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HEAVY METAL CONTAMINATION OF SOME SELECTED NIGERIAN AND IMPORTED ALCOHOLIC DRINKS

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ABSTRACT

Heavy metal contents in selected imported and Nigerian beers were investigated. In addition samples from locally produced gin called "ufofop" and 2 commercially marketed gin were also analysed for heavy metal contents. Atomic Absorption spectrophotometer method as contained in AOAC was used for all determinations. The gin 'ufofop' was found to contain Cu (3.1625 to 6.212), Zn (0.325 to 5.000), Iron (6.000 to 28.500), pb (3.000 to 6.75) and Al. (0.220 to 0.715) mg.L. Apart from Zinc all other samples of ´ufofop' contained heavy metal in excess. The metals were traced largely to the use of galvanized metal drums which have generally replaced traditional clay and wooden vessels in many countries. The health hazard of such heavy metals is worrisome. The results obtained from the imported and Nigerian beers as well as the two commercial gins were within recommended limits indicating their suitability for consumption as far as heavy metal is concerned.

INTRODUCTION

Some heavy metals were naturally found in the body and are essential for human health. For example, iron prevents anaemia, and zinc is a cofactor in over 100 enzymic reactions (Harte *et al*. 1991). In high doses they may be toxic to the body or produce deficiency in other trace metals. For instance, high level of zinc can result in a deficiency of copper, another metal required by the body (Harte *et al*. 1991). Metal contaminated environment poses a serious health and ecological hazard: metals such as, cadmium, arsenic, lead, mercury and silver cause conditions including hypophosphataemia, heart disease and liver damage, cancer, neurological and cardiovascular disease, central nervous system damage, encephalopathy and sensory disturbances (Crapper *et al*. 1986).

A decrease in the mental skill had been attributed to the lead poisoning from wine stored in pottery lined with lead and from lead water pipes (Maier *et al*. 2000). Haemosiderosis occurs frequently among Bantu men of South Africa as a result of the high iron content of their beer, which is fermented in iron pots (Kreutler, 1980).

An alcoholic beverage is any fermented liquor, such as wine, beer or distilled spirit that contains ethyl alcohol, as an intoxicating agent (Fox and Cameron 1970). Nigerian beers and native gins belong to this group of beverages.

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Because of the health implications on the presence of heavy metals on our beverages, water and other food items, it becomes necessary to carry out this research study to ascertain the level of these metals in the Nigerian beers and gins. The shift from the use of wooden, clay, calabash vessels to metals in the processing of alcoholic drinks in Nigeria, further strengthens the justification of this study. The sources of these contaminants will also be identified and solutions may be professed.

Heavy metal contamination in home produced alcoholic drinks has been reported (Reilly, 1973). The presence of these metals may be essential for living organisms, but their concentration and accumulation in the physiological systems is detrimental to health especially where such metals are found in high amounts (Shils *et al*. 1994).

MATERIALS AN METHODS

Collection of Samples

Six samples (750 mL each) of locally distilled gin commonly called úfofop' were collected from two distillers, each in three different Local Government Areas in Akwa Ibom State, Nigeria. Two samples of different types of commercial gin (Chelsea and Bull) were also purchased from supermarket in Uyo, AKS.

Another set of six different beer products (60cl per bottle) were collected randomly from shops within Uyo municipality. Three of the samples were selected Nigerian beers (Star, Champion and "33"), while the other 3 were imported beers (Becks, Heineken, and Holsten).

All collected samples were stored in a refrigerator (10^0C).

Determination of Metal Contents

Heavy metals like Copper, Zinc, Iron, Lead and Aluminum, were determined using a unicam Model 919 Atomic Absorption Spectrophotometer with different wavelengths - Cu - 440 nm, Zn - 213.9 nm, Fe - 248.3 nm, Pb - 217 nm, Al - 309.3 nm, (A.O.A.C, 1975).

Preparation of Ufofop

A fresh palm wine contains fermentable sugars and yeast (Okafor, 1978). The fresh palm wine may be allowed to stand for 2 to 3 days, and during this period, the yeast present in the wine would ferment the sugars to produce alcohol (ethanol). The resulting mother solution is then distilled to produce a clear alcohol called `Ufofop' (Reilly, 1973)..

RESULTS AND DISCUSSIONS

Heavy metal contents in six different commercial beer samples were analysed, three of these beer samples were Nigerian beers and the other three were imported beers. The results (mg/L) are shown in Table 1. Additionally samples of Nigerian native gin popularly called `Ufofop' from six villages were also analysed for heavy metal content. The results are shown in 2.
The heavy metals analysed for included Lead, Copper, Iron, Zinc and Aluminium.

Lead was not detected in any of the beer samples. Copper and Iron were detected in all the six beer samples, while zinc and aluminium were only detected in '33', Heineken and Holstein samples none exceeded the recommended limits.

The results in Table 2 present an overall picture of the widespread metal contamination typical of home produced or locally distilled alcoholic drinks (Reilly 1973). Table 2 shows clearly that copper, iron, lead and aluminium contamination is wide spread in locally produced gin úfofop'. It is observed that the concentration of each of the metals varies with the following ranges:- copper (Cu) between 3.1625 - 6.2125 mg/L, Zinc (Zn) 0.325 - 5.000 mg/L, Lead (Pb) 3.000 - 6.750 mg/L, Iron (Fe) 6.000 - 28.500 mg/L and Aluminum (Al) 0.220 - 0.715 mg/L.

The maximum limits allowable for trace elements such as Cu, Zn, Pb, Fe and Al as contaminant in beverages (alcoholic and non-alcoholic) are fixed by law and they vary between 1.0 to 2.0 mg/L for Cu., 0.5 to 5.0 mg/L for Zn, 0.05 to 0.20 mg/L for Pb, 0.3 to 1.0 mg/L for Fe and 0.2 mg/L for Al (NIS, 1992; WHO, 1984). Using the maximum values of 2.0 mg/L for Cu, 5.0 mg/L for Zn, 0.2 mg/L for Pb, 1.0 mg/L for Fe and 0.2 mg/L for Al, excess contaminants in the analyzed gin samples can be calculated by subtraction to obtain the following results tabulated in Table 3.

Table 3 shows that the samples analyzed for zinc had no excess. Iron has the highest mean concentration of excess metal, followed by lead, copper and the least being aluminium. These results show that Cu, Pb, Fe and Al contamination is widespread in locally distilled gins.

These metal contamination may be largely due to the containers in which fermentation was carried out, and to a lesser extent, the distillation apparatus (Reilly 1973). The source of iron in the sample may be attributed to galvanized drums and similar metal drums used for fermentation and heating of the palm wine, because merely washing out a galvanized drum, which had been used in beer making, with 5% acetic acid, produced a solution containing 187.5 mg/L iron, 8.5 mg/L zinc and 0.25 mg/L copper (Reilly, 1973).

The source of copper in the sample can also be attributed to the galvanized drum which was used for fermentation and heating of the palm wine (Reilly, 1973).

However, for comparative purpose, analyses of

Table 1. Heavy metals contents in samples of Nigerian/imported beers

Sample	Country of Production	Metal Content (mg/L)				
		Pb	Cu	Fe	Zn	Al
Star	Nigeria	N.D	0.05	0.286	N.D	N.D
"33"	Nigeria	N.D	0.10	0.500	0.0032	N.D
Champion N.D	Nigeria	N.D	0.05	0.643	N.D	
Becks	Germany	N.D	0.05	0.429	N.D	N.D
Heineken	Holland	N.D	0.05	0.286	0.0032	0.003
Holstein	U.S.A.	N.D	0.05	0.286	0.0065	0.003

KEY: N.D. => Not Detected

Table 2. Heavy metal content in samples of distilled Traditional gin (Ufofop)

Sample No.	Villages obtained	Metal content (mg/L)				
		Cu	Zn	Pb	Fe	Al
1.	Mbiabong Itam	3.1625	1.058	3.000	6.000	0.625
2.	Mbiabam Ididep	6.2125	5.000	6.750	9.500	0.715
3.	Mbiakong Uruan	4.4625	0.433	4.375	8.500	0.220
4.	Afaha Nsai	3.900	0.325	4.750	7.500	0.215
5.	Ibiaku Itam	4.4625	2.092	5.250	14.000	0.564
6.	Ibikpe Uruan	5.200	0.367	5.250	28.500	0.224

Table 3. Excess amount of Cu, Zn, Pb, Fe and Al from locally distilled alcohol called "Ufofop".

Sample No.	Villages obtained	Excess Metal content (mg/L)				
		Cu	Zn	Pb	Fe	Al
1.	Mbiabong Itam	1.1625	-	2.8	5.000	0.425
2.	Mbiabam Ididep	4.2125	-	6.55	8.500	0.515
3.	Mbiabong Uruan	2.4625	-	4.175	7.500	0.02
4.	Afaha Nsai	1.9	-	4.55	6.500	0.015
5.	Ibiaku Itam	2.4625	-	5.05	13.000	0.364
6.	Ibikpe Uruan	3.2	-	5.05	27.500	0.024
	MEAN	=2.567	-	=4.695	=11.333	=0.227

Table 4. Heavy metal contamination in single samples of commercial gins

Sample No.	Name	Metal content (mg/L)				
		Cu	Zn	Pb	Fe	Al
A	Bull gin	N.D	N.D	N.D	N.D	N.D
B	Chelsea dry gin	0.043	N.D	N.D	N.D	N.D

KEY: N.D. = Not detected

some commercial drink were made and the result is indicated in Table 4. Clearly the technique of commercial distilling reduces the probability of metal contamination (Reilly, 1973). The only metal detected in one of the samples of commercial gin is copper with concentration of 0.43 mg/L only. The source of the lead and in the samples may be attributed to carrying out fermentation in lead-lined material and the use of aluminium coolware respectively (Kellas, 1996).

For comparative purpose, analyses of some commercial gins were made and the results (Table 4) show that commercial distilling reduced the probability of metal contamination (Reilly, 1973). The only metal detected in one of the samples of commercial gin is copper with concentration of 0.043 mg/L.

This study has shown that the Nigerian native gin especially `Ufofop' contains high concentration of Cu, Pb, Fe and Al as contaminants which could lead to serious health hazards, (Reilly, 1973). The commercial beers do not contain heavy metals in excess.

CONCLUSION

This research has revealed that locally distilled alcohol (`Ufofop') is not of high quality. They do not meet the specifications of the Standard Organisation of Nigeria (SON) and World Health Organisation (WHO).

It is recommended that apart from total banning of locally produced gin, the other way is to ask the producers to use equipment less liable to contaminate the produce with these heavy metals.

REFERENCES

A.O.A.C. 1975. The Association of Official Analytical Chemists. *Methods of Analysis*. Horwitz, W. Ed. 12th Edu. Washington D.C. 1015.

Crapper – Mclachlan, Dr. and VanBerkum, M.F.A. 1986. "Aluminum: A role in degenerative brain disease associated with neurofibrillary degenerations, In : *Progress in Brain Research*. Vol. 70. Swaab *et al.* Eds. – Elsevier Science Publishers, Amsterdam. 339 - 403.

Fox, B.A. and Cameron, A.G. 1970. *Food Science -A Chemical Approach*. The English University Press Ltd London. 70 - 76.

Harte, J., Dorkin, A., Zavon, A. 1991. Toxic A to Z. In: *A Guide to Everyday Pollution Hazards*, University of California Press, Berkeley, CA 246 -247.

Kellas,B. 1996. *Surviving the toxic Crisis. Professional Preference*. Publishers Oliveham, CA. USA. 186 (217) : 230 - 231.

Kreutler, P.A. 1980. Nutrition in Perspective. Prentice Hall, Inc./Englewood Cliffs. New Jersey – 339 - 347.

Maier, R.M. Pepper, I.L. and Gerba, C.P. 2000. *Environmental Microbiology* Academic Press London UK 404 - 406.

Okafor, N. 1978. Microbiology and biochemistry of oil palm Win. *Advances in Applied Microbiology*. 24 : 237-250.

Reilly, C. 1973. *Heavy Metal Contamination in home – produced Beer and Spirits in Ecology of Food and Nutrition.* Vol. 2. Godon & Bleach Science Publishers Ltd. Northern Ireland 43- 47.

Shils, M.E., Olson, J.A. and Shilke, M. 1994. *Modern Nutrition in Health and Disease*. Vol. 1 8th Edu. William and Wilkins. London. 83 -90, 201-206.