Pollution Of Imported Basa Fish Fillets By Some Heavy Metals

El-Sayed S. El-Sebaey
Central Laboratory of Faculty of Veterinary Medicine, Zagazig University

ABSTRACT

This study was conducted to quantitate the concentrations of heavy metals, such as Cd, Pb, Cu and Zn in imported Basa fish (*Pangasius hypothalamus)*. The concentrations of Cd, Pb, Cu and Zn were determined in fourty (40) samples (*Pangasius hypothalamus*), which were imported from Vietnam and obtained from different shops and markets at Sharkia governorate, Egypt. Samples of frozen Basa fish fillets were collected bimonthly between December 2008 and February 2009. The metals: Cd, Pb, Cu and Zn were recorded in appreciable quantities, signifying their bioavailability. The levels of Cd, Pb, Cu and Zn may have obvious health implications on the communities that depend on fish species as fish supplement in view of its rich protein content and its bio-economic value. The statistical analytical results indicated that Basa fish fillets contained residues (Cd, Pb) above the permissible limits.

INTRODUCTION

Basa are species of fresh water catfish native to the Mekong River Delta in Vietnam, and Chao Phraya basin in Thailand. They are belongs to the family of pangasidas or shark catfish, these fish include *pangasius hypothalamus* (irridescent shark) and *Pangasius pangasius* (yellow catfish). *Pangasius hypothalamus* fillets were characterized by high moisture content (80 - 85%), low protein (12.6 - 15.6%) and lipid (1.1- 3.0%) *(1)*.

Recently, in the year 2008, basa fish (*Pangasius hypothalamus*) introduced to Egyptian markets as frozen fillets. However, in a very short time it has grown popularity; this was mainly due to its low price.

Fish have the ability to accumulate heavy metals in their tissues to higher levels (several hundred times) more than the concentration of such metals in their surrounding water medium *(2, 3)*.

Sources of cadmium pollution to aquatic environment including the mining company, industrial company, sewage sludge applied to land and phosphate fertilizer. While, the production of phosphate fertilizer may be the main source of cadmium in the environment. Cadmium is a toxic metal which causes a broad spectrum toxicological and biochemical dysfunctions *(4)*. Cadmium has been known to have contributed to pulmonary disease, reduced glucose tolerance, severe kidney and liver damage and death in human beings *(5)*.

Lead levels in edible tissues of fish over permissible limits are implicated in chronic lead toxicity (Plumbism) results in anemia, abdominal pain (lead colic) encephalopathy, renal damage, lead palsy. Recently, lead is considered as one of immunosuppressive agents in animal and human *(6)*. Moreover, Lead contamination has a serious public health hazard such as nervous manifestation, arthritis, immune suppression and infertility problems in human and animals *(7)*. Lead is known as a deadly and cumulative poison even when consumed in small quantities and is capable of deadening nerve receptors in man *(8)*.

Fish importing countries have instituted regulation and quality requirements and standards for many chemical hazards including toxic metals in fish and fishery products. The Egyptian Organization for Standardization and Quality Control *(9)* have set safety limits for such hazards, it has become mandatory for all fish exporting countries to monitor the levels of trace metals in their fishery products. Egyptian Organization for Standardization and Quality Control pointed that the maximum levels for cadmium (Cd), lead (Pb), copper (Cu) and zinc (Zn) must not exceed 0.1, 0.1, 20 and 50 ppm, respectively.

The present study planned to fulfill detection of heavy metals Cd, Pb, Cu and Zn in muscular tissues of Basa fish fillets (*Pangasius hypothalamus*) which collected from different shops and markets at Sharkia governorate, Egypt, as well as a comparative between the obtained results and the standard limits of *(9)*.

MARTIAL AND METHODS

Collection of samples

Fourty samples of frozen Basa fish fillets were collected during 2008 and 2009 from different shops and markets at Sharkia governorate, Egypt. The fish specimens were individually placed in clean polyethylene bags and immediately taken to the laboratory where they were kept deeply frozen at -20°C until the samples were prepared for digestion and analysis.

Preparation and analysis of samples

Estimation of metals concentration (Cd, Pb, Cu and Zn) was carried out in Central Laboratory of Faculty of Veterinary Medicine, Zagazig University. All results were expressed as ppm (mg /kg).

Whole samples were oven dried and pulverized into fine textures. Two grams of oven-dried samples were dissolved in distilled water in a digestion flask and digested with a mixture of 10 mL of concentrated nitric acid and 2 mL of concentrated perchloric acid. The contents of the flask were digested gently and slowly, by heating in a water bath till the contents got to near dryness. It was then set aside to cool. The digest was filtered into a 50 mL volumetric flask, made up to mark with distilled water. Aliquots of the filtrates were used to estimate the concentration of the various metals by using Atomic Absorption Spectrophotometer (model 210 VGP, Buck Scientific USA) with an oxidizing air acetylene flame. *(10)*.

RESULTS

Table 1. Ranges and mean of heavy metal concentrations (ppm) in *Pangasius hypothalamus* (N = 40)

Metals	Residual metals concentration/ ppm		
	Min	Max	Mean ± SE*
Cd	0.02	1.14	0.13 ± 0.043
Pb	0.06	2.81	1.03 ± 0.11
Cu	0.49	2.24	1.43 ± 0.23
Zn	0.08	8.96	3.57 ± 0.33

N = Number SE* = Standard error

Table 2: Heavy metal concentrations (ppm) in *Pangasius hypothalamus* compared with permissible limits of *(9)*

Metals	Heavy metal concentration / ppm			
	Within P.L. *		Over P.L. *	
	No.	%	No.	%
Cd	22	55	18	45
Pb	1	2.5	39	97.5
Cu	40	100	-	-
Zn	40	100	-	-

P.L. * = permissible limit.

DISCUSSION

1.Cadmium (Cd)

The presence of cadmium in seafood is of a serious concern in recent years, due to its cumulative effect and toxicity to the consumer *(11)*. Cadmium poisoning may lead to anemia, bone disease, cirrhosis, diabetes impotence and kidney and liver damage *(12)*.

The obtained results in Tables 1,2 showed that the residual concentration of Cd in muscle of Basa fish fillets was in a range of 0.02 to 1.14 ppm with a mean value of ± SE 0.13 ± 0.043 ppm. Twenty two (22) samples (55%) were within the permissible limits, while 18 samples (45%) were over the permissible limits (0.1 ppm) *(9)*.

Nearly similar results were recorded *(13)* where Cd level in *Claris lazera* collected from River Nile at Assiut governorate ranged from 0.014 to 0.62 ppm and the mean concentration of (Cd) residues in Catfish at Qena governorate , Egypt was 0.45 ppm *(14)*.

Higher results were recorded *(15)* which reported that the Cd level in muscle of six species of fish collected from fresh water lakes of Pakistan ranged from 0.15 to 1.121 mg/kg and it has been reported that the mean value of Cd in 56 imported fresh and frozen fish samples collected from a local market in Jordan was 3.32 and 1.46 ppm, respectively *(16)*. Moreover, lower results were recorded *(17)*, which reported that (Cd) level in flesh of five species of fresh water fish from eastern England ranged from 0.01 - 0.05 ppm. Also Cd residue in the muscle of Catfish at Behera governorate, Egypt during the year 2008 were 0.062 ppm *(18)*.

2. Lead (Pb)

Lead is one of the most important pollutants in our environment which accumulates in the body due to its low rate of elimination; its biological half-life in bones is a bout 27 years *(19)*.

Table 1 revealed that minimum, maximum and mean values ± standard error of Pb contents in Basa fish fillets were 0.06, 2.81 and 1.03 ± 0.11, respectively.

The present results were nearly parallel to that previously recorded *(20)* where the average concentration of trace metals in the edible fillets of all fish samples which taken from Occoquan reservoir in Virginia was eleven out sixty four basa had level of (Pb) in the fillets above that recorded *(21)* where the level was 0.25 mg/g, Pb concentration in muscle of *Clarias lazara* fish collected from Assiut governorate was 1.780 ppm *(22)*.

Higher results were recorded *(23)* where Pb the concentration in an edible part of fish was 48.7 mg/kg and the concentration of (Pb) in muscle of fresh water fish from Pakistan ranged from 0.765 to 45.316 mg/kg *(24)*.

On the other hand, lower results were recorded *(25)* where the mean value of (Pb) in six fresh water fish from river in the province of Turin was 0.09 ppm. Pb level in fish muscle of different species from the Arabian Gulf and Shat Al-Arab River, Iraq ranged from 0.02 to 0.82 mg/kg dry weight *(26)*. In addition, the mean value of (Pb) in River Nile Fish (*Clarias lazera*) collected from Assiut Governorate Egypt was 0.456 ± 0.01 ppm *(27)* and in the muscle of Nile Catfish during the year 2008 at Behera governorate was 0.204 ppm *(18)*.

Comparing the results with the data outlined *(9)*, it is evident that one sample (2.5%) of Basa fish fillet contained Pb level within the permissible limits. Whereas (39) samples (97.5%) exceeded the permissible limits (0.1 ppm) as presented in (Table 2).

3. Copper (Cu)

The obtained results (Table 1) showed that the residual concentration of (Cu) in muscle of Basa fish fillets was in a range of 0.49 to 2.24 ppm with mean values ± standard error 1.43 ± 0.23 ppm. All examined samples (100 %) were within the permissible limits (20 ppm) *(9)*.

Similar trend in metal levels was observed where it has been found that (Cu) content in edible parts (muscle, fillet) of 49 commercially used fish species from Mediterranean Sea was 1.14 mg/kg *(28)*. However, higher levels has been reported *(29)*. The mean concentration of (Cu) in fresh water fish was 0.5 - 8.6 ppm Cu concentration in fresh water fish (*Clarias lazera*) caught from Nile River at Assiut governorate was 9.59 ppm *(30)*. The average of (Cu) level in muscle of catfish at Assiut governorate was 5.55 ppm *(27)*.

On the other hand, lower result was recorded in Catfish at Qena governorate where it was 0.35 ppm *(14)*. Also the (Cu) level in muscle of catfish at Behera governorate was 0.793 ppm *(18)*.

Copper poisoning include nausea, vomiting, diarrhea, hematemesis and jaundice, while chronic disease from excessive copper storage was epitomized (Wilson's disease) which characterized by excessive copper deposition in most organs (liver, kidney, brain and eyes) *(31)*.

4. Zinc (Zn)

The results given in Table 1 pointed out that a wide variation in tissue concentration of Zn residues (0.08 - 8.96 ppm), while the mean

value was 3.57 ± 0.33. According to Table 2, all examined samples (100%) were within the permissible limit (50 ppm) ***(9).***

Higher results were recorded where Zn level in edible parts of fresh water fish ranged from 1.87 to 50.6 ppm ***(24)*** and the Zn level in edible part (muscle and fillet) of 49 commercially fish species from the eastern Mediterranean sea were 8.6 and 9.73 mg/kg, respectively ***(32)***. However, lower results were recorded where Zn level in catfish at Qena governorate were 2.9 -3.9 ppm ***(14)***. Also Zn level in muscle of Nile catfish at Behera governorate was 2.078 ppm ***(18)***.

Zinc toxicity from excessive ingestion is uncommon but gastrointestinal disturbances and diarrhea has been recorded ***(33).***

It therefore follows that Basa fish, known as bottom feeders, would record elevated levels in the study. The high levels of metals in the catfish gives a cause for concern when viewed in perspective to community health issues, as the communities depend directly on catfish as a major protein source.

It has been concluded that the appreciable levels of Cd and Pb observed in this study would have detrimental effect on the health of the community (the ultimate consumers in the food chain) in Egypt. It is therefore recommended that more stringent management/control measures should be adopted to reduce the amount/levels of pollutants discharged into the imported Basa fish fillet from Vietnam._As a result of the probable impact of these pollutants on community health, the health and food and/or relevant authorities should institute quarterly monitoring programmes on the levels of these pollutants in the Basa fish fillets.

REFERENCES

1 . ***Orban E, Nevigato T, Masci L M, Casini J, Gambelli L and Caproni R (2008):*** New trends in the seasfood market sutchi catfish (*Pangasius hypothalmas*) fillets from Vitenam, Nutritional quality and safety aspects Italy, Food Chemistry Vol. 110 (2): 383-389.

2.Nammalwar P (1983): Heavy metal pollution in marine environment. Sci. Rep. 3: 158.

3.Marouf H A and Dawoud AS (2006): Evaluation of heavy metals content in fresh water cray fish in Damietta. J. Egypt. Vet. Med. Assoc., 66 (3): 217-225.

4.Funakoshi T, Ohta O, Shimada H and Kojima S (1995): Effects of dithiocarbamates and cadmium on the enzymatic activities in liver, kidney and blood of mice. Toxicol. Lett, 78: 183-188.

5.Voogt dept van HB, Feemstra JP and Copius peeretom JW (1985): Exposure and health effects of cadmium. Toxicol. Environ. Chem. Rev., (3), 89-109

6.Koller LD (1979): Effect of environmental advanced in veterinary science and comparative medicine, 23: 267.

7.Robaire B and Hales B F (2003): Advances in male mediated developmental toxicity (kluwer / plenum, New York, 2003)

8.Bodansky O and Latener A L (1987): Advances in Clinical Chemistry. Vol. 20 Academic Press. New York. 288.

9."EOSQC" Egyptian Organization for Standardization and Quality Control (1993): Maximum levels for heavy metals contamination in food E. S. No. 2360.

10.AOAC (1990): Association of Official Analytical Chemists. Offacial Methods of Analysis 15th ed.Vol.I.Arlington, Virginia USA. 247 pp.

11.Prafulla V, Francis L and Lakshmanan P T (2001): Concentration of trace metals in the squads, Loligo duvaucli and doryteuthis sibogae caught from the south west coast of India. Asian Fisheries Science (14): 399-410.

12.Klassen CD (2001): Casarett and Doull's. Toxicology The basis science of poisons 6th ed. (McGraw – Hill, New York, 2001).

13.Abd El-Nasser M, Shaaban AA, Ally SM and Sayed MM (1996): Level of some heavy metals in fish caught from River Nile at Assiut governorate, Egypt. Assiut Vet. Med. J. 34: 68

14. ***Labib H Y, Nassar A, Ahmed A and Shaker A (2000):*** Pollution of Nile fish by some heavy metals at Qena, Upper Egypt. Assiut Vet. Med. J.

15. ***Tariq J, Ashraf M and Jaffar M (1994):*** Assessment of pollution of rivers Jehlum and Sutlej, Pakistan through trace metals in fish, sediment and water. Toxicol. Enviorn. Chem. 43: 169.

16. ***Juma H, Battah A, Salim M and Tiwari P (2002):*** Arsenic and Cadmium levels in important fresh and frozen fish in Jordan. Bulletin of Environmental Contamination and Toxicology 68 (1): 132-137.

17. ***Barka N A and Mason CF (1990):*** Survey of heavy metals levels in eel (*Anguilla anguilla*) from some rivers in east Anglia England. The use of eels as pollution indicators. Int. Revue Ges, Hydrobiol. 75: 827-833.

18. ***Abdel–Hasseb A and El-Sebaey ES (2009):*** Monitoring of some trace and heavy metals residues in nile Catfish (*Clarias lazera*) at Behera Governorate, Egypt. Alex. J. Vet. Vol. 28 (1): 149-155.

19. ***Schibamoto, T. and Bjeldances, L. F. (1993):*** Introduction to Food Toxicology. Academic press, Inc. Harcourt Brace and company. New York Food Science and Technology, International Series.

20. ***Paul R J (1999):*** Trace metals in fish from a reservoir receiving runoff from developing water shed. Master's thesis of science, Department of civil engineering. Virginia Tech. Univ.

21. ***FDA (1998):*** Fish and fisheries products Hazards and Control Guide. 2nd Ed. Appendix 5 FDA and EPA guidance levels US. Food and Drug Administration. Office of Seafood Washington, D.C.

22. ***Sayed MM (1995):*** Toxicological studies on some metallic pollution in River at Assiut governorate. M. V. Sc., Fac. Vet. Med. Assiut Univ.

23. ***Kruse R and Kruger K E (1984):*** Toxic heavy metal and chlorinated hydrocarbon content in North Sea fish in relation to food legation. Archive Fur. Lebensmittelhygiene, 35 (6): 128-131.

24. ***Jaffar M, Ashraf M and Rosool A (1988):*** Heavy metals contents in some selected local fresh water fish and relevant waters. Pakistan Journal of Scientific and industrial research 31 (3): 189-193.

25. ***Parisi E, Forneris G and Giaccone V (1986):*** Fresh water fish as biological indicator of heavy metal pollutions. Industrie Alimentari, 25 (236): 214-218.

26. ***Abaychi J and Al-Saad H T (1988):*** Trace elements in fish from the Arabian Gulf and the shatt Al-Arab River, Iraq. Bull, Environ. Contam. Toxicol. 40: 226.

27. ***Seddek A S H, Salem DA, EL-Sawi N M and Zaky Z M (1996):*** Cadmium, lead, nickel, copper, manganese and fluorine levels in Rive Nil Fish. Assiut Vet. M. J. (34): 95.

28. ***Celik U and Oehlenschlager J (2005):*** Zinc and copper content in marine fish samples collected from eastern Mediterranean sea in Turkey. European Food Research and Technology 220 (1): 37-41.

29. ***Fernandey – Aceytuna G J, Ricoconzalez J, Hernandez L M and Balya G (1984):*** Organ chlorine and metal pollution in aquatic organisms from the parque nacional de danana spain. Revista de Agroquimicay Technological de Alimenta, 24 (2): 221-232.

30. ***Hassan H A and Youssef H (1985):*** Determination of cadmium, copper and zinc in muscles of some fresh water fishes. Assiut Medical Journal.

31. ***Zenz CL (1988):*** Occupational Medicine Principles and Practices 2nd Ed. Elsevier New York.

32. ***Celik U and Oehlenschlager J (2004):*** Determination of zinc and copper in fish samples collected from North East Atlantic Turkey. Food Chemistry 87 (3): 343-347.

33. ***Casarett and Douill's (1996):*** Toxicology, the Basic Science of Poisons 5th Ed. Mc Graw – Hill Companies, Inc., USA.

الملخص العربي

تلوث فيليه أسماك الباسا المستوردة ببعض المعادن الثقيلة

السيد سليمان السباعى
المعمل المركزى – كلية الطب البيطرى – جامعة الزقازيق

تم جمع عدد أربعون عينة عشوائية من فيليه أسماك الباسا المجمد (منزوع العظم والجلد) والمستورد من فيتنام والمعروض للبيع في محلات واسواق محافظة الشرقية بمصرحيث تم تحليل العينات للكشف علي بقايا عناصر الكادميوم والرصاص والنحاس والزنك بواسطة جهازمقياس الضوئي الطيفى بعث اللهب / الامتصاص الذرى. وأشارت نتائج التحليلات الاحصائية إلى أن أسماك الباسا المستوردة تحتوى علي بعض بقايا بعض المعادن الثقيلة أكثر من الحدود المسموح بها وهي الكادميوم بنسبة ٤٥% والرصاص بنسبة ٩٧,٥% وذلك طبقاً للمواصفات القياسية المصرية (١٩٩٣). هذا وقد نوقشت مصادر التلوث البيئي بمثل هذه المعادن وعليه يتضح ضرورة الحيطة والحذر من ارتفاع معدلات التلوث بالكادميوم والرصاص فى هذه الأسماك مع التأكيد علي اتخاذ كافة الإجراءات الصحية المرتبطة بذلك. هذا وقد نوقشت خطورة المعدلات الزائدة لتلك المعادن علي صحة وسلامة الإنسان.