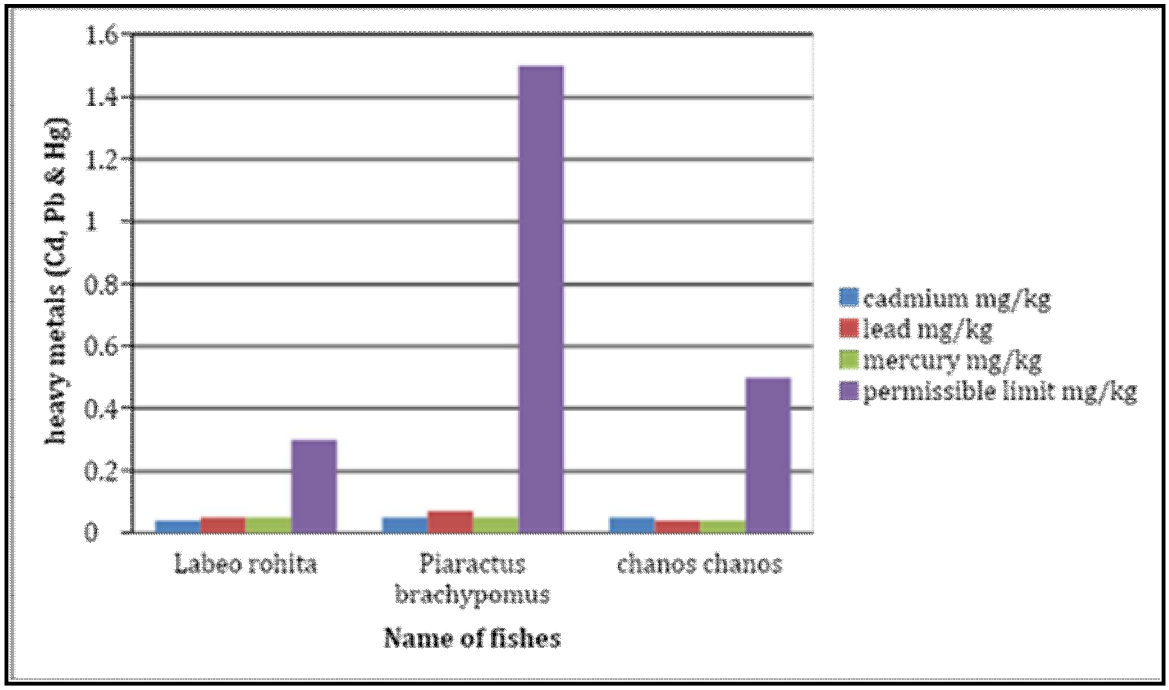

Figure1*:* Comparative graphical representation of the concentration of heavy metals in the muscle of different edible fishes taken with its permissible limits given by WHO/FAO (1984, 1989)

IV. DISCUSSION

Heavy metals are accumulated in aquatic ecosystems due to urbanization, industrial waste discharge, and agricultural runoff [9]. Aquatic pollution is one of the major rising problems globally and it also affects the total aquatic food. Ingestion of polluted fish and exposure to heavy metal cause health problems in people [10]. But in the current study, the focus is on the concentration of heavy metal in the muscles of the fish, because it is the part most consumed by people. The range of heavy metal concentration in my study is cadmium ranges from 0.04 - 0.05mg/kg while lead ranges from 0.04-0.07mg/kg and mercury ranges in 0.05mg/kg.

The permissible limit of Cadmium is 0.3mg/kg ,Lead is 1.5mg/kg & Mercury is 0.5mg/kg is given by FAO/WHO (1984, 1989) [11]. In the present study, we compared heavy metals (Cd, Pb &Hg) in the muscle of three edible fishes namely Labeo rohita (Rohu), Piaractus brachypomus (Roopchand), and Chanos chanos (Milkfish), and found to be less than the permissible limit given by WHO/FAO (1984,1989).

V. CONCLUSIONS

By comparing the results of this study with permissible values given by FAO/WHO (1984,1989), we can conclude that the three heavy metals cadmium, lead, and mercury in three different edible fishes seen in the same concentration with a slight difference and by consuming these three fishes namely Rohu (Labeo rohita), Roopchand (Piaractus brachypomus) & Milkfish (Chanos chanos) does not cause any health risk to human.

VI. ACKNOWLEDGMENT

Study design: ASD, CM; Data collection: ASD; Data analysis and interpretation: ASD, and CM; Drafting of the manuscript: ASD and CM; Revising manuscript: ASD, and CM; CM takes responsibility for the integrity of the data analysis. The authors have no conflict of interest.

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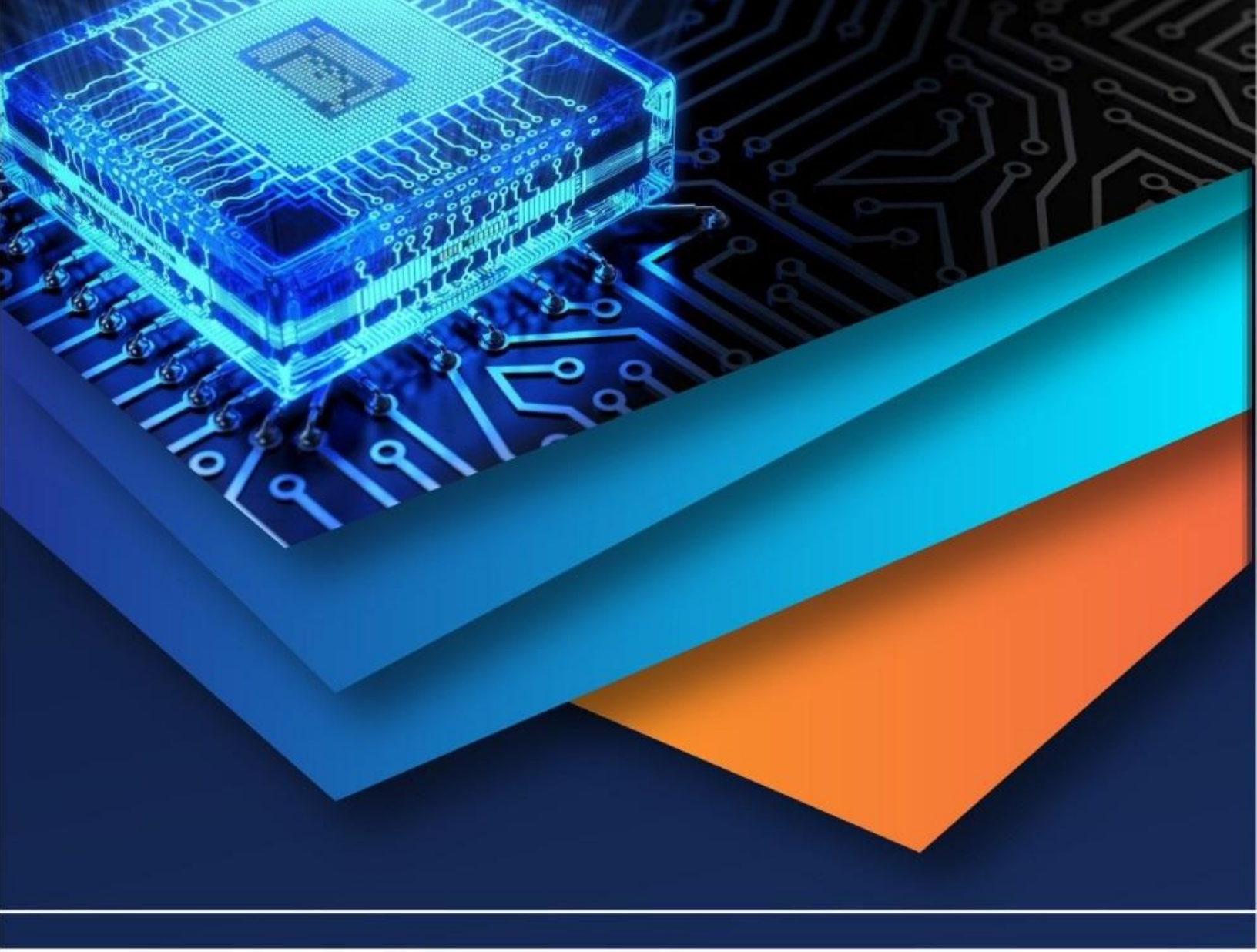

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