***Available online at* www.pelagiaresearchlibrary.com**

Pelagia Research Library

Der Chemica Sinica, 2012, 3(3):557-560

Pelagia Research Library
ISSN: 0976-8505
CODEN (USA) CSHIA5

Copper levels in semi finished and finished cocoa products in Ghana

[1]J. K. KoKa*, [1]J. Kambo-Dorsa, [2]J. B Agbemaka and [1]E J Koranteng-Addo

[1]Department of Chemistry, School of Physical Science, University of Cape Coast, Ghana
[2]Department of Mathematic Education University of Education, Winneba, Ghana

---

ABSTRACT

Ghana is the world's second largest producer of cocoa beans. In addition to exporting raw cocoa beans, the country also processes some of its beans into finished and semi-finished cocoa products for both the local and international markets. The levels of copper were determined in four batches of raw cocoa and semi-finished cocoa products sampled at various intermediate stages of the manufacturing process. The copper contents of four batches of ten different finished cocoa products in Ghanaian market were also determined. Analyses of the copper contents in cocoa containing samples were affected by atomic absorption spectrometry. An average recovery of 99.3% was obtained for the metal when the samples were spiked with known concentrations of copper. The variations in the copper contents of raw cocoa, semi-finished and finished products show that there were no effective contaminations of copper during the manufacturing process; the amount of copper in the finished products corresponded to the fraction of cocoa mass present. The copper content of locally manufactured cocoa products was lower than WHO acceptable levels.

Key Words: Raw Cocoa, semi-finished, finished products, copper, Ghana.

INTRODUCTION

The welfare of millions of people continues to be plagued by growing lack of vital nutrient in food. This has partially been met with the consumption of Cocoa products such as Milo, Chocolate, Cocoa powder, Chocolim just to mention but a few.

Cocoa, which is used mainly in the production of chocolate, is an important agricultural export commodity to Ghana. Currently, Ghana produces about 700,000 tons of cocoa beans annually, and is ranked second in the world, after her neighbour Côte d'Ivoire. In terms of quality however, Ghana is recognized as the world leader in premium quality Cocoa beans production [1].

Cocoa serves as the major source of revenue for the provision of socio-economic infrastructure in the country. In terms of employment, the industry employs about 60% of the national agricultural labour force in the country [1]. Cocoa contributes about 70 -100% of their annual household incomes for these farmers [3].

It has therefore been the intention of government, which is committed to reaping the maximum benefit from the cocoa sector, to ensure that the country increases its Cocoa production and also processes more of the beans into downstream products for both the local and export markets [2]. In pursuance of this goal, Copper fungicides are made available at very low price to help address the two major causes of decline in Cocoa production: pests and diseases in Ghana. Consequencely, farmers are progressively integrating fertiliser use and spraying practices into their own cultivation of the Cocoa crop.

Firstly, the copper residue in cocoa is of high interest due to the application of Copper fungicides such as Kocide 101 (cupric hydroxide 77%), Copper Nordox (cuprous oxide), Champion (Cupric Hydroxide 77%), Ridomil (Copper Oxide 60%) and Caocobre Sandoz (50% Copper Oxide) to combat the attacks of various Cocoa pest and diseases. Hence determination of Copper fungicides should be given high attention because any hazardous residues left can cause lasting danger to quality of Cocoa and its products, the environment and consumers' health.

Secondly, the increasing global consumption makes it highly important to monitor the quality of cocoa. For instance, in 2010, Chris Uba projected that Cocoa consumption would amount to 3.6 million tonnes, reflecting an average annual increase of 2.1% from 2.8 million tonnes during the base period. He further indicated that consumption would concentrate in developed countries, which might constitute 64% of world's consumption. Consumption in these countries was projected to increase at an annual rate of 2.2% from 1.8 million tonnes during the base period to 2.3 million tonnes in 2010 [7].

The big consumers of chocolate and other Cocoa products are Europe and North America, accounting for 49% and 25% of global consumption respectively. Consumer demand in Europe and the United States show an increasing trend for specialty chocolate products such as those with high Cocoa content [8]. Records show that Europe's consumption was expected to grow by 1.7% per annum and that of North America by 3.6% per annum in 2010.

Other areas like former Soviet Union/CIS and Japan, were to have an expected growth in Cocoa consumption from 65 000 tonnes to 71 000 tonnes and 48 000 tonnes to 56 000 tonnes respectively during the base period in 2010.

Invariably, consumption in developing countries as a group was expected to amount to 1.3 million tonnes in 2010, an annual growth rate of 1.8%. Africa, the largest consuming region in this group, accounted for 35% of the consumption of Cocoa while in the Far East, where per capita consumption is small, the share in consumption was projected to increase from 31% during the same period to 34% by 2010 [7].

The objective of this research was to determine the level of Copper residue in the raw Cocoa, semi-finished and finished Cocoa products since Copper accumulation can lead to Wilson disease. Wilson disease a genetic disorder that prevents the body from getting rid of extra Copper. In Wilson disease, Copper builds up in the liver, brain, eyes, and other organs. Over time, high Copper levels can cause life-threatening organ damage [6]. Excessive Copper intake can cause nausea, vomiting, stomach pain, headache, dizziness, weakness, diarrhoea, and a metallic taste in the mouth. Copper toxicity is rare but can cause heart problems, jaundice, coma, and even death [9].

MATERIALS AND METHODS

Four batches of raw Cocoa and semi-finished products (S_1-S_6) at various intermediate stages were obtained from Tema Cocoa Processing Factory in Ghana between February and March 2000 additionally, various finished cocoa products were obtained from the Ghanaian market all before their use-by dates. The semi finished products were gently melted over a steam bath to ensure homogeneous sampling.

2.5 g of each were weighed in acid washed porcelain crucibles, heated gradually to and maintained at 250°C for 2 hours, and there after heating continued at 450°C for 16 hours in an muffle furnace. The ashed products were then wetted with deionized distilled water, treated with $5cm^3$ concentrated HNO_3, evaporated to dryness on a steam bath, and returned to the furnace at 450°C for one hour. The resulting ash was then digested with $5cm^3$ of redistilled 6M HCl and made up to $25cm^3$ with deionized distilled water. The resulting solutions were analysed for Copper using Atomic Absorption spectrometer (AAS) Shimadzu model 6401F at wave lengths of 324.8nm. All the samples were prepared in replicates of four. To determine the suitability of the sample preparation and analysis method, samples were spiked with 1μg g^{-1} sample of Copper. All the spiked samples were quadruplicated and subjected to the same preparation and analysis procedures as the unspiked samples.

RESULTS AND DISCUSSION

Recovery and reproducibility studies

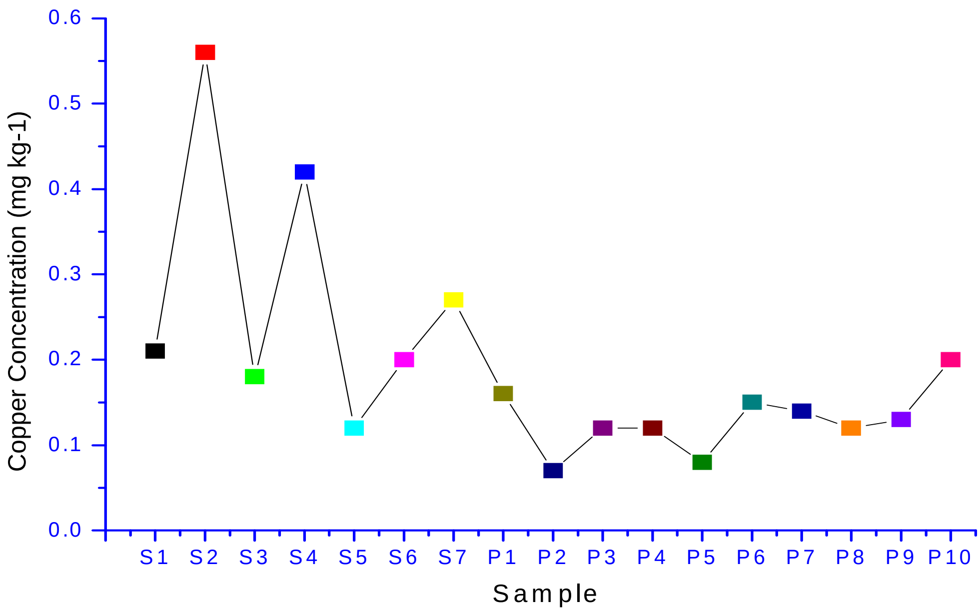
The percentage of Copper recovered in the reproducibility studies was 99.3% ± 0.24.The standard error is less than 0.5, suggesting that the method employed to analyse copper is reproducible.

Table1: Copper level in various Samples

SAMPLE	BATCH 1	BATCH 2	BATCH 3	BATCH 4	Average (mg kg^{-1})
S_1	0.20±0.01	0.20±0.01	0.21±0.01	0.22±0.01	0.21±0.01
S_2	0.50±0.02	0.60±0.02	0.51±0.02	0.61±0.02	0.56±0.06
S_3	0.18±0.01	0.17±0.01	0.018±0.01	0.02±0.01	0.18±0.01
S_4	0.40±0.01	0.40±0.01	0.41±0.01	0.45±0.01	0.42±0.01
S_5	0.13±0.01	0.12±0.01	0.11±0.01	0.11±0.01	0.12±0.01
S_6	0.29±0.02	0.28±0.02	0.26±0.02	0.26±0.02	0.27±0.02
S_7	0.21 ±0.01	0.19±0.01	0.20±0.01	0.20±0.01	0.20±0.01
P_1	0.16 ± 0.01	0.17 ± 0.01	0.15 ± 0.01	0.16 ± 0.01	0.16± 0.01
P_2	0.07 ± 0.01	0.07 ± 0.01	0.07 ± 0.01	0.07 ± 0.01	0.07± 0.01
P_3	0.12 ± 0.01	0.11 ± 0.01	0.12 ± 0.01	0.13 ± 0.01	0.12± 0.01
P_4	0.12 ± 0.01	0.12 ± 0.01	0.12 ± 0.01	0.12 ± 0.01	0.12± 0.01
P_5	0.08 ± 0.01	0.06 ± 0.01	0.10 ± 0.01	0.08 ± 0.01	0.08± 0.01
P_6	0.15 ± 0.01	0.15 ± 0.01	0.16 ± 0.01	0.14 ± 0.01	0.15± 0.01
P_7	0.13 ± 0.01	0.15 ± 0.01	0.15± 0.01	0.13 ± 0.01	0.14± 0.01
P_8	0.12 ± 0.01	0.12 ± 0.01	0.12 ± 0.01	0.12 ± 0.01	0.12± 0.01
P_9	0.13 ± 0.20	0.11 ± 0.20	0.15 ± 0.20	0.14 ± 0.20	0.13± 0.01
P_{10}	0.20 ± 0.03	0.20 ± 0.03	0.20 ± 0.03	0.20 ± 0.03	0.20± 0.01

S_1-S_6 Semi finished products
S_1- Cocoa Powder Alkalized,
S_2-Cocoa Cake Natural,
S_3.Cocoa Powder Natural,
S_4-Cocoa Butter,
S_5-Cocoa Cake Alkalized,
S_6- Cocoa Liquor,
S_7. Raw Beans
P_1-P_{10} Finished Products

Fig.1 The Graph of Copper Concentration against Cocoa Products in Ghana.



The concentration of Copper in the semi-finished products range from 0.12 to 0.56mg kg^{-1} with S_2 having the highest concentration of 0.56mg kg^{-1} and the S_5 has the lowest concentration of 0.12mg kg^{-1} while Copper levels in the locally manufactured products range from 0.07 to 0.20 mg kg^{-1} and the raw bean has mean concentration of 0.14 mg kg^{-1}. The concentration of Copper in decreasing order in the semi-finished products $S_2 > S_4 > S_1 > S_6 > S_3 > S_5$. Though the source of the Cocoa beans cannot be ascertain all the values observed in the raw Cocoa beans, semi finished and finish products in the Ghanaian market were higher than the value 0.02mg kg^{-1} obtained in cocoa beans analysed from the farm in the Central Region where no Copper fungicide was applied [4]. One could suspect that the beans were from farms where Copper fungicides were applied or Copper rich farm soils.

CONCLUSION

Due to benefits derived from copper fungicides in controlling cocoa pests, fungicide threat to human life seems to be overlooked. As a result of increasing high copper fungicide poisoning effect, FAO strongly recommends that many individual countries as possible should provide all relevant fungicide data to help the joint FAO-WHO meeting of experts on fungicides residue to make recommendation, which would take account of the special requirement of countries concerned and reflect the needs of producers and exporters. The values obtained for World Health Organization (WHO) recommends a minimal acceptable intake of approximately 1.3mg kg^{-1} [5] when compared with the values obtained in this research WHO minimal value recommended is 57% higher than the highest Copper concentration in the semi finished product and 84% higher than the highest Copper concentration observed in the finished products. It is therefore clear that Copper contents of locally produced Cocoa products are within acceptable levels during the manufacturing process observed and there was no Copper contamination in finished products in the Ghanaian market at the time of this research.

REFERENCES

[1] M.R Appiah (**2004**) Impact of Cocoa research innovations on poverty alleviation in Ghana. Ghana Academy of Arts and Sciences Publication;
[2] P.K Awua (**2002**). The success story of Cocoa processing and chocolate manufacturing in Ghana the success story that demolished a myth. Saffron Walden, Essex: David Jamieson & Associates Ltd.
[3] COCOBOD (1998) Socio-economic study. Final report [MASDAR]. Ghana: Cocoa Board.
[4] J.K. Koka, D. K Dodoo, P. K Kwakye, J. Kambo- Dorsa (**2011**). *J. Chem. Pharm. Res.*, 3(4): 467-471.
[5] WHO/FAO/IAEA (**1996**) Trace Elements in Human Nutrition and Health. World Health Organization, Geneva,
[6] http://digestive.niddk.nih.gov
[7] http://businessworldng.com/web/articles/1179/1/Cocoa-Consumption-in-2010/Page1.html
[8] http://www.teacoffeecocoa.org/tcc/Commodities/Cocoa/Consumers
[9] http://www.umm.edu/altmed/articles/copper-000296.htm