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Analysis of Mercury in Seafood by Cold Vapor Atomic Absorption Spectroscopy

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Abstract: Mercury concentration in seafood from Pakistan coast is being reported. For this purpose ten different fish specie were examined for the analysis of Mercury. Mercury concentration in prawn and crab specie was also determined. The samples were collected from coastal area of Karachi, namely Vindar, from where it is not only supplied to local markets but also exported to different countries. Mercury concentration in muscles of Mushka (Pseudosciena sina) is found to be higher as compared to other specie. Determination of Mercury has been carried out by Cold Vapor Atomic Absorption Spectroscopy.

Key words: Mercury, seafood, toxicity, cold vapor atomic absorption spectrophotometer

INTRODUCTION

For centuries, fish has been a source of food for man. The numbers of fish specie are estimated to range between 15000 and 40000 (Cohen, 1970). The seafood is normally defined as; the flesh or muscle tissues of the animal used as food but this may include other edible tissues. Like other living organisms, fish contains most of the ninety naturally occurring elements, like carbon, hydrogen, nitrogen, oxygen and sulfur. Other elements like calcium, magnesium, phosphorus, sodium, potassium and chlorine are also present in gm per kg quantity. Some other elements are also present but in trace amounts (at mg or μg kg^{-1} level). Monitoring of the level of these elements in seafood may indicate the quantity of such food. Among other elements trace metals have great importance as indicators of pollution and Mercury is one of them. Toxicity of Mercury is well known.

The annual production of Mercury in world has decreased recently in the industrialized countries, as people are getting aware of the toxicity and diseases caused by this metal. However, still a large portion of its production reaches the seas and oceans. Different industrial processes are carried out using Mercury like Chlorine and Caustic soda manufacturing industries use Mercury electrodes and during the process about 150–200 g of Mercury per ton of product is lost in the environment and sea (Clark , 1992).

Mercury has the tendency to accumulate in marine organism and the cause of this accumulation in fishes is its peculiar property where in it gets methylated by marine bacteria. The Mercuric ion has 5–10% absorption rate in the gastrointestinal tract of man and animals. The methylated Mercuric ion however is strongly absorbed in intestine (Ruiter, 1995). Mercury concentration is high in the flesh of fishes which are carnivorous than in herbivorous (Klemmer *et al*., 1976). The Mercury levels in fishes generally depends upon several factors, like the position of the fish in the food chain, size (Barak *et al*., 1990a,b; Baghigiani and Raniesi, 1992) and age (Kruger, 1990). For these reasons it is pretty difficult to give a normal value of Mercury in fish and other aquaculture. Most species of fish in oceanic waters contain 150 μg kg^{-1}. Much higher values are found in fish from contaminated waters (Clark, 1992). The distribution of metal in fishes is specie – specific as well as site – specific (Kruger, 1990).

The danger of Mercury pollution to the environment has accelerated the speed of progress of analytical methods for Mercury determination. Improvements to the instruments, like cold vapor generation technique in the field of Atomic Absorption Spectroscopy, has made it possible to determine the Mercury concentration in the natural samples up to sub – ppb level (Hatch and Ott, 1968). Cold Vapor Atomic Absorption Spectroscopy was first proposed by Poluektov *et al*. (1964) and Hatch and Ott (1968). Since then several improvements have been made to this technique, but all involve measurements of transient atomic absorption signal of the elemental Mercury vapor.

In the present study, Mercury concentration has been determined in different fish specie, crab (Pertunus plagicus) and a prawn specie. The samples were collected from the coastal area of Karachi, namely Vindar, near the power plant, Korangi Creek, during the summer season in the month of August.

MATERIAL AND METHODS

All the atomic measurements were carried out with a Perkin Elmer model 3100 coupled with an MHS – 10 (Mercury/Hydride) system, also from Perkin Elmer

The working conditions were as follows

1	Wavelength for Mercury	253.7 nm
2	Lamp current	6 mA
3	Spectral band width	0.7 nm
4	Carrier gas	99% pure nitrogen operated at 3.0bar

comp. USA. The apparatus was equipped with a Mercury Hollow Cathode lamp from Cathodeon Corp. The gas flow quartz cell was 162 mm in length and 13mm in diameter, constructed from Pyrex tubing.

All the reagents of analytical grade (Merck) were used. To eliminate Mercury from other reagents, appropriate blanks were run containing all the reagents for every sample. A Si antifoaming agent, was used to avoid excess foaming during analysis. Deionized distilled water was used having conductance not more than 2.25×10^{-4} mhos

Sample were collected from the local market in replicates, in polythene bags and stored in freezer at temperatures of lower than –4°C.The method employed here for sample pretreatment is extraction rather than digestion, as this method is less time consuming and more accurate (Matsunaga *et al*., 1976). In this method Mercury is liberated completely from fish sample with a solution in the presence of 1M HCl and Cupric ion (Moore, 1991). The mechanism of action seems to be based on the degree of stability of the chelating compounds. It was found that Mercuric ion was set free in exchange of cupric ion with the Mercury present in the tissues. The method is simple and its accuracy is comparable with results obtained by other analytical techniques pertaining to fish samples (Matsunaga *et al*., 1976).

Only muscle tissues from skinless fillets of the fish were tested from each specimen. 10 gm of finely cut tissues were homogenized from each specimen with a little deionized distilled water. The homogenized fish sample paste was transferred to a 250 ml volumetric flask containing 0.5 g of $CuCl_2$ salt and 20 ml of 1M HCl solution. Then the volume of the flask was made up to the mark. This solution was transferred in 25 ml centrifuge tubes and centrifuged at 3000 rpm until the clear upper layer is obtained; the upper clear solution was collected in a separating funnel.

10 ml of pretreated sample solution was taken in the reaction flask of MHS-10 analyzer followed by addition of 10 ml of 1.5% HCl, two drops of Silicon antifoaming agent and one drop of 5% $KMnO_4$ were added. 3% $NaBH_4$ solution in 1% NaOH is run through the reaction flask for quantitative analysis through Atomic Absorption Spectroscopy.

RESULTS AND DISCUSSION

The total Mercury contents in the mentioned seafood were found to be in the range of 0.2 μg $g^{-1}$to 0.12 μg g^{-1}as shown in Table 1. Only the muscles were analyzed

Table 1: Concentration of Mercury in different specie in μg g^{-1}

Name of the specie	Concentration of Hg (μg g^{-1})
Sillago shima	0.029±0.00939
Liza subviridis	0.035±0.011625
Pertunus plagicus(crab)	0.0445±0.00189
Prawn	0.0204±0.0796
Alia dumeri	0.0442±0.0207
Pomadasys kaakan	0.036±0.01294
Alepes melanopfera	0.043±0.00366
Pampus argenteus	0.03925±0.009567
Cynoblosses bilineata	0.0475±0.00716
Chirocentrus dorab	0.04025±0.00845
Lepturacenthus savala	0.0355±0.0071125
Psedosina sina	0.11575±0.0379

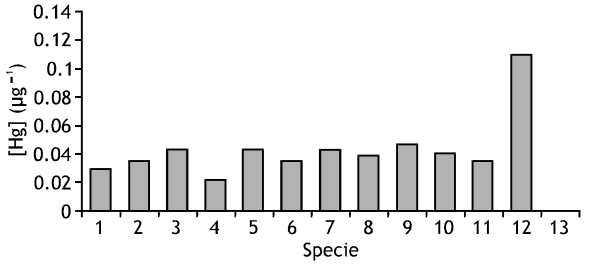

Fig. 1: Concentration of Mercury in different specie in μg g^{-1} 1. Sillago shima, 2. Liza subviridis, 3. Pertunus plagicus(Crab), 4. Prawn, 5. Alia dumeri, 6. Pomadasys kaakan, 7. Alepes melenopfera, 8. Pampus argenteus, 9. Cynoblosses bilineata, 10. Chirocentrus dorab, 11. Lepturacarthus savala, 12. Pseudosina sina

priorly because Mercury was reported to mainly accumulate in muscle tissues rather than other organs and tissues (Moore, 1991) and that tissues are commonly the main constitute of seafood. This may result from the lipophilic character of Methyl Mercury, which is the main chemical form of Mercury in fish. High concentrations of Mercury had been reported earlier (Tariq *et al*., 1996), like 3.012 μg g^{-1}in Thilapia mozambica, 2.917 μg g^{-1} in Thilapia nilotice, 3.920 μg g^{-1} in Channa marulius and 1.982 μg g^{-1} in Mystus seenghala, caught from different sites of River Indus. The species investigated and reported here differ in Mercury contents because these different specie from the one which had been reported earlier and have different migratory and feeding habits as well as different metabolic and excretion rates. Furthermore they hold different positions in the

marine food. The highest value that has been found is in Pseudosina sina which is 0.11575 μg g^{-1}, which is in the limits given by WHO (3.3 μg kg^{-1}). All the fish samples were found to contain mercury within the safe limits.

REFERENCES

Baghigiani, I. and S. Raniesi, 1992. Mercury Content in Different Size, Classes of Important Edible Specie of Northern Tyrrhenian Sea. Marine Pollution Bulletin 24.

Barak, N.A.E. and C.F. Mason, 1990a. Mercury, Cadmium and Lead in Eels and Roach; The Effect of Size, Season and Locality on Metal Concentration in Fish Liver. The Science of Environment Vol. 92.

Barak, N.A.E. and C.F. Mason, 1990b. Mercury, Cadmium and Lead concentration in Five Specie of Fresh Water Fish from Eastern England. The Science of Environment Vol. 92.

Clark, R.B., 1992. Marine Pollution. Clarendon Press Oxford.

Cohen, D.M., 1970. How Many Recent Fishes are There? Proceeding California Academy of Science, 4th Seies 38 :17.

Hatch, W.R. and W.L. Ott, 1968. Determination of submicrogram quantities of mercury by atomic absorption spectrophotometry. Anal. Chem., 40: 2085-2087.

Klemmer, H.W., C.S. Unniyer and W.I.Okubo, 1976. Mercury content of Biota in Coastal Waters in Hawaii. Bulletin of Environment.

Kruger, K.E., 1990. Der Quecksil Bergehalt Der Seefishei Erste ergebmisse Einer Trendshidie. Tagging Des Arbeitsgebietes, Lebensmitelhygiene. 31 Garmisch-Partenkirchen. 25 October.

Matsunaga, K., T. Ishida and T. Oda, 1976. Extraction of mercury from fish for atomic absorption spectrometric determination. Anal. Chem., 48: 1421-1423.

Moore, J.W., 1991. Inorganic Contaminants of Surface Water. Springer- Verlag, New York

Poluektov, N.S., R.A. Vitkun and Y.V. Zelyukova, 1964. Determination of milligamma amounts of mercury by atomic absorption in the gaseous phase. Zh. Analit. Khim., 19: 937-942.

Ruiter,A., 1995. Contaminants in Fish: Fish and Fishery Products, Composition, Nutritive Properties and Stability. Edited by A. Ruiter. CAB International, Wallngford.

Tariq, J., M. Ashraf, M. Jaffar and M. Afzal, 1996. Pollution Status of the Indus River, Pakistan Through Heavy Metals and Micro Nutrient Content of Fish, Sediments and Water. Wat. Res., 30: 1337-1344.