The Determination of Heavy Metals and Trace Elements in Meats and Meat Products Found in Lagos State

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Abstract

Introduction

The concentration of heavy metals (Pb, Cr, Cd) and trace elements (Zn, Cu, Mg) were evaluated in a variety of cow meat, goat meat and their organs.

Methods

The analysis was done using Atomic Absorption Spectrophotometry (AAS).

Results

The concentration of the heavy metals were in these range: Pb (0.06-1.44 µg/g), Cr (0.04-0.22 µg/g), Cd (0.002-0.08 µg/g), As (0.02 – 0.03 µg/g). The concentration of the trace elements were in these range: Zn (0.15-3.16 µg/g), Co (0.21-0.38 µg/g), Cu (0.011-0.073 µg/g), Mg (0.2-2.72 µg/g).

Discussion

The concentration of arsenic in all samples examined was negligible indicating that the samples were free from arsenic toxicity. The concentration of the other heavy metals examined were below the permissible limit of the WHO. This shows that most of our meat products together with their organs were free from heavy metal toxicity. However, cow liver shows a high concentration of lead but still below the tolerance limit.

Conclusion

The government should pay more attention to regular screening of meat for the safety of the populace.

Keywords

(WHO, zinc, magnesium, lead, cadmium)

Introduction

Heavy metals are metals which have no beneficial effect in the body. Their presence in body leads to many biological changes. They are also known as metals with high specific weight, more than 5g/cm³. In this century, industrialization has greatly increased and this has led to more metals entering into the environment. The major sources of toxic metals in the environment are chemical industries, petroleum industries, mining industries, fossil fuels, waste disposals, municipal sewage, farming and forestry (Nielsen, 1998).

Due to environmental pollution, heavy metals enter into the food chain where they bio accumulate. The chances of contamination of food with various environmental pollutants have increased through improvement in food processing technology.

Grazing of cattle on heavy metal contaminated soil leads to deposition of residues in meat (Amani and Lamia, 2012).

Trace elements are in minute quantities are necessary for metabolic process in the human body. They play different roles in the body but whenever they are deficient or in excessive amounts, they lead to various metabolic disturbances. It is therefore of great importance that the levels of these metals are kept within the required range so as to maintain proper metabolic functions in the body.

Meat is a rich source of protein. The chemical composition of meat depends on what the animal fed on. Contamination of meat with heavy metals is a major cause of concern because of their bioaccumulation in the food chain (Demirezen and Uruc, 2006).
Contamination of meat in Nigeria can be through direct unclean water, industrial effluent, vehicular emission and dirty slaughter places.

This study was carried out to determine the concentrations of heavy metals and trace elements in cow meat, goat meat and their organs in Lagos, Nigeria.

Materials And Methods

Sample collection: In animal, meat of cow and goat together with their organ meats (Spleen, heart, leg, intestines, liver, offal) were collected randomly from different markets in Lagos metropolis. Meat products (suya meat and kilishi) were also collected randomly from different shops in Lagos metropolis.

Sample preparation: The solutions of these samples were prepared by digestion method. The meat and organ meats were boiled and then cooled. The samples were grated using a fume cupboard until the solution becomes clear.

After digestion, hydrogen peroxide was added dropwise to get a clear solution, the resulting solution was filtered and made up to 100ml with distilled water. Determination of metals were done using Perkin Elmer Analyst Atomic Absorption Spectrophotometer.

Results and Discussion

The concentration of heavy metals are presented in the Table below.

Lead ranged from 0.06 - 1.40 µg/g, chromium ranged from (0.04 - 0.22 µg/g), cadmium ranged from (0.02 - 0.086 µg/g), arsenic ranged from (0.016 - 0.030 µg/g)

| Sample             | As   | Cd   | Cr   | Pb    |
|--------------------|------|------|------|-------|
| Goat meat          | 0.009| 0.01 | 0.076| 0.065 |
| Cow meat           | 0.023| 0.002| 0.050| 0.073 |
| Cow intestinal meat| 0.019| 0.006| 0.035| 0.090 |
| Cow intestines     | 0.026| 0.025| 0.090| 0.096 |
| Goat heart         | 0.023| 0.035| 0.097| 0.073 |
| Cow heart          | 0.030| 0.102| 0.120| 0.116 |
| Goat organ meat    | 0.023| 0.029| 0.023| 0.111 |
| Cow organ meat     | 0.026| 0.035| 0.097| 0.072 |
| Goat Liver         | 0.030| 0.009| 0.069| 0.079 |
| Cow Liver          | 0.026| 0.055| 0.076| 1.220 |
| Cow offals meat    | 0.023| 0.069| 0.146| 0.140 |
| Cow stomach meat   | 0.029| 0.014| 0.090| 0.144 |
| Cow leg meat       | 0.026| 0.034| 0.055| 0.073 |
| Cow suya meat      | 0.021| 0.002| 0.046| 0.066 |
| Cow kilishi        | 0.016| 0.069| 0.070| 0.094 |

Table 1: Concentration of metals in meat, organ meats and meat products

Table 2: Concentration of essential metals in organ meats and meats products

The highest concentration of lead was found in the liver of cow (1.220 µg/g) while the lowest concentration of lead was found in goat meat (0.065µg/g). Cow meat contains a higher concentration of lead than goat meat. Goat liver and goat heart contain lesser amounts of lead than cow liver and cow heart. Cow liver concentrates a high amount of lead (1.220 µg/g) while cow leg, cow suya meat and dried meat all have low amounts of lead present in them.

Goat liver and goat heart is quite safer to eat than cow liver and cow heart. This shows that cow liver and heart is more exposed to pollutants from its diet and accumulates high amount of lead more than the concentration of lead than in goat. However, the concentrations of lead in cow and goat meats are within permissible limits as directed by World Health Organization (WHO, 2003) and are quite safe to eat. All the other organ meats were also within the permissible limits of WHO.

Similar results were obtained by Farmer and Farmer in 2000, who found high levels of cadmium and lead in livestock feed and organ meats in Eastern Kazakhstan. Ferdousi et al in 2011, found Cd in sausages consumed in Iran.

From this study, the highest chromium value was found in cow offal meat (0.146 µg/g), followed by cow heart meat. The lowest value of chromium was found in cow suya meat while goat meat and its organs contain lower values of chromium than goat intestinal meat. Chromium in trace amounts is an essential element in the body but it can also be carcinogenic in high amounts. High amounts of chromium in the body leads to adverse effects (Martin and Griswold, 2009). Cow meat contains low concentrations of chromium. The highest value of cadmium was found in cow meat and cow suya meat. Goat meat contains the lowest value of cadmium. The concentration of cadmium in goat organ meat samples is lesser than that found in cow organ meat samples. It has been reported that cadmium accumulates in the kidney and liver over a long period of time. Cadmium is toxic and it has been reported to affect calcium, phosphorus and bone metabolism in people exposed to it (Amani and Lamia 2006).

Demirezen and Uruç also detected high levels of heavy metals in meat products in their country were above the permissible limit. In this study, it was discovered that cadmium in all the samples studied were lower than the limit.

The highest arsenic concentration of was found in cow organ meat (heart and liver samples: 0.030µg/g), while the lowest concentration was found in goat meat. All the samples studied had lower arsenic concentration than the permissible limit.
High concentrations of arsenic have been reported in meat products of cattles (Demirezen and Uruc, 2006).

The essential metals, (Table 2) Zn ranged from 0.140 – 0.690 µg/g, magnesium ranged from 2.090 - 2.660 µg/g, copper ranged from 0.01 - 0.69µg/g, cobalt ranged from 0.021- 0.039 µg/g.

For the essential metals, the highest value of zinc was found in cow meat and low in goat meat. Cow heart contains significant high concentration of zinc. Zinc is a powerful antioxidant and it’s an essential element in the body. The concentration of zinc in all the meat products is below the permissible limit set by the WHO.

Magnesium ranged from 2.009 - 2.360 µg/g. High levels of magnesium were found in cow meat when compared with goat meat.

Copper ranged from 0.01 - 0.690 µg/g. The highest copper level was found in cow intestines while the low concentrations were found in cow offals. The samples studied contained copper in small amounts and were below the permissible limit.

Copper is an essential component of various enzymes and it is essential for good health. It helps to maintain the integrity of connective tissue and also helps in bone formation and skeletal mineralization (Nielsen, 1998).

Conclusion

Meat is an important source of protein. It is an essential macronutrient that the body needs. The absence of protein in the body can lead to malnutrition. As important as meat is, it is also necessary to conduct environmental studies on its heavy metal contents so as to ensure the safety of public health.

From the studies carried out, it was detected that cow meat samples, contains a high level of heavy metals and trace metals when compared with goat meat. This can be attributed to the fact that, in Nigeria, cows are allowed to graze in all kinds of places, where they are exposed to environmental pollutants. They eat grass in different places both contaminated and uncontaminated. Cows feeds essentially on grass, even on dump sites, and they pick up metals from these locations. They are not really well taken care of and they pick up metals as they graze every where.

Goats on the other hand are not grass specific. They also feed on other types of foodstuffs, and they are found mainly within communities where they are not exposed to heavy metals.

All the meat samples examined in this study, contains metals below the permissible limits set by World Health Organization and are quite safe for public consumption. However, our government should provide safe grazing grounds with uncontaminated grass for our cattle herdsmen and their cattle so that they stop feeding on polluted grass and wandering everywhere, seeking for food for the cattle. There should be pasture grounds for herdsmen and their cattle in every state.

It is of paramount importance that the government looks into the affairs of cattle rearing in our nation.

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