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Concentrations of Manganese in Edible Tissues of Slaughtered Animals in upper Egypt

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ABSTRACT

A total of 168 samples of livers, kidneys and muscles (part of the diaphragm) were screened. The samples were subjected to preparation & for measurement the level of copper by using Atomic Absorption/Flaming Emission Spectrophotometer. Buffaloes organs showed variations in their manganese content.Results revealed that manganese concentrations in buffalo livers were 3.82 ±0.61 as a mean where the levels varied from 2.85 to 5.36 µg/g wet weight. In kidneys of buffalo the minimum, maximum and mean values were 1.50, 4.47 and 2.96 ± 0.71 µg/g wet weight, respectively. Moreover, the mean concentrations of manganese in muscles of buffalo was 1.85 ± 0.52, with a minimum of 0.89 and a maximum of 2.68 µg/g wet weight. On the other hand, for cattle, mean ± standard deviation and range of manganese concentrations in livers were 4.54 ± 2.51 and 2.14-14.14 µg/g wet weight, respectively. While the corresponding values in kidneys were 3.07 ± 2.47 and 0.89 -13.57 µg/g wet weight. Moreover, the mean concentrations of manganese in muscles of cattle was 3.11 ± 5.5 with a minimum of 0.89 and a maximum of 28.57 µg/g wet weight. In conclusion, livers samples have high concentrations of manganese than kidneys and muscles.

Keywords: *Manganese toxicity in cattle, Manganese toxicity in buffaloes, Egypt.*

INTRODUCTION

Although metals are perhaps the longest known toxic agents, they are still of scientific interest. Hence, knowledge regarding their potential toxic effects and mechanisms of action has increased in recent years (Gutierrez et al., 2007).Metal as, manganese is considered essential for humans but lead to toxic effects when ingested in excess(Frias et al., 2008). Food and water are the main sources of metals for humans (Rubio et al., 2005; Gonzalez-Welleret al., 2006). Manganese is an essential nutrient to humans as it acts as an activator and a constituent of various enzymes. It is involved in carbohydrate and fatty acid metabolism and the synthesis of arginase and coenzyme A and represents a component of metalloenzymes like superoxide dismutase A (Reilly 2002; Nielsen 1994).

The toxic action of manganese is exerted on the pulmonary epithelium and cerebral cortex, resulting in degenerative lesions. There are also modifications of the voice, the word and writing, as well as neurovegetative disorders and psychiatric symptoms, irritability, violent behaviour and hallucinations (Villa Elízaga Etal.,1999; Klaassen and Watkins 2001). Manganese (Mn) is an essential element for maintaining the proper functions and regulation of many biochemical and cellular reactions. Manganese is essential for the formation of thyroxin and necessary for vitamin K production. Manganese deficiency can cause dizziness, ear noises, and deafness.

Manganese helps treat myasthenia gravis (failure of muscular coordination and loss of muscle strength) and important in the treatment of multiple sclerosis and diabetes. Manganese is effective in increasing copper excretion from the body. Because manganese is essential element for man the recommended daily intakes for adults is 2-5 mg. However, Mn is also a common environmental contaminant, which can cause toxic effects in animals and humans.

In addition to reproductive and developmental effects, Mn toxicity is primarily associated with neurological effects (Committee on Dietary Allowance, Food and Nutrition Board, 1980). Therefore, the current study investigated manganese concentrations in the muscles (part of the diaphragm), livers and kidneys of cattle and buffalo which are slaughtered in Assiutcity

by using of Atomic Absorption/Flaming Emission Spectrophotometer (Shimadzu model AA 630-02) and assessed the human risk of this metal.

Material and Methods

Collection of Samples

A total of 168 samples of liver (part of caudate lobe), kidney and muscles (part of diaphragm) were collected from 23 male cattle and 33 male buffaloes 2-3 years old (livers, kidneys and muscles specimens from each species) slaughtered in Assiut abattoirs.

Each sample was about 50 grams weight and was individually placed in polyethylene bags and labeled with the date, kind, age and sex of each animal. The collected samples were immediately taken to the laboratory in an ice box where they were kept deeply frozen at -20°C until preparation, digestion and analysis.

Preparation of Equipments

All glass utensils were thoroughly cleaned with water and then dipped in glass jars containing mixture of hydrochloric acid 25% and nitric acid 10% in ratio of 1:1 and leftover night. After that all utensils and instruments were thoroughly washed by distilled water and dried.

Preparation of N/10 Hydrochloric Acid

According to A.O.A.C. (1975) 8.9 ml conc. Hydrochloric acid were added to one liter of distilled water. The prepared stock solution of N/10 Hcl was preserved for dilution of the digested samples.

Laboratory Technique

Digestion Procedure

The applied technique recommended by Fahmy (1971) was followed. In a clean dry Kjeldhal flask of 250-300 ml capacity, one gram of wet sample, 5 ml of 50% sulphuric acid and 5 ml of concentrated nitric acid were added. The flasks were heated gently over a low flame of a minor-burner until clear fumes of nitric and sulphuric acids appeared, where the flame was turned off and the flasks were allowed to cool.

On reheating the dark brown liquid formed in the flask is gradually disappeared. Complete digestion is indicated by colorlessness of the liquid. Stronger heating was continued for sometimes to drive off most of the nitric acid in the flask.

To hasten digestion, it was found better to use only 3 ml of the concentrated acid initially and then the other 2 ml were added after cooling.

Filtration

10 ml Hcl N/10 were dissolved in 90 ml distilled water in volumetric glass cylinder to obtain 100 ml. About 50 ml of the prepared solution were added to the digested particles previously heated and cooled in a glass flask.

The mixture was agitated well for thorough mixing.The obtained mixture was filtrated through a glass funnel containing filter paper, where the filtrate was collected in a glass cylinder. The remainder 100 ml of the prepared solution were added also to the digested flask to dissolve any other digest particles which may be still adhered on the flask wall, and the mixture was thoroughly agitated, then filtrated.

The obtained filtrate for every sample was put in two special vials each of 50 ml capacity, stoppered and preserved at room temperature. Every laboratory technique was done in duplicate for each sample.

Estimation of Manganese

The previously digested and filtrated samples were prepared for measurement the level of zinc in each sample in Biochemistry Department, Faculty of Medicine, Assiut University, by using the Atomic Absorption/Flaming Emission Spectrophotometer (Shimadzu model AA 630-02), using an air acetylene flame and hallow cathode lamp.

$$C = \frac{R}{S} \times \text{conc. of standard X dilution}$$

C = concentration of heavy metal µg/g wet weight.

R = reading of element conc. on digital scale of Atomic Absorption Spectrometry (AAS).

S = Reading of standard.

Mn: the wave length was adjusted to 279.5 n.m. and the used lamp current was 10 mA. All slit width 1.9 n.m.

Statistical Analysis

Data was represented as (Mean ± SD).

T-test was used to compare between any two groups with normal data.Mann-Whitney Rank Sum test was used to compare between any two groups with skewed data.

Results & Discussion

Comparisons (Mean ± SD, Range) Between Concentrations of Manganese (µg/G Wet Weight) in the Examined Buffalo and Cattle

The mean ± standard deviation and range of manganese in livers, kidneys and muscles (µg/g wet weight) in buffalo and cattle were recorded

in (Table 1 and Fig. 1). Results revealed that manganese concentrations in buffalo livers were 3.82±0.61 as a mean where the levels varied from 2.85 to 5.36 µg/g wet weight. In kidneys of buffalo the minimum, maximum and mean values were 1.50, 4.46 and 2.69±0.70 µg/g wet weight, respectively. Moreover, the mean concentrations of manganese in muscles of buffalo was 1.85 ± 0.52, with a minimum of 0.89 and a maximum of 2.68 µg/g wet weight.

Table1. *Comparisons (Mean ± SD, range) between concentrations of manganese(µg/g wet weight) in the examined buffaloes and cattle.*

Kind of animal	Buffalo			Cattle		
	Liver*	**Kidney***	**Muscle***	**Liver***	**Kidney***	**Muscle***
Manganese	3.82±0.61 2.85-5.36	2.69±0.70 1.50-4.46	1.85±0.51 0.89-2.68	4.54±2.51 2.14-14.14	3.07±2.47 0.89-13.57	3.14±5.77 0.89-28.57

** No. of samples= 33* *** No. of samples= 23*

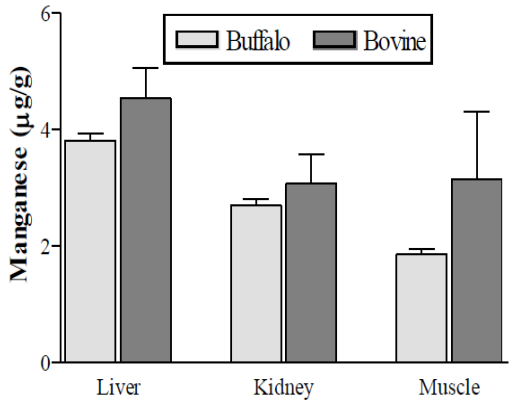

Figure1. *Mean±SD of manganese content in liver, kidney and muscles in buffaloes and cattle.*

For cattle, mean ± standard deviation and range of manganese concentrations in livers were 4.54±2.51 and 2.14-14.14 µg/g wet weight, respectively. While the corresponding values in kidneys were 3.07±2.47 and 0.89-13.57 µg/g wet weight. Moreover, the mean concentrations of manganese in muscles of cattle was 3.14±5.57 with a minimum of 0.89 and a maximum of 28.57 µg/g wet weight.

Differences of Manganese Concentrations (µg/G Wet Weight) In Livers, Kidneys and Muscles of Buffaloes and Cattle

Variations in manganese concentrations in livers, kidneys and muscles of buffaloes and cattle are recorded in (Table 2) pointed that there is a very highly significant difference in manganese concentration in buffalo livers versus buffalo kidneys, and a very high significant difference in buffalo livers versus buffalo muscles. Furthermore, a very high significant difference in manganese in buffalo kidneys versus buffalo muscles.

Regarding cattle there is a very significant difference in manganese concentrations in cattle livers versus cattle kidneys, and a very high significant difference in cattle livers versus cattle muscles, as well a very high significant difference in cattle kidney versus cattle muscles.

Table2. *Differences of manganese concentrations (µg/g wet weight) in livers, kidneys and muscles of buffaloes and cattle.*

	Site			Significance		
Metal	**Liver**	**Kidney**	**Muscle**	Liver v Kidney	Liver v Muscle	**Kidney v Muscle**
Cattle	4.54±2.51 2.14-14.14	3.07±2.47 0.89-13.57	3.14±5.57 0.89-28.57	***	***	***
Buffalo	3.82±0.61 2.85-5.36	2.69±0.70 1.50-4.46	1.85±0.51 0.89-2.68	***	***	***

* Significant ($p < 0.05$). ** Highly significant ($p < 0.01$). *** Very highly significant ($p < 0.001$).

The present data was lower than the findings obtained by Ammerman et al., (1974); Abou-Arab (2001) and Iwegbue (2008). Many authors noticed that reduced or increased manganese in organs is related to deficient or increases intake via the diet (Lassiter and Morton, 1968; Howes and Dyer, 1971 and Watson et al., 1973).In conclusion the results of manganese in livers, kidneys and muscles of slaughtered buffaloes and cattle in Assiut city confirmed by statistical analysis, showed significant differences among the samples collected. The differences may probably result from different diets, whereas the animals are exposed to the influence of air pollution for longer periods, during which they accumulate heavy metals.

Conclusion and Recommendations

The majority of Egyptians are low-income consumers; however, the meat-centric food culture in Egypt remains unchanged. The data resulting from this study demonstrate the need to assess metals concentrations in food to establish safe, overall intakes for the population.The information given by the achieved results proved that all the examined livers, kidneys and muscles of both buffalo and cattle were found contaminated with manganese.

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