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Assessment of Heavy Metals in Trona from Yobe State, Nigeria

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ABSTRACT
The level of the heavy metals concentration in trona mined in Yobe state was determined. The heavy metals such as lead (Pb), zinc (Zn), iron (Fe), copper (Cu), and manganese (Mn) were analyzed using Atomic Absorption spectrophotometer. The results shows the heavy metals concentration in the mineral were in the range of 4.22 ± 0.07 µg/g – 6.19 ± 0.06 µg/g for Pb, 22.65 ± 0.02 µg/g – 36.25 ± 0.222 µg/g for Zn, 0.22 ± 0.10 µg/g for Fe, 5.60 ± 0.06 µg/g – 7.80 ±0.12 µg/g for Cu and 0.21 ± 0.01 µg/g – 0.24 ± 0.02 µg/g for Mn. The results indicated that the contamination levels compared with WHO (2004) IFEPA standard fall below the standards, but there are possibilities of bioaccumulation.
Keywords: Trona, Heavy metals, Bioaccumulation

INTRODUCTION

Trona (trisodium hydrogen carbonate dehydrate, $Na_3(CO_3)(HCO_3).2H_2O$) is an evaporate mineral which occur in granular compact or fibrous crystalline masses in sedimentary beds. Trona in its pure form is white, but due to impurities the mineral appears gray, brown, pink and even black in nature (Deer *et al.*, 1992).

In Nigeria, trona is widely found along the chad basin areas of Borno, Yobe and Adamawa stats trona exist as encrustation in dried-up lakes and it is called "Kangwa" among the Hausa speaking tribes of Nigeria.

Trona is a relatively rare sodium rich mineral which is mined and processed intosoda ash (International mineral Association, 1995). Soda ash is a significant economic commodity because of its several applications in the manufacturing industries (Raw materials Research and Development Council, 1988). It is used locally as an ingredient for animal appetizer, cooking soup and medicinal purposes. Mining of trona which mainly in Borno and Yobe states are still in small scale and the operation involves mainly the surface mining using shovels by local people (Ministry of Soil Mineral Development, 2000*)*. The trona ores commonly contains 2.4 % NaCl, 20 % Na_2CO_3, 26.5 % Na_2SO_4, and 30.8 % $CaCO_3$, 2.0 % $CaSO_4$, 1.4 % insoluble solids and 3.2 % water (The Maiduguri Soda-ash production Company Limited, unpublished document).

Heavy metals are natural component of earth crust and they cannot be degraded or destroyed. In a small content they enter our bodies through food, drinking water and air. As trace elements some heavy metals like copper, selenium and zinc are essential to maintain the metabolism of human body. However, at higher concentrations they can lead to poisoning (John and Duff, 2002). Heavy metals are dangerous because they tend to boiaccumulate. Bioaccumulation means an increase in the concentration of a chemical in biological concentration in the environment. Compounds accumulate in living things any time they are taken up and stored faster than they are broken down, metabolized or excreted. The danger of bioaccumulation of trace metals in bioorganism has in recent times reported by many workers. These workers attributed the incidents to indiscriminate disposal of domestic waste, industrial waste and natural source (Ndiokwere, 1983 and Usman *et al.*, 2003)

The fate of trace metals such as lead (Pb), zinc (Zn), iron (Fe), copper (Cu), and manganese (Mn) in the food web is of great concern owning to their impacts on the entire ecosystem.

The trona ore in Yobe state is of good quality (The Maiduguri Soda-ash production Company Limited, unpublished document) the ingredient is known to consist of some essential minerals in varying quantities. This micronutrient is essential to the health and development of human beings. But the safety of these ingredients in regard to the ore sources remains unknown and uncertain.

This research is therefore deemed it necessary to carry out investigation into the level of some heavy metals in trona from Yobe state and to find out whether the level of their concentration has exceeded the maximum limit, so as to pose human health risk.

MATERIALS AND METHODS

The area studied covers Nguru, and Gashua local Government areas of Yobe state, Nigeria. The locations indentified are Margadu, Dokon Kuka 1, Dogon Kuka 2 and Garbi. These are the villages where local mining activities have been taking place. The sampling procedure described by Nelson (1994) was adapted for the work. Samples were collected from five sampling points at distance of about 200 meters a part per location. A gross sample of about 1 kg obtained from five sampling points. The gross sample was quartered to give a representative sample of 100 g for analysis.

Sample Treatment and Analysis

Samples were air dried in the laboratory by spreading on previously washed and dried polyethene sheets. The dried trona samples were grounded and sieved. The sieved samples were down-sized by multiple conning and quartering and finally 10 g of each sample were stored in a clean container for analysis.

The sample was digested and analyzed for heavy metals as described by Ashwini *et al.*, (2014) with little modification. About 1.0 g of each sample was digested twice with 2.0 cm^3 of nitric acid (HNO_3) and 4.0 cm^3 of hydrogen peroxide (H_2O_2). After second digestion, the solution was left to evaporate to dryness. The sample was later dissolve in 2.0 cm^3 of 0.1M of HNO_3 and diluted to 100 cm^3 with distilled water, before analysis for the metals using atomic absorption spectrophotometer (VGB system model 210).

TABLE 1: results of Mean Heavy Metal Content in Trona at Different Locations

	Heavy metals (µg/g)				
Locations	**Pb**	**Zn**	**Fe**	**Cu**	**Mn**
Margadu	4.22	25.30	0.52	4.90	0.21
	(1.07)	(0.08)	(0.05)	(0.22)	(0.01)
Dogon Kuka 1	4.80	36.25	0.22	5.60	0.22
	(0.05)	(0.02)	(0.10)	(0.06)	(0.03)
Dogon Kuka 2	6.19	28.90	0.61	7.80	0.24
	(0.06)	(0.05)	(0.03)	(0.12)	(0.02)
Garbi	5.65	34.10	0.86	5.22	0.23
	(0.03)	(0.01)	(0.12)	(0.03)	(0.02)

Values in parenthesis refer to the standard deviation of five analyses.

Table 1: Results of Mean Lead in µg/g Content in Trona at Different Locations

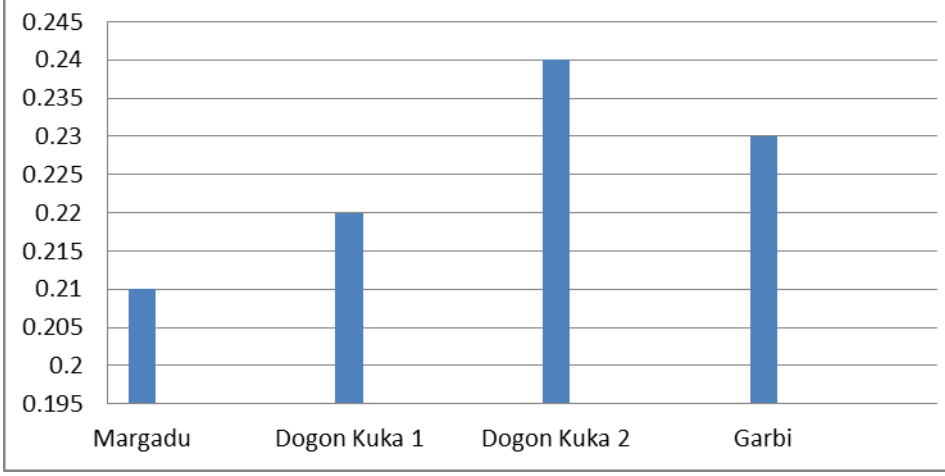


Table 2: Results of Mean Zinc in µg/g Content in Trona at Different Locations

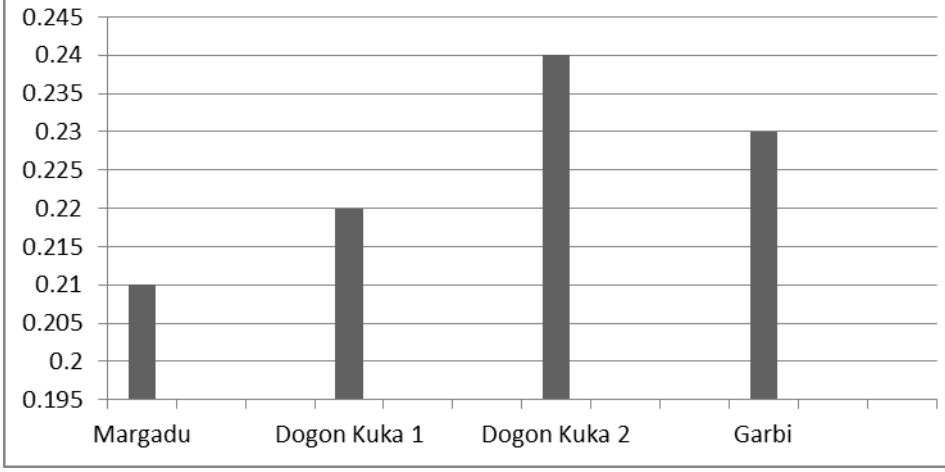


Table 3: Results of Mean Iron in µg/g Content in Trona at Different Locations

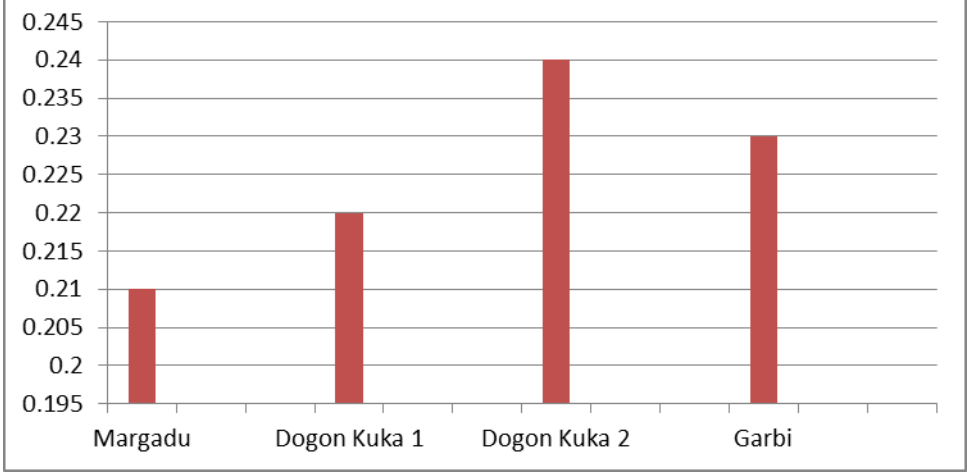
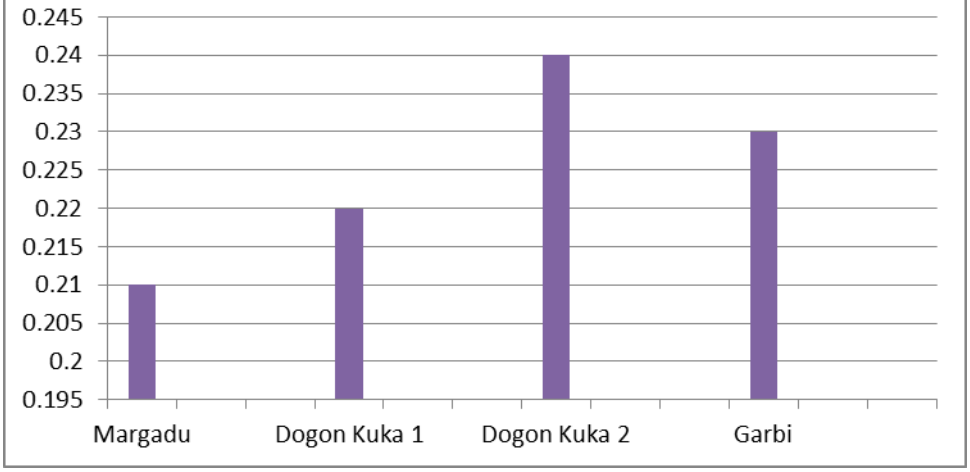
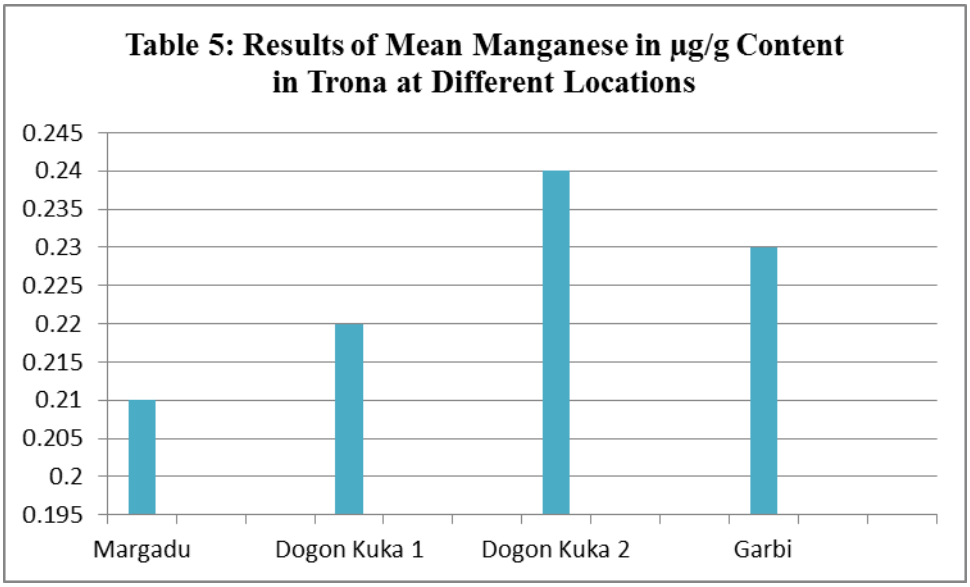


Table 4: Results of Mean Copper in µg/g Content in Trona at Different Locations





RESULTS AND DISCUSSION

Table 1. shows the level the of Pb, Zn, Fe, Cu and Mn in trona obtained from different mining locations in Yobe state. The levels of the Zn and Cu were higher when compare with those of Pb, Fe and Mn. The high level of Zn obtained in this study could be attributed primarily to pollution originating from galvanized product, in which Zn serves as additive which might be able to have deposited from the village run-off and anthropogenic sources. The mean concentration of zinc in the trona were; 25.30 µg/g in Margadu, 36. 25 µg/g in Dogon Dogon Kuka 1, 28.90 µg/g in Dogon Kuka 2 and 34.10 µg/g in Garbi. The sequential arrangement of the concentration in descending order for the various locations are; Dogon Kuka 1> Garbi > Dogon Kuka 2 > Margadu.

The mean concentration of Cu in the trona were; 4.90 µg/g in Margadu, 5.60 µg/g in Dogon Kuka 1, 7.80 µg/g in Dogon Kuka 2 and 5.22 µg/g in Garbi. Thus given an order of Dogon Kuka 2 > Dogon Kuka 1> Garbi > Margadu.

The mean distribution of Pb in the trona were 4.22 µg/g in Margadu, 4.80 µg/g in Dogon Kuka 1, 6.19 µg/g in Dogon Kuka 2 and 5.65 µg/g in Garbi. The sequential arrangement of the concentration of lead in descending order for the various locations are; Dogon Kuka 2 > Garbi > Dogon Kuka 1. Margadu. The high level of Pb could be attributed to inproper waste disposal by nearby Nguru town.

The mean concentration of Fe in the trona were; 0.52 µg/g in Margadu, 0.22 µg/g in Dogon Kuka 1, 0.61 µg/g in Dogon Kuka 2 and 0.86 µg/g in Garbi. The relative comparison in descending order at concentrations of Fe is; Garbi . Dogon Kuka 2 . Margadu > Dogon Kuka 1. The high level of Fe could be associated with the metal iron been precipitated from host rock during mineralization.

CONCLUSION

From the results of the of this study, it can be concluded that most of concentrations were found to be high even though not exceeding the maximum permissible limits set by either WHO (2004), SON (2003) or IFEPA.

The presence of the metals especially Pb and Zn in the mineral is dangerous, since these salts are low when these metals are taken by animals, they enter the food chain and become bioaccumulated and later biotransfered to man, the ultimate consumer of animals. These metals could become a threat to man's life. Since trona is used locally as an ingredient in preparation of soup, cooking, and an additives in traditional medicine, which when consumed by man, ailment associated with these metals could be contacted thus could be lethal.

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