Comparative Study of Some Heavy Metal Concentrations in Coconut Fluid and Milk Obtained From Taraba, Imo and Adamawa States, Nigeria

Akakuru, O. U[1]., Magu, T. O[1]., Louis H[1*]., Maitera O.N[2]., Fidelis, T.T[2]. And Bisong E.A[1].

[1]DEPARTMENT OF PURE AND APPLIED CHEMISTRY, UNIVERSITY OF CALABAR, CALABAR.
[2]DEPARTMENT OF CHEMISTRY, MODIBBO ADAMA UNIVERSITY OF TECHNOLOGY, YOLA.

***Abstract*-** Coconut fluid and milk obtained from Takum, Taraba State, Owerri, Imo State and Jimeta, Adamawa State were analysed for the presence of the metals Fe, Pb, Cu, and Zn. The determination of their individual concentrations was done using AAS (model VGP 210 bulk scientific) and the results obtained were of the following trends; in coconut fluid, Fe>Zn>Cu>Pb, while in the coconut milk it follows this trend, Fe>>Zn>Cu>Pb. The overall results show that the metal levels were higher in the milk than in the fluid and for all the metals, the values obtained for Takum were generally low compared to those of Owerri and Jimeta.

***Index Terms*-** Coconut, Fluid, Milk, Metals, Concentration.

I. INTRODUCTION

The coconut palm, *Cocos nucifera* is a member of the family Arecaceae (palm family). It is the only specie in the genus cocos and is a large palm growing to 30m tall with pinnate leave 4-6m long. It is generally classified into two general types, tall and dwarf. On fertile land, a tall coconut palm tree can yield upto 75 fruits in a year (Hahn, 1997).

Botanically, the coconut fruit is a drupe not a true nut. Like other fruits it has three layers: exocarp, mesocarp, and endocarp. The exocarp and mesocarp make up the husk of the coconut. The mesocarp is composed of fibres called coir, it has many traditional and commercial uses. During the growth of the coconut palm, several mineral nutrients and metals are absorbed by the plant root as either major or trace elements. In this case the term coconut fluid is used for the liquid endosperm while the coconut milk is the white emulsion obtained by pressing grated coconut in hot water. The coconut Fluid (water) is considered the purest liquid second only to water itself. It is full of electrolytes, calcium, potassium, magnesium and it is also used for medicinal purposes such as in the cure of urinary problems, kidney stones, etc (Tommy, 2008).

Pollution is the release of harmful substances into the environment (water, air, or land) in quantities or the level that are harmful to man, animal and plants. One of the major pollutants on land is heavy metals which may come from scraps of metals, chemicals, glass particles, pesticides and fertilizers. Most of these trace metals may be required in trace quantities in the coconut fluid or milk such as nitrogen, phosphorus, magnesium, calcium, and others like sulphur, sodium, chlorine, aluminium, manganese, boron, copper and zinc (Michael, 2006).

The various parts of coconut have a number of uses. The nut provides oil for frying, cooking and making margarine. The coconut meat is edible and used fresh or dried in cooking especially in confections and desert like macaroons. Desiccated coconut can be used as an ingredient or to produce coconut milk which is frequently added to curry dishes and other savory viands (Yong et.al, 2009).

Coconut water (fluid): serves as a suspension for the endosperm of the coconut during its nuclear phase of development later, the endosperm matures and deposit into the coconut rind during their cellular phase. It contains sugar, fibre, proteins, antioxidants, vitamins and minerals and provides an isotomic electrolyte balance (Paniappan, 2002).

Cocconut milk: is obtained primarily by extracting juice by pressing the grated coconuts white kernel or by passing hot water or milk through grated coconut which extracts the oil and aromatic compounds. It has fat content around 17% when refrigerated and left to set coconut cream will rise to the top and separate from the milk.

This study is aimed at determining the levels of trace metals in the fluid and milk of coconut obtained in Takum from Taraba State, Jimeta market in Adamawa State and Owerri in Imo State using Atomic Absorption Spectrophotometry (AAS) and to compare the values with other standards.

II. MATERIALS AND METHODS

Sample Collection

Coconut fruits were collected from farms in Takum LGA, Taraba State by pulling it with the use of sticks, while the ones from Jimeta market, Adamawa State and Owerri, Imo State were purchased from the market. They were labeled A, B, C for each of the states. The husk of the coconut was peeled and removed from the husk followed by breaking the shell of the coconut and punching it with a sharp object in order to create a hole on the coconut which enables the water (fluid) to flow out. The flesh of the coconut is broken into pieces and crushed enabling the milk to be extracted for use in the analysis.

All weighings were done using the mettler balance and the glass wares were soaked in concentrated nitric acid followed by washing with detergent then several rinsing with distilled water before drying in an oven. Likewise all the reagents used were of analytical grades.

Extraction of the coconut Fluid and Milk

The hard epicarp (shell) of the coconut seed was carefully cracked and the fluid (liquid endosperm) was collected in a clean beaker, filtered and measured. 100g of the soft endosperm (seed) was weighed and washed with distilled water. It was crushed and pounded to fine powder. The white emulsion obtained by washing the coconut seed is the milk. It was recovered by washing with several small portions of 200cm^{3}distilled water after series of pounding to ensure complete extraction. To reduce the oil content in the milk, it was filtered using what Mann filter paper. The filtrate is the coconut milk.

Preparation of the Aqueous Portion of the coconut Fluid and Milk

Based on the proportion of the reagent used in the preparation of the calibration curve, 80cm^3 of the aliquot portion of the coconut milk was measured and placed in a 100cm^3 volumetric flask. 4cm^3 of conc. HNO_3 acid was added followed by the addition of 10cm3 of the 8% ammonium thiocynate solution. The solution was diluted to the mark with distilled water and gently shaken to mix well. A red colouration was observed. Using similar procedure, blank solutions prepared with 80cm^{3}distilled water, 4cm3 conc. HNO_3 and 10cm^3 of 8% ammonium thiocynate solution. The solution was made up to mark before mixing well by shaking. A faintcolouration was obtained.

The samples collected labeled A, B, C were analysed using Atomic Absorption Spectrophotometry (AAS) model VGP 210 bulk scientific). For each solution, the absorbance versus a blank was measured and recorded at wavelength of maximum absorbance (480nm). The measured absorbance were plotted against the concentration (ppm) inorder to obtain a calibration curve from which the various concentration of the metals were obtained (Grompose et al, 1987).

III. RESULTS AND DISCUSSION

The results obtained from the analysis of coconut fluid and milk from Takum, Jimeta, and Owerri are as shown in Table 1 below

Table1: Mean Concentration of Metal Levels in Coconut Fluid and Milk Obtained From Takum, Jimeta and Owerri.

Sample Location	Iron (Fe) ppm	Lead (Pb) ppm	Copper (Cu) ppm	Zinc (Zn) ppm
Takum (A)				
Fluid	0.280	0.076	0.300	1.040
Milk	0.700	0.138	1.280	0.850
Jimeta (B)				
Fluid	2.970	0.084	0.760	1.780
Milk	1.100	0.132	1.960	1.600
Owerri (C)				
Fluid	2.080	0.061	0.900	0.350
Milk	12.260	0.300	2.060	3.760
Mean of ABC				
Fluid	1.7767	0.3017	0.6533	1.390
Milk	4.6867	0.1967	1.7667	2.070
Recommended Standard Value				
Fluid	0.290	NA	NA	0.100
Milk	2.430	NA	NA	1.100

From the results in Table 1, the metal levels in the coconut fluid (water) were low compared to those of coconut milk and generally in the fluid the concentration of Iron (1.7767ppm) is highest, followed by Zinc (1.390ppm) while lead (0.3017ppm) was the least. The concentrations follows the following trends; Fe>Zn>Cu>Pb. While the pattern in the coconut milk was similar to that of the fluid though the concentration of the metal levels were generally high compared to those in the fluid and the trends in the milk follows this pattern Fe>>Zn>Cu>Pb.

If the metal level concentrations were considered based on location, that of locations B and C are on the higher level compared to those of A. This may be attributed to the fact that coconut obtained from B (Jimeta market) might have been brought from the eastern part of Nigeria. Of interest is the high level of iron (12.260ppm) in the milk of coconut from Owerri compared to that obtained in the fluid (2.080ppm).

The variation in the metal levels may be due to regional factor due to variation of the soil pH, the extent of deposition of used metal scraps and similar objects which may be more in the eastern part of Nigeria because of its industrialization compared to Takum, Taraba State which is in northeastern Nigeria which is far less industrialized.

IV. CONCLUSION

Both coconut fluid and milk contain Fe, Cu, Zn and Pb though they vary from one location to another but the concentration levels are moderate and essential for human consumption. Amongs the samples anaysed the coconut obtained from Takum has the least concentration of metals which makes it much better than the others. These values of metal levels are within the permissible levels of the World Health Organization (WHO, 2007).

REFERENCES

[1] Grompone, M.A.J (1987). Chemistry Education Spectroscopy/Quantitative Analysis. Pp.64-105.

[2] Hahn, W.J.,(1997). Arecanae: The Palms (http://tolweb.org/Arecanae/21337). Retrieved April 4, 2011.

[3] Michael, M.C., (2006). Pollution of Land, Essential Biology for Senior Secondary Schools. Pp.119-121.

[4] Paniappan S. (2002). The Mystery behind Coconut Water. http://www.hindu.com

[5] Tommy, F.(2008). Seven Benefits of Coconut Water.Healthmad.com/tag/benefit/page/8/

[6] WHO (2007). Culdrins for Drinking Water Quality and Editor, recommend. Chem. Geneva. Vol.1 pp.30-113.

[7] Yong, J.W.H; Ge,I,; Ng, Y.F.; Tan, S.N. (2009). The Chemical Composition and Biological Properties of Cococnut Water. Molecules 14(12); 5144-5164.

AUTHORS

First Author – Akakuru, O. U, Department Of Pure And Applied Chemistry, University Of Calabar, Calabar

Second Author – Magu, T. O, Department Of Pure And Applied Chemistry, University Of Calabar, Calabar
Third Author – Louis H, Department Of Pure And Applied Chemistry, University Of Calabar, Calabar
Fourth Author – Maitera O.N, Department Of Chemistry, Modibbo Adama University Of Technology, Yola
Fifth Author – Fidelis, T.T, Department Of Chemistry, Modibbo Adama University Of Technology, Yola
Sixth Author – Bisong E.A, Department Of Pure And Applied Chemistry, University Of Calabar, Calabar