

# Heavy Metals Contamination in Two Popular Local Drinks Consumed in Northern Nigeria

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## Abstract

The study was carried out to assess the heavy metal contamination in two popular local drinks consumed in Northern Nigeria. The Zobo and Kunu samples were collected from six Local Governments of Gombe State and were analyzed for heavy metals (Fe, Cd, Mn, Co, Ni, Cr, Pb, Cu and Zn) using atomic absorption spectrophotometer. The results obtained from two local drink samples in mgL<sup>-1</sup> showed that Fe (0.09 - 2.85); Cd (0.01 - 0.03); Mn (0.02 - 0.10); Ni (0.00 - 0.01); Cr (0.02 - 0.07); Pd (0.03 - 0.12); Cu (0.01 - 0.03); Zn (0.35 - 0.71). The results showed that the concentration of Cr (0.02-0.07) were above the WHO recommended guideline of 0.01 mgL<sup>-1</sup> in both drinks. The concentrations of Fe (0.43-2.85) and Pb (0.03-0.12) in Kunu drinks were also above the WHO recommended of 0.3 and 0.01 mgL<sup>-1</sup> while in Zobo samples within the WHO permissible limit.

**Keywords:** Heavy Metals, Kunu, Local drinks, Zobo

## Introduction

Heavy metals contamination is a major problem of our environment and they are also one of the major contaminating agents of our food supply [1-2]. The knowledge of metals in foods is essential for calculating the dietary intakes of essential metals and evaluation of human exposure to toxic elements [3]. This problem is receiving more and more attention all over the world, in general and in developing countries in particular. The excessive intake of these toxic heavy metals can lead to several diseases such as organ failure, cancers, retardation of mental development in children in pregnant women [4]. Therefore it is important to monitor the level of such pollutants in the environments especially the foods and drinks consumed in the rural areas of developing countries like Nigeria which suffers neglect from the government [5].

Zobo is a Nigerian drink from the dried red calyces and sepals of the Roselle plant (*Hibiscus Sabdariffa*) known as zobo leaves in Nigeria. Zobo is usually served as a chilled refreshing drink but can also be enjoyed as a relaxing hot tea and leaves used in production of jam/jelly, food colouring, syrups and soup/sauces. According to several scientific investigations, weather in form of tea, jams or sauces is said to help reduce high blood pressure, aid digestion, promote the health of the urinary tract and also great for overall health [5]. Kunu is a popular drink consumed throughout Nigeria, mostly in the Northern Nigeria. It is usually made from grains such as millet or sorghum, although it can be made from maize as well. The variety of the drink made from sorghum is a milky light-brown colour, while Kunu made from millet and maize is whitish in colour [6].

According to several scientific investigations, millet and other grains use in the production of these local drinks contains a poly-nutrient called ligman, which has cancer fighting properties and is beneficial in the treatment of heart disease. These drinks contain fibre thus helping to promote a healthy digestive system and also help in the prevention of chronic inflammatory diseases such as rheumatoid arthritis. The processing of these local drinks is carried out in a small scale enterprise involving the possible use of low water quality, there is a distinct possibility of contamination of these products with understand able elements [7]. The availability of metals in our local drinks may be as result of the bio-accumulated metals in the plants which are used for the production processes. The present study focuses on heavy metal contents of two popular local drinks.



100cm<sup>3</sup> with deionized water. Fe, Cd, Mn, Co, Ni, Cr, Pb, Cu and Zn were all determined using atomic absorption spectrophotometer (AAS). All the samples analysis was done in three replicates.

### Quality assurance protocol

Precision and accuracy of the analytical procedure was investigated by carrying out recovery experiments. Samples were handled carefully to avoid contamination. All glassware and other containers were properly cleaned and the reagents were of analytical grade. Accuracy of the digestion procedures was verified by examination of the recovery data, spiking analyzed samples with aliquots of metal standards and then reanalyzing the samples. The percentage recoveries lay within the range 89.5-104.70% with the percent relative standard deviations less than eleven, indicating good accuracy and precision.

### Result and Discussion

The levels of heavy metals in Zobo drink samples collected in Gombe, Bajoga, Kumo, Deba, Billiri and Kaltungo towns of Gombe State was shown in Table 1. Fe has the highest mean concentration ranged from 0.09 - 2.85 (mgL<sup>-1</sup>) in all zobo samples. Cd was not detected in Zobo drinks collected in Gombe, Deba and Kaltungo respectively. Mn was not detected only in Billiri and Kaltungo sample of Zobo drinks but present in Gombe, Bajoga, Deba, Kumo samples. Co was not at detectable range in all Zobo samples collected. Ni was also not at detectable range in Gombe, Bajoga, Deba and Billiri towns respectively. Cr was detected in samples collected from Gombe, Kumo, Billiri and Katungo towns. Among the detectable metals in the Zobo samples, Pd was only detected in sample from Billiri. The concentration of Cu was detected in Zobo drinks from Gombe, Kumo and Katungo. Zn was the second highest metal to Fe in all samples which ranged from 0.71 - 0.35 (mgL<sup>-1</sup>). The general trend of the heavy metal in all Zobo samples collected in the six sampling point of the State was found to be as: Fe>Zn>Mn>Cr>Cu>Cd>Ni>Pd.

**Table 1;** Metal Concentrations (mgL<sup>-1</sup>) in Zobo drink samples from Gombe, Northern Nigeria

Metals	GMB	BJG	DB	KM	BLR	KTG
Fe	0.12	0.26	0.17	0.18	0.28	0.10
Cd	ND	0.03	ND	0.01	0.01	ND
Mn	0.02	0.03	0.10	0.02	ND	ND
Co	ND	ND	ND	ND	ND	ND
Ni	ND	ND	ND	0.01	ND	0.01
Cr	0.07	ND	ND	ND	0.03	0.03
Pd	ND	ND	ND	ND	ND	0.01
Cu	0.01	ND	ND	0.03	ND	0.02
Zn	0.71	0.45	0.50	0.35	0.55	0.61

**GMB** = Gombe; **BJG** = Bajoga; **DB** = Deba; **KM** =Kumo; **BLR** =Billiri; **KTG** = Kaltungo; **ND** = Not detected.

The level of heavy metals in Kunu drinks consumed in Gombe, Bajoga, Kumo, Deba, Billiri and Kaltungo towns of Gombe State was shown in table 2. The level of Fe in all Kunu samples collected ranged from 0.56 - 2.85 (mgL<sup>-1</sup>). Cd was not detected in Kunu samples of Bajoga, Deba and Kumo town. The Mn was also not at detectable range for samples collected in Kumo towns. Among the detectable heavy metals in Kunu samples collected, Co and Ni were not at detectable range in all the six sampling towns where Kunu samples were collected. Cr was detected in samples collected from Deba, Kumo, Billiri and Kaltungo but not detected in samples from Gombe and Bajoga towns. Pb was in detectable level in Bajoga, Billiri and Kaltungo but Cu was detected only in Billiri and Kaltungo samples. Zn has the mean concentration range from 0.46 - 0.67 (mgL<sup>-1</sup>) in all Kunu sample collected. The general trend of the heavy metal in all Kunu samples was found to be as: Fe>Pd>Mn>Zn>Cr>Cu>Cd.

**Table 2;** Metal Concentrations (mgL<sup>-1</sup>) in Kunu drink samples from Gombe, Northern Nigeria

Metals	GMB	BJG	DB	KM	BLR	KTG
Fe	2.85	0.87	0.77	0.43	1.08	0.56
Cd	0.01	ND	ND	ND	0.02	0.01
Mn	0.06	0.05	0.03	ND	0.02	0.07
Co	ND	ND	ND	ND	ND	ND
Ni	ND	ND	ND	ND	ND	ND
Cr	ND	ND	0.06	0.04	0.02	0.02
Pd	ND	0.03	ND	ND	0.11	0.12
Cu	ND	ND	ND	ND	0.02	0.01
Zn	0.67	0.46	0.55	0.52	0.49	0.60

**GMB** = Gombe; **BJG** = Bajoga; **DB** = Deba; **KM** =Kumo; **BLR** =Billiri; **KTG** = Kaltungo; **ND** = Not detected.

Comparison of the levels of heavy metals in Zobo and Kunu collected in the sampling point was showed in Fig. 2 Fe has the highest mean concentration in all local drinks ranging between 0.43 - 2.85 (mgL<sup>-1</sup>) in Kunu and 0.09 - 0.28 (mgL<sup>-1</sup>) in Zobo. The mean concentration of Fe in the present study is above the WHO recommended limit of 0.3 (mgL<sup>-1</sup>) in Kunu drinks. The high metal content of Fe in Kunu could be from cooking utensil where high temperature was applied during the production process. This is not acceptable to the consumers; as it could give rise to iron dependent bacteria which in turn cause further deterioration in the quality of local drinks by prohibition of slimes, or objectionable colour [10]. The result indicates that, the mean concentration of Cd in Zobo sample ranged between 0.01 - 0.02 (mgL<sup>-1</sup>) and 0.01 - 0.03 (mgL<sup>-1</sup>) in Kunu and Zobo drinks respectively, in both samples were fall within the WHO limit. The Mn content of the Zobo samples varied between 0.01 - 0.03 and 0.02 - 0.07 (mgL<sup>-1</sup>) in Kunu samples. The concentration of Mn in Zobo and Kunu samples were below WHO permissible limits of 0.4 (mgL<sup>-1</sup>) of beverage drinks. Mn is an essential element and one of moderate toxicities. Mn has been implicated in neurological problems, especially when inhaled [11]. Cobalt was not detected both in Zobo and Kunu samples of all six sampling point. Nickel was not detected in Kunu but the mean concentration of Nickel was 0.01 (mgL<sup>-1</sup>) in Zobo which fall within WHO recommended range for local beverage drinks without adverse effect. From these results prolonged intake of these drinks can cause decreased body weight, heart and liver damage and skin irritation. Even though a small amounts of Nickel are needed by human body to produce red blood cells [12].

The mean concentrations of Cr ranged between 0.01 - 0.03 and 0.02 - 0.06 (mgL<sup>-1</sup>) in Zobo and Kunu respectively. The concentrations of Cr in Kunu were above the 0.05 (mgL<sup>-1</sup>) WHO standards of beverage drinks. Chromium toxicity is very dependent on the species and oxidation states present. It is normally found in the considerably less toxic trivalent state in foods and is poorly absorbed in the gastrointestinal tract. Chromium has been reported to have beneficial effects on types eleven diabetes [13]. However, the hexavalent form is carcinogenic. It has been estimated that human requires nearly 1 ugcr/day. The mean concentration of Pd in this study was above the WHO recommended standard of 0.01 (mgL<sup>-1</sup>) in Kunu drinks. The high content of Pd in the Kunu samples could be the water source or the production materials. Lead is a well known toxicant that has several deleterious effects even at minute concentration and has no known function in biochemical processes [13]. Lead is commonly known to inhibit active transport mechanism involving ATP to depress the activity of the enzyme cholinesterase, to suppress cellular oxidation-reduction reaction and to inhibit protein synthesis [15]. Prolonged consumption of Lead may also increase red cell fragility and kidney tubular cells and may become necrotic, while chronic exposure may lead to intestinal nephritis. Prolong consumption of Lead may result to

impairment of the hearing process [16]. The Cu content of Kunu samples varied between 0.01 – 0.02 ( $\text{mgL}^{-1}$ ) and Zobo was having the highest concentration value of 0.03 ( $\text{mgL}^{-1}$ ). The permissible limit for Cu in the drinking water in Nigeria is 1.0 mg/L (Standard Organization of Nigeria) [17]. The Cu content of the all samples was below the permissible limit. Similar observation was reported in locally produced beverages in Ethiopia [18]. The Zn concentrations in samples Zobo ranging between 0.35 - 0.71 and 0.45 - 0.67 ( $\text{mgL}^{-1}$ ) in Zobo and Kunu drinks respectively. The mean concentration of Zn was found to be below the WHO limit for local drinks standard of 3.0 ( $\text{mgL}^{-1}$ ) in all the two popular local drinks in this study.

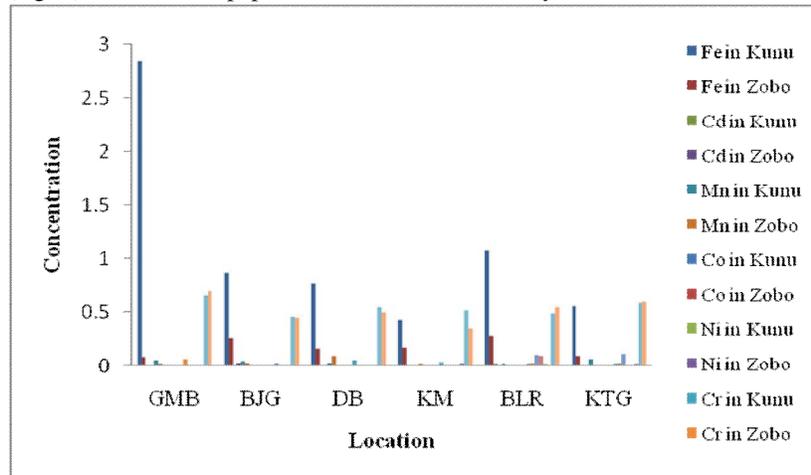


Fig. 2 Comparison of heavy metals levels in Zobo and Kunu

### Conclusion

The results of this study assessed the of heavy metal contamination in two popular local drinks in Gombe, Northern Nigeria. The Zobo and Kunu samples were collected from six Local Governments of Gombe State and were analyzed for heavy metals (Fe, Cd, Mn, Co, Ni, Cr, Pb, Cu and Zn) using atomic absorption spectrophotometer. The result revealed that the various metals are mostly below the safe limits specified for specific beverages and cereal-based foods by the Nigerian local food standards which are essentially adopted from international food standards. The results showed that the concentration of Cr (0.02 - 0.07) were above the WHO recommended guideline of 0.01  $\text{mgL}^{-1}$  in both drinks. The concentration of Fe (0.43 - 2.85) and Pb (0.03 - 0.12) in Kunu drinks were also above the WHO recommended guidelines of beverage drinks, while the concentration in Zobo samples falls within the WHO permissible limit of 0.3 and 0.01  $\text{mgL}^{-1}$  respectively in both drinks for beverage drinks.

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