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308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

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Determination of Trace Elements in Selected Organs of Cow for Safety Consumption among Rural Dwellers in Kwara State, Nigeria

G.B. Adebayo[1], G.A. Otunola[2] and F.O. Oladipo[3]
[1]Department of Chemistry, University of Ilorin, Ilorin, Nigeria
[2]Department of Home Economics and Food Sciences, University of Ilorin, Ilorin, Nigeria
[3]Department of Agricultural Extension and Rural Development, University of Ilorin, Ilorin, Nigeria

Abstract: A general awareness on the safety consumption of food in our society is imperative. In determing the trace element that could be toxic, three different organs (liver, kidney and lung) of cows were carefully selected and analyzed for the quantification of essential trace element, Cr and potentially toxic trace elements, Pb and Co. Atomic Absorption Spectrophotometry (AAS) was used for the analysis. The results showed that the concentrations of these elements were relatively high with highest being recorded in the liver. The concentration has been attributed to the source of food of the animals and other environmental factors

Key words: Rural dwellers, cow, trace elements, kidney, liver, lung, AAS, food and safety consumption

INTRODUCTION

Safety consumption of both crops and livestock products is inevitably important for good human health and as such, the intake of safe product must be ensured. To this, the federal government of Nigeria, nowadays through the Directorate of National Agency for Food and Drug Administration and Control (NAFDAC) has been very serious and moving a checkpoint on taking food, drugs etc that are not certified and there is the need for certification or proof of safety of food or drug before advocating their consumption to the public (Oguntola, 2008). However, the place of beef as a protein source cannot be over employed and the consumption of some organs in cow needs to be examined and seen so as to be sure of the safety, taking into account those need to be taken in bit or large quantity.

Trace metals are metals in extremely small quantities almost at the molecular level that reside in or are present in animal and plant cells and tissues. Some are necessary part of good nutrition. They include Iron, Zinc, Copper, Chromium, Cobalt, Molybdenum, Manganese, Selenium and others.

Trace metals are depleted through the expenditure of energy by a living organism. They are replenished in animals by eating plants which gets them through uptake of minerals from the soil (Francis, 1990). Human vitamin pills and plant fertilizers both contains trace metals and as addition source for trace metals. Human Soft tissue contains 0.13-0.50 ppm lead in brain and from 1.3-1.7 ppm lead (wet weight) in the liver (Kehoe and Storey, 1979). It is a constituent of vitamin B12 an essential nutrient for man in prevention of pernicious anemia (Eric, 1977). The special concentrations of cadmium in the liver and kidneys, particularly the kidney cortex is apparent from many studies with several species. Mean value for adult kidney is 13.9±0.7, liver 4.3±1.0, brain 0.3±0.04 and muscle 0.03±0.01 ug/g wet weight (Hamilton, 1979). Cadmium reduces the toxicity of Hg^{2+} ions and possibly that of other divalent metals (Lucas and Coleman, 1978). The healthy adult body has been estimated to contain 80 mg of total copper (Cartwright and Wartrobe, 1978), the distribution of total copper among the tissue varies with the species, age and copper status of the animal (Hamilton, 1979) found the following mean concentration in adult human, liver 14.7±3.9, brain 5.6±0.2, kidney 2.1±0.4 µglg wet weight. Copper helps in well functioning of erythrocytes in the body (Cartwright and Wartrobe, 1978). The whole body of man (adult) is estimated to contain 1.4-3.3 g of zinc of which about 20% is present in the skin (Miller and Clifton, 1972). It plays role in collagen synthesis and in DNA, RNA and protein formation in the brain.

Chromium is found primarily in two forms: Trivalent (Cr^{3+}) which is biologically active and found in food and the Hexavalent (Cr^{6+}) a toxic form resulting from industrial pollution. Chromium is known to enhance the action of insulin, a hormone critical to the metabolism and storage of carbohydrate, fat and protein in the body. Compounds of chromium like chromium chloride are used for impaired tolerance in diabetic patients (Glinsman and Mertz, 1966; Schroeder, 1968). The contents of chromium has been reported to be affected by processing, for instance whole wheat 53 µg chromium per 100 kcal, raw sugar 6.0-8.8 µg Cr per 100 kcal but after processing it reduces to, white flour 6.6 µg Cr per 100 kcal, refined sugar 0.3-2.5 µg Cr 100 kcal. (Engel *et al*., 1967). Absorption of chromium from the intestine tract has been reported to be low, ranging from less than 0.4-2.5% of the amount consumed; the remains are excreted in faeces and urine. Drugs like

antacids hydrogen blockers e.g. Cimetidine, femotidine, nizatidine, corticorsteriods; proton pump inhibitors e.g. Omeprazole, lansoparole, rabeprazole, pantoprazole alter stomach acidity and impair chromium absorption. Enhancing the mineral absorption are Vitamin C (Ascorbic acid) and B (Niacin) found in fruits, vegetables, meat, poultry, fishes and grains. Absorbed chromium is stores in the liver, spleen, soft tissue and bone, body chromium content may be reduced under several conditions. Diets high in simple sugars can increase chromium excretion in the urine. Chromium deficiency is a disorder that results from an insufficient dietary intake of chromium. It occurs rarely in developed nations. In valent chromium is an essential trace metal and required for proper metabolism of sugar in humans. Deficiency affects potency of insulin in regulatory sugar balance. Unlike other essential trace metals, chromium has not been found in a metalloproteinase with biological activity. Therefore the functional basis for chromium requirement in the diet remains unexplained. Chromium picolmate is the most commonly used synthetic supplement to correct imbalance in glucose metabolism due to chromium deficiency.

Cobalt has been found to be essential for human beings and animals (Underwood, 1971). The only function of cobalt in humans and animals appears to be a constituent of Vitamin B_{12}. The pathway of cobalt from the soil to Vitamin B_{12} in the ingested in the ingested food of human beings and non-ruminant animals is sometimes called the cobalt cycle. Plants obtain cobalt from the soil. Ruminant animals Cattle, Sheep, Goats eat the plants and the bacteria in their rumina. Use the cobalt to form Vitamin B_{12}. These animals absorb the vitamin which is distributed throughout the whole body tissue. Human beings ingest the meat and milk of these animals and obtain their Vitamin B_{12}. Nothing is known about the deficiency of cobalt in humans. However if cobalt is ingested in large quantities, the number of red blood cells increases, a condition called polycythemia (Underwood, 1971) studies with preadolescents however indicates that 7.7 μg of cobalt is needed for balance; suggested allowance for this age group is 15 μg per cobalt.

The liver is a large reddish brown organ with two lobes lying just below the diaphragm, overlapping the stomach. Being a complex organ, metabolically and plays role in homeostasis, screening and adjusting food-laden blood composition to the body needs before entering the circulatory systems. Among other functions of the liver is the storage of Vitamins and Minerals, Fats soluble vitamins A, D, E and K and the water soluble Vitamins A and C, also Iron, Zinc, Copper, Potassium and Chromium are usually stored in the liver. One other important function of the liver is the conversion toxic and biologically active substances into harmless forms. This process is known as detoxification.

The lungs are a very vital and delicate organ in the body. The animals use lungs as a gaseous exchange organ. Lungs are closely linked to the circulatory system, so that oxygen can easily be transported over long distance. This enables vertebrates to attain the large sizes seen in many types of animals. The structure and excretory functions of the kidney are numerous. The kidney is a bean-shaped organ. It is the excretory organ of humans. The kidneys increases re-absorption of water by the tubules into the bloodstream by increasing the permeability of tubules and the collecting ducts to water. As good as these organs are to the proper functioning of the body system, there is need to checkmate their consumption to avoid over accumulation of some heavy or trace metals that are likely to be stored in them in order avoid being reach toxicity level. It is in line with this perspective that these organs are selected for analysis to create awareness for possible toxicity effect of over accumulation of these elements in the body tissues.

MATERIALS AND METHODS

Sources of sample: The samples consist of three different parts of cow (lung, liver and kidney) which were purchased at three different markets in Kwara State, Nigeria.

Digestion: The samples were dried in the oven for three days at temperature 105°C. After which they were grinded in a mortar into fine powder. 2 g of the well grounded samples were weighed into 1000 cm^3 Kjeldahl flasks; 20 cm^3 of deionized distilled water was added followed by 20 cm^3 of concentrated HNO_3. The mixtures were boiled at about 100°C for 60 min, when the samples pass into colloidal solution, the solution was cooled and 10 cm^3 of conc H_2SO_4 was added. The mixture were heated again and continued at a temperature of 140°C, for 20 min when a dense white fume of the conc H_2SO_4 was noticed. The solution was allowed to cool and transferred quantitatively into 100 cm^3 volumetric flask and made up to the mark. The solutions were finally transferred into sample bottles (already labeled). and were analyzed for the presence and quantity of Chromium (Cr), Cobalt (Co) and lead (Pb) using Atomic Absorption Spectrophotometer (AAS).

RESULTS AND DISCUSSION

The concentration of chromium is the least while that of cobalt and lead are in high side with the highest concentration of the elements in the liver when compared with other organs (the lungs and kidney) (Table 1). This showed that liver acts as a store-house for toxic and heavy metals. This gives a clue to why the concentration is high in the liver sample as shown in Table 1.

The high concentration of Pb is woresome when considering the toxicity effect of the element. Lead is a

Table 1: The mean concentration in various organs of cow determined by AAS in microgram per gram

Element	Lung	Liver	Kidney
Chromium (Cr)	22.60±7.65	39.60±4.05	12.60±0.20
Cobalt (Co)	61.80±0.50	88.10±1.00	29.80±0.60
Lead (Pb)	66.70±0.70	85.20±0.00	38.70±0.20

poisonous metal which make it to be very harmful to the body. The level of lead reported in human brain 15-25 µg Pb/g and in the liver 65 µg/g/ Pb-85 µg/g/Pb. (Kehoe and Storey, 1979). When compare this standard with the result, it shows that the concentrations are relatively high taking into consideration the possible accumulation of this element due persistent consumption of these organs.

In the case of cobalt which is a major constituent of Vitamin B_{12} (Cyano Cobalamin), it enhances formation of red blood cells and its deficiency causes pernicious anemia (Sarojimi *et al*., 1979). The daily intake is reported to be 3 mg. The concentration obtained from the analysis is however not low, taking into consideration quantity of the sample used which is 2 grams (2 g).

The chromium in its useful form enhances the action of insulin (Gormican, 1970). Average daily intake ranges from 2.5 µg/day-3.5 µg/day. The samples were however not undergone processes of preservation or addition of preservatives hence the chromium content is good for consumption. The presence of the above samples in our diet is good despite the fact that it is high. Chromium is stored in the liver, spleen and soft tissues but lost through urine and faeces. The sources of these elements may be traced to either sources of their food or environmental pollution which results from industrial, agricultural and other sources resulting from urban populace.

Conclusion: The various consumed parts of cow in rural areas in Kwara State, Nigeria, seem to be safe for consumption considering the concentrations of lead, cobalt and chromium present in them. The various parts of cows are main sources of proteins but also a major source of these micro elements (Heavy metals) to the human body. The concentrations of these metals seem to be moderate for the body. However, since there can be accumulation of these elements resulting in toxicity, it is advisable to limit their consumption most especially the liver.

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