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ISSN 2319-3077 Online/Electronic

ISSN 0970-4973 Print

Index Copernicus International Value

IC Value of Journal 46.52 Poland, Europe (2015)

Journal Impact Factor: 4.275

Global Impact factor of Journal: 0.876

Scientific Journals Impact Factor: 3.285

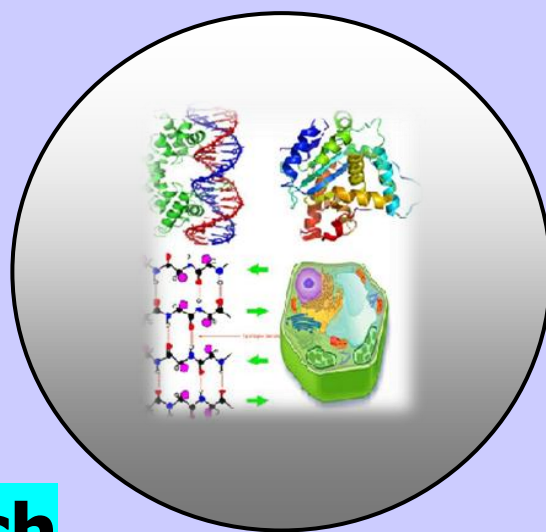
InfoBase Impact Factor: 3.66

J. Biol. Chem. Research

Volume 34 (1) 2017 Pages No. 68-71

Journal of Biological and Chemical Research

An International Peer Reviewed / Referred Journal of Life Sciences and Chemistry



Indexed, Abstracted and Cited in various International and National Scientific Databases

Published by Society for Advancement of Sciences®

J. Biol. Chem. Research. Vol. 34, No. 1: 68-71, 2017

(An International Peer Reviewed / Refereed Journal of Life Sciences and Chemistry)

Ms 34/1/26/2017

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ISSN 0970-4973 (Print)**ISSN 2319-3077 (Online/Electronic)**

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[http:// www.sasjournals.com](http://www.sasjournals.com)[http:// www.jbcr.co.in](http://www.jbcr.co.in)jbiolchemres@gmail.com**RESEARCH PAPER**

Received: 07/01/2016

Revised: 04/03/2017

Accepted: 05/03/2017

Heavy Metal Contents of Meat Samples Sold in Awka Metropolis, Anambra State, Nigeria

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ABSTRACT

This study was conducted to evaluate the contents of heavy metal such as cadmium (cd), arsenic (As), nickel (Ni), and mercury (Hg) in cow meat (beef) from five different markets in Awka metropolis, Anambra State, Nigeria. The technique used in determining the heavy metals was Atomic Absorption Spectrophotometric method. The heavy metals in the investigated samples indicated the following range of concentrations: Cadmium; $0.01 \pm 0.00 - 0.28 \pm 0.08$ ppm, Nickel; $0.95 \pm 0.02 - 1.32 \pm 0.04$ ppm, Arsenic; $0.24 \pm 0.02 - 6.56 \pm 3.05$ ppm, and Mercury $2.03 \pm 0.64 - 4.88 \pm 0.00$ ppm respectively. Mercury was found in high concentrations in all meat samples ranging well above RDA, seconded by Arsenic. Cadmium and Nickel were found within the recommended limit. The results suggest that some of the cow meats sold in Awka markets are not healthy for consumption. Heavy metals are associated with health complications.

Keywords: Heavy metals, Nickel, Mercury, Arsenic and Cadmium.

INTRODUCTION

Heavy metals are the metals found in the gap between group 2 and 3 in the periodic table. They can as well be referred to as transition metals. They contain the S, P, and d electrons and are therefore said to form the "d-block" (Osei, 2005). They do not metabolize easily in the body, and are therefore said to bio-accumulate. They are found in all parts of the environment and can also be seen as contaminants in foods like water, meat, fish, vegetables etc.

Meat is one of the major sources of proteins and can be gotten from animals like cow, goat sheep, and poultry. Most Nigerian homes use meat as one of their sources of getting first class protein. Meat is an animal flesh that is eaten as food. It can also include the skeletal muscle, associated fat and tissue-like offal. Meats are usually gotten from cattle, pig, goat, sheep, cow, poultry etc. these animals can either be raised domestically or they can grow

independently as wild animals. The quality and quantity of meat depends on the source (the animal where it is gotten from). The nutrition of the animal also determines the quality and quantity of the meat that is, whether the animal is over or under fed (Borron, 2011). Environmental factor can also contribute to the nutritional and contamination contents of meat. Cadmium, mercury, and arsenic are the main toxic metals which accumulate in food chains and have a cumulative effect (Cunningham and Saigo, 1997). Heavy metals often have direct physiological toxic effects and are stored or incorporated in living tissues (Baykov *et al.*, 1996). Food is one of the principle environmental sources of cadmium. As cadmium moves through the food chain it becomes more and more concentrated as it reaches the carnivores where it increases in concentration by a factor of approximately 50 to 60 times (Daniel and Edward, 1995). Toxic effects of cadmium are kidney dysfunction, hypertension, hepatic injury and lung damage (John and Jeanne, 1994). Animals vary in their arsenic accumulation, depending upon the type of food they consume (John and Jeanne, 1994). Acute arsenic exposure can give symptoms with rapid onset of headache, nausea, and severe gastrointestinal irritation (Allan *et al.*, 1995). Nickel is a very common metal that occurs in soil, water, air, and in the biosphere. It is combined with other heavy metals to form alloys. Nickel is contained in many everyday objects and is also used for detergents, soaps, and cosmetics. Nickel enters the body by four different routes; oral intake, inhalation, parenteral administration, and percutaneous absorption. Meat is a very rich and convenient source of nutrient including also, to a large extent microelements. Chemical composition of meat depends on both the kind of feed and degree of feeding given to the animal. The need for mineral compounds depends on the age, physiological state and feed intake as well as on living conditions (Baykov *et al.*, 1996). Contamination with heavy metals is a serious threat because of their toxicity, bioaccumulation, and biomagnifications in food chain (Demirezen and Uruc, 2006). The risk of heavy metal contamination is of great concern for both food safety and human health because of the toxic nature of these metals at relatively minute concentrations (Santhi *et al.*, 2008). Meat is a food material which is composed of mainly protein, fat and some important essential elements. It is essential for growth and maintenance of good health. Contamination of meat can also be caused by vehicle emissions and from dirty slaughter places. This study is carried out to determine the contents of heavy metals in cow meat samples obtained from five different markets in Awka, Anambra state, Nigeria.

MATERIAL AND METHOD

Sample procurement

The five different samples of meat used for the study were bought from different markets within Awka metropolis, Anambra State, Nigeria.

Sample preparation

- The meat samples were bought between the hours of 8 & 9.30am and got to the lab 30 minutes later.
- Ten grams (10g) of each of the meat samples was cut into the crucibles which were weighed in an electronic mettler weighing balance.
- After which the samples were placed in an oven to remove the moisture content at 100°C.

- Two grams (2g) were weighed from the oven dried samples into a crucible and heated in a muffle furnace at 450°C for 3 hours after which 20ml of 20% H₂SO₄ was added and filtered.
- The filtrate was then made up to 50ml with distilled water. It was taken to the Atomic Absorption Spectrophotometer (AAS) for readings.

Reagents

All reagents used were of analytical grade.

Methods

The methods of Pearson (1976) were used for the heavy metal (cadmium, nickel, mercury, and arsenic) contents analyses.

RESULTS

The results of the study showed that all the meat samples contained heavy metals at varying concentrations (Table1)

Mercury was found in high concentrations in all meat samples ranging well above RDA, seconded by Arsenic. Cadmium and Nickel were found within the recommended limit.

Table 1. Heavy Metal Contents of Meat Samples.

Heavy metals(ppm)	Sample A	Sample B	Sample C	Sample D	Sample E
Cadmium	0.28±0.08	0.04±0.04	0.02±0.01	0.05±0.01	0.01±0.00
Nickel	1.32±0.04	1.17±0.07	0.95±0.02	1.26±0.01	1.15±0.04
Arsenic	0.33±0.01	0.24±0.02	2.68±0.63	6.56±3.05	6.32±0.22
Mercury	2.03±0.64	3.17±0.48	4.68±0.79	4.88±0.00	4.16±0.08

DISCUSSION

From the results of the analysis, mercury was found to have the highest concentration (2.03±0.64 – 4.88±0.00ppm) in all the meat samples (A, B, C, D, E). This implies that all meat samples sold in five markets contained mercury with concentrations above the internationally recommended standard of 0.05ppm (WHO, 2002). This can result in mercury toxicity on consumption of these meat samples.

High levels of arsenic were seen in samples C, D, and E (2.68±0.63, 6.56±3.05, and 6.32±0.22ppm respectively), which are far above the RDA of arsenic i.e. 1.4ppm (WHO, 2002), which makes them very unsafe for human consumption. While arsenic contents of samples A and B (0.33±0.01 and 0.24±0.02 ppm) were within the limit set by WHO (2002). The high levels of arsenic seen in samples C, D, E could be from the environment or exposure to contaminated water, or from method of processing the meat.

Except for sample A, the cadmium contents of all the meat samples were within limit set by WHO (2002), which is 0.2ppm. The cadmium content of sample A (0.28±0.08ppm) is a bit high which is not safe to human health. When the concentration of cadmium in diet is higher than RDA value, it accumulates especially in the kidney and the liver that causes serious biological and neurological changes in human body even at ultra trace level. Toxic effects of cadmium are kidney dysfunction, hypertension, hepatic injury and lung damage (John and Jeanne, 1994).

The concentration of nickel in all the meat samples fell within the RDA. The nickel contents of the samples ranged between 0.95-1.32ppm. This implies that the samples are safe from nickel toxicity. WHO (2002) stipulates a nickel limit of 1.5ppm. Cadmium, mercury, and arsenic are the main toxic metals which accumulate in food chains and have a cumulative effect (Cunningham and Saigo, 1997). Heavy metals often have direct physiological toxic effects and are stored or incorporated in living tissues (Baykov *et al.*, 1996).

CONCLUSION

The results obtained from the study has shown that cow meats sold in Awka market are to some extent safe but to a larger extent high in some of the toxic heavy metals which are harmful to human health upon consumption. This implies that more efforts are needed on the part of regulatory agencies such as National Agency for Food and Drug Administration and Control (NAFDAC) to ensure that meats consumed in Awka metropolis, Anambra state, Nigeria are wholly safe for human consumption.

ACKNOWLEDGEMENTS

We appreciate Spring Board Laboratories, Awka, Anambra State, Nigeria, for their technical assistance

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