Determination of Mineral Contents of Milk of Cattle, Goats and Sheep in Sabon Kaura and Mangas Villages, Bauchi,Nigeria.

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Abstract.

In this study the mineral contents determination of milk obtained from cattle, goats and sheep raised in Sabon Kaura and Mangas Villages, Bauchi, Nigeria was carried out. Quantitative analysis was done in triplicate for seven (7) metals; zinc Zn, manganese Mn, copper Cu, iron Fe, calcium Ca, sodium Na and potassium K using Atomic Absorption Spectrophotometer (AAS). Milk samples were collected at a fixed time intervals of the day after previous feed. Milks samples were collected manually from 8-10am for four (4) hours when there was no breast feeding. Milk samples were prepared according to the method described by Vidovic et al., 2005 from August to December 2013. From the results obtained the mineral contents of milk for cattle, goats and sheep, Zn concentrations varied from 1.933 to 2.567 mg kg^{-1}, with Zn concentration being the highest in cattle milk and lowest in goats' milk. Mn concentrations varied from 0.423 to 2.417 mg kg^{-1}, with Mn concentration is highest in cattle milk and lowest in sheep. Cu concentrations varied from 0.583 to 1.467 mg kg^{-1}, with Cu concentration highest in cattle milk and lowest in goats. Fe concentrations varied from 2.243 to 3.700 mg kg^{-1}, with Fe concentration highest in sheep milk and lowest in goats milk. Ca concentrations varied from 2.367 to 4.267 mg kg^{-1}, with Ca concentration highest in cattle milk and lowest in goats' milk. Na concentrations varied from 0.711 to 1.667 mg kg^{-1}, with Na concentration highest in sheep milk and lowest in cattle milk. K concentrations varied from 0.250 to 1.233 mg kg^{-1}, with K concentration highest in sheep milk and lowest in cattle milk. From the results obtained, cattle had the highest concentration of Zn (2.567 mg kg^{-1}) and Ca (4.267 mg kg^{-1}) and sheep had the highest concentration of Fe (3.700 mg kg^{-1}) while goat has the lowest concentration of Zn (1.933 mg kg^{-1}), Cu (0.583 mg kg^{-1}), Fe (2.243 mg kg^{-1}) and Ca (2.367 mg kg^{-1}).

Key words: Sabon Kaura, Mangas, Atomic Absorption Spectrophotometer and Milk.

Introduction

The concentration of minerals in milk varies from country to country depending in milk in on the physiological state of the animals which is influenced by dietary factors. For the dietary minerals, the current cattle are based on a factional division of the requirements for maintenance, growth, gestation and lactation [1,2]. Other factors includes, the growing conditions of feed (soil type, fertilizer type and irrigation water) as well as the type of processing used which affects the pH and use of metal containers [3]. According to Oehme (1979), “minerals at nutritional standard concentrations in foodstuffs are necessary for human health; however, when these nutritional values are low or exceed the required limit they are likely to cause diseases”. The health effects of high mineral concentrations in consumption of foodstuffs as been found to include gastric irritation and diarrhea, and might affect other organ system [2,4,5]. The target for toxicity are specific biochemical processes (enzyme) and/or membranes of cells and organelles. Some useful metals such as calcium and magnesium are competitive with respect to their absorption sites and calcium may partially inhibit the absorption of magnesium [4,6]. The contribution of milk products to the diet in western countries is significant for sodium, potassium, chloride, calcium, phosphorus, zinc and iodine [6].

More than 20 different enzymes are known to be either zinc metallo enzymes that require zinc for activation. Zinc has to be implicated in conditions such as dwarfism and poor sexual development and in other metabolic process including maintenance of the integrity of the gonads and of the brain, the skin, the eyes and the bones [7].

Manganese occurs in relatively constant amount in the tissues and organs both plants and animals, and that manganese is especially concentrated in the reproductive organs. Manganese is essential for normal growth and reproduction, high mortality, testicular degeneration and poor lactation accompany manganese defiant and there is risk of deficiency considering observed levels of manganese in sub-desertic forages [8].

Copper and iron are needed for normal red blood cells formation. Furthermore Cu is essential for normal activity of many enzymes. Copper plasma level maybe considered as a good reflection of Cu intake in ruminants, normal level lies between 70-200µg/100ml. Most of the observed values in cow fluctuate between these two values. However, some enterprises comparison shows that the Cu plasma values are on average slightly higher than other ruminants [9].

Like copper, iron is a characteristic constituent of the blood and pure crystals of hemoglobin contain 0.335% iron. Enzymes such as cytochromes, catalases and peroxidases also were shown to contain iron. The flaroprotein enzymes, cytochrome reductase and xamhine oxidase, have been found to contain iron. The muscles contain an oxygen-carrying compound, myoglobin, which contains iron [10].

Calcium is a metallic element that is present abundantly in limestone and gypsum. It is the most abundant mineral in the body accounting for about 1.5-2.0% of an adults total body weight, with many functions which includes maintenance and development of strong bones and teeth, keeping the heat regularly alleviating insomnia, helping to metabolized the body [11]. Deficiency causes osteoporosis, hypertension, preeclampsia and other disorder. During pregnancy causing high blood pressures, swelling and weight gain greater than one pound per day [12].

Sodium ions, mainly extracellular are important in maintaining osmotic pressure, acid-based balance and membrane potential. Sodium and water metabolism are closely related, and in the cow as in other mammals are controlled by aldosterone, rennin angiotensin, antidiuretic hormone and arterial natriuretic peptide [13].

Potassium is the third most abundant element in the body and is the principal constituent of intracellular fluid. It is also a constituent of extracellular fluid where it influences muscle activity. Potassium is required for a variety of the body functions including osmotic balance, acid-base equilibrium, several enzyme systems and water balance. Ionic balance exists between K, Na, Ca and Mg [14], also in the homeostatic mechanism for K is inseparable Na and aldosterone was found to affect K excretion, level of K in the extracellular fluid stimulates aldosterone secretion in the same way that low Na does. In K deficiency some Na is transferred inside the cell to replace K, and in that way preserve osmotic and acid-base equilibrium, the K recruitment appear to be increased for livestock under stress such as pregnancy [15]. Excitement tends to increase urinary loss of K. High level of dietary K reduces the apparent absorption of Mg [16]. Prolong elevation of K in blood plasma of ruminants may lead to a series of metabolic disturbance elevated insulin [11].

In this study the mineral contents of milk obtained from cattle cattle, goats and sheep raised in Sabon Kaura and Langas Villages ,Bauchi, Nigeria was carried out quantitatively and analysis was done in triplicate for seven (7) metals; zinc Zn, manganese Mn, copper Cu, iron Fe, calcium Ca, sodium Na and potassium K using Atomic Absorption Spectrophotometer (AAS)

Material and Methods

Milk samples were collected at a fixed time intervals of the day from the farm animals under investigation at some selected farms in Sabon Kaura and Mangas Villages of Bauchi, Nigeria. The milks Samples were collected manually at from 8 – 10 am for four (4) hours when the animals are not breast feeding. The samples were analyzed with Atomic Absorption Spectrophotometer (Model 211) to determine its mineral contents (trace elements) at Abubakar Tafawa Balewa University,Bauchi Post Graduate Chemistry Laboratory, Chemistry Department, School of Science. The study was carried out from August to December 2013. The hollow-cathode lamps for zinc Zn, manganese Mn, copper Cu, iron Fe, calcium Ca, sodium Na and potassium K were employed as radiation source. The flames used were air/acetylene.

Nitric acid, sulphuric acid, hydrochloric acid, hydrogen peroxide and deionized water were of analytical grade (E. Merck). Deionized water was used during the entire experiment.

Sample preparation: Milk samples were prepared according to the method being described by Vidovic et al., 2005. With minor modification, 10 ml of milk was used, five milliliter of concentrated nitric acid was added and the suspension was evaporated to dryness. The dish was transferred to muffle furnace and was heated to ash at 450^{o}C for twelve (12) hours. After mineralization 5ml of 10% HCl was added, the mixture was heated and the solution was filtered to 25ml in a volumetric flask and made up to volume using deionized water. Analysis of trace elements in the sample was carried out by Atomic Absorption Spectrophotometer (Model 211) AAS [17,18].

Results and Discussion

The mineral contents of milk in cattle, goats and sheep (mg kg^{-1}) were analyzed and presented in table 1 below:

Table 1: Mineral contents of milk in cattle, goats and sheep (mg kg^{-1}) in September 2013.

Samples	Zn	Mn	Cu	Fe	Ca	Na	K
Cattle	2.567±0.31	2.417±0.13	1.467±0.15	3.233±0.19	4.267±0.19	0.711±0.04	0.250±0.05
Goats	1.933±0.15	1.300±0.26	0.583±0.076	2.243±0.21	2.367±0.32	1.300±0.20	0.835±0.11
Sheep	2.233±0.21	0.423±0.025	1.367±0.15	3.700±0.17	2.843±0.13	1.667±0.21	1.233±0.21

From the results obtained for the mineral contents of milk in cattle, goats and sheep, Zn concentrations varied from 1.933 to 2.567 mg kg^{-1}, with Zn concentration highest in cattle milk and lowest in goats. Mn concentrations varied from 0.423 to 2.417 mg kg^{-1}, with Mn concentration highest in cattle milk and lowest in sheep. Cu concentrations varied from 0.583 to 1.467 mg kg^{-1}, with Cu concentration highest in cattle milk and lowest in goats. Fe concentrations varied from 2.243 to 3.700 mg kg^{-1}, with Fe concentration highest in sheep milk and lowest in goats milk. Ca concentrations varied from 2.367 to 4.267 mg kg^{-1}, with Ca concentration highest in cattle milk and lowest in goats milk. Na concentrations varied from 0.711 to 1.667 mg kg^{-1}, with Na concentration highest in sheep milk and lowest in cattle milk. K concentrations varied from 0.250 to 1.233 mg kg^{-1}, with K concentration highest in sheep milk and lowest in cattle milk. The results shown above agreed with the work reported by Al-Wabeel (2008) although lower in Ca, Na and K may be due to the nutritional composition of the feed used.

Conclusion

The mineral contents of milk of cattle, goats and sheep were determined using atomic absorption spectrophotometer (AAS). Concentrations of seven (7) elements Zn, Mn, Cu, Fe, Ca, Na and K were determined. From the results obtained it can be concluded that cattle had the highest concentration of Zn (2.567 mg kg^{-1}) and Ca (4.267 mg kg^{-1}) and sheep has the highest concentration of Fe (3.700 mg kg^{-1}) while goat has the lowest concentration of Zn (1.933 mg kg^{-1}), Cu (0.583 mg kg^{-1}), Fe (2.243 mg kg^{-1}) and Ca (2.367 mg kg^{-1}).

References

1. Nielsen, R. G. and Volden, M., (2002). "Collaborative metal analysis of high risk" **Population Court 79 (12): 1341-52.**
2. Al-Wabel, N. A., (2008). "Mineral contents of milk of cattle, camels, goats and sheep in the central region of Saudi Arabia", **Asian Journal of Biochemistry, 3(6): 373-375.**
3. Muller, T., Feichtinger, H., Berger, H. and Muller, W., (1996). "Endemic tyrolean infantile cirrhosis: An ecogenetic disorder", **Lancet, 13: 2031-2041.**
4. Goyer, A. A., (1986). "Toxic effects of metals: Casarett and Doull's Toxicology" **The basic science of poisons, Klaasen, C. D., Amdur, M. O. and Doull, J., (Eds.). MacMillan, New York, ISBN-13: 9780071470513, pp:582-635.**
5. Blunden, S. and Wallace, T., (2003). "Tin canned food: a review and understanding of occurrence and effect" **Food Chemistry Toxicology, 41: 1651-1662**
6. Flynn, A., (1992). "Minerals and trace elements in milk" **Advanced Food Nutrition, Res., 36: 209-252.**
7. Washington State University, (2001). "Titration determination of Mg and Ca", Retrieved world wide web www.acr.wsu.edu
8. Smith, G. D., (2001). "The effect of age and level of dietary calcium intake on calcium metabolism in sheep" **The British Journal of Nutrition 26: 215-225**
9. Tartour, W. P., (2001). "Macromineral digestion by lactating diary cowsfacting affecting digestibility of magnesium" **Journal of Diary Science 87: 2167-2171.**
10. Gupta, R., (2001). "Trace elements in human and animal nutrition" **Journal fot the Society of Chemical Industry 58: 791-796**
11. Allen, J. A., (1877). Part II, chapter 4. "Domestication of the buffalo" **80 : 343-348**
12. Brown, B. A. T., Stellen, A. J. and 'O' Haro, K. P., (2000). "A dairy study of information capture in working life" **CHI 438-445**
13. Yagili, N., (1998). "the expression of genes for trans epithelial calcium transporting protein in the bovine doudeunum" **The veterinary Journal 171: 363-366**
14. Church and pond, (1988). "Potency to proprietary micronutrient" **20: 837-846**
15. Kemp, J., (1961). "Minor and trace element content of two typical Haliashee" **The veterinary Journal 171: 363-225**
16. Vidovic, M. A., Sadibasic, A., Cupic, S. and Lausevic M., (2005). "Cadmium and zinc atmosphere deposit, soil, wheat and milk"**Environ. Res., 97: 26-31**
17. Vidovic, M. A., Sadibasic, A., Cupic, S. and Lausevic M., (2005). "Cu, Zn and Mn atmosphere deposit, soil, wheat and milk" **Environ. Res., 97: 26-31**