An Evaluation of the Quality of Locally Processed Salts Consumed In Some Parts of Plateau State, Nigeria

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ABSTRACT

Salt is a very important and loved additive in a variety of foods. Therefore the quality of this important product needs to be certain as it can be a vehicle for a number of contaminants. Deposits of the halite or rock salt were found in some communities of Quan-Pan, Shendam, Langtang North and Mikang L.G.A. while it is only consumed in Bokkos. Analysis of the locally processed salts for iodine contents and heavy metal contaminants were carried out. ICP Technique was used to measure the levels of iodine, lead, calcium, zinc, manganese, iron, nickel, chromium, copper and cobalt in the samples. The results show that the iodine levels in the salts were quite low (4.32mg/kg salt to 6.107 mg/kg salt) compared to the recommended level of 50mg /kg salt that should be in edible salts. The levels of some of the heavy metals were adjudged as constituting health risk; these include: cobalt (4.32 μg/kg salt to 6.11μg/kg salt), chromium (3.40×10^{-2} mg/kg salt to 3.91×10^{-2} mg/kg salt), nickel (1.99×10^{-3} mg/kg salt to 4.09×10^{-3} mg/kg salt) and lead (10.69mg/kg salt to 15.45mg/kg salt). It is evident that the salts are not safe for human consumption.

Keywords: Salt iodization, Microorganism, Food, and Contaminants.

INTRODUCTION

The contamination of food with microorganisms, their toxins and/or heavy metals could cause acute poisoning as well as long term health problems. Table salt being an essential additive is frequently added to certain foods in order to improve their taste or for the purpose of preservation. As a result of the frequent consumption of table salt, any contamination, even in low levels could put the consumers' health at risk. This is why constant evaluation of the quality of the salts consumed is an imperative.

According to CODEX standard (2001), food grade salt is a crystalline product consisting predominantly of sodium chloride. It is supposed to be obtained from the sea, underground rock salt deposits or from natural brine. The quality should be on the basis that NaCl should not be less than 97% on a dry matter basis exclusive of additives while fortification with iodine (expressed in mg/kg) is established in the light of the local iodine deficiency situation.

Salt iodization is considered the most effective long term public health intervention for achieving optimal iodine nutrition. Effective salt iodization is a prerequisite for the sustainable elimination of iodine deficiency disorders, which include retarded mental and physical development, hypothyroidism, endemic goiter, reproductive failure and childhood mortality (WHO/UNICEF/ICCIDD, 2001).

Equally, food grade salt may not contain contaminants in amounts and in such forms that may be harmful to the health of the consumers. A common class of the contaminants that has implication for the quality of a table salt is heavy metal ions. These are toxic, non-biogradable and tend to be accumulated in the human vital organs, where they can act progressively over a long period through food chains (Xie *et al.*, 2008; Tuzen and Soylak, 2009) and their reported primary adverse health effects are lung cancer and kidney damage (Cheraghali *et al.*, 2010). Among these heavy metals, arsenic, copper, lead, cadmium, aluminium and mercury are considered most toxic (Wilson, 2012).

On the basis of these, the study was designed to evaluate the quality of locally processed salts as a step to arresting any public health damage. Therefore, the locations in Plateau State where local salts were identified and samples collected; the levels of iodine and heavy metal (lead, calcium, zinc, manganese, iron, cobalt, nickel, chromium and copper) contamination in the samples were determined.

MATERIALS AND METHODS

Sample Collection and Preparation

All the identified halite (rock salt) deposits in Plateau State were visited and the locally processed salts purchased as well as the soil at site of processing collected in some areas. The samples were labelled as follows: Shendam soil (SSO), Shendam salt (SSA); Langtang soil (LSO), Langtang salt (LSA); Mikang soil (MSO), Mikang salt (MSA); Quan-Pan salt (QSA) and Bokkos salt (BSA). There was no deposit located in Bokkos. The samples were then prepared as described by UNICEF/PAMM/MI/ICCIDD/WHO (1995).

Elemental Content Analysis Using Inductively Coupled Plasma (ICP)

The mineral contents of the digested samples were determined using ICP at the Post Graduate Research Laboratory of the Geology and Mining Department, University of Jos, Nigeria. The sample solution was converted to aerosols through a nebulizer. The aerosols were transported to the inductively coupled plasma which was a high temperature zone (8,000–10,000°C). The analytes were heated (excited) to different (atomic and/or ionic) states and produce characteristic optical emissions (lights). These emissions were separated based on their respective wavelengths and their intensities were measured (spectrometry). The intensities were proportional to the concentrations of analytes in the aqueous sample. The results which were obtained in ppm (parts per million) were converted to other concentration units as considered appropriate (mg element/g sample; mg element/kg sample and µg element/g sample).

RESULTS

Location of Halite (Rock Salt) Deposits in Plateau State

Deposits of the halite or rock salt were found in communities in the following Local Government areas Quan pan, Shendam, Langtang North and Mikang. There was no deposit located in Bokkos, but some of the communities in this area have the local salt sold in their community markets. Some of the people depend on this salt as additive in their foods.

Description of the Salts

The salt samples were translucent and coarse crystals. Their colour ranged from brownish yellow to brownish pink. They were also moist.

Level of Iodine in the Salts

Figure 1 presents the levels of iodine in the different samples collected and analyzed. The iodine level varied between 4.321 x 10^{-3} mg/kg salt (QPSA) to 6.107x10^{-3} mg/kg salt (MSA). The soil samples analyzed had higher levels of iodine (up to 7.437x10^{-3} mg/kg soil) than the salt samples extracted from the same soil. Generally MSO soil had the highest iodine level (7.44x10^{-3} mg/kg soil) while the least is of SSO (5.81x10^{-3} mg/kg soil).

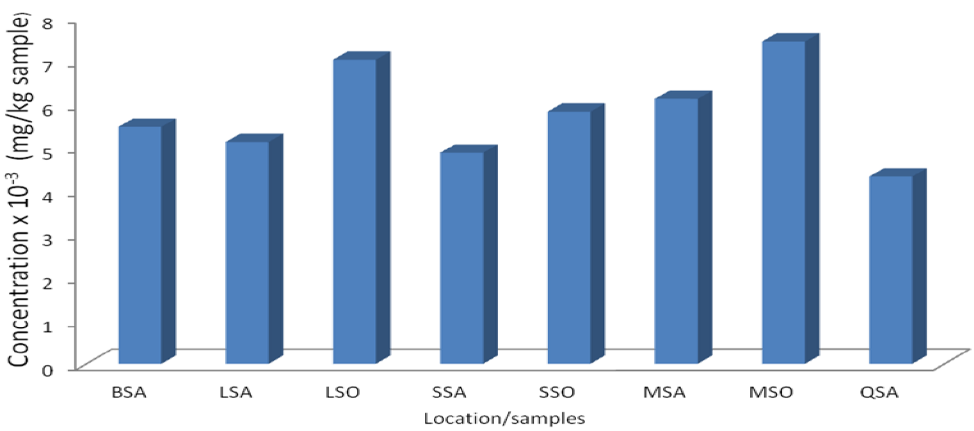

Figure 1: Levels of Iodine in the Samples of Salts and Soils

Levels of Heavy Metals in the Samples

The metals of the contaminants were observed to vary in levels across the different samples analyzed. Figure 2 shows the level of Calcium in the samples of salts and soils. QSA recorded the highest level while the BSA recorded the least level. The concentration ranged between 6.063mg/kg salt and 38.100mg/kg salt.

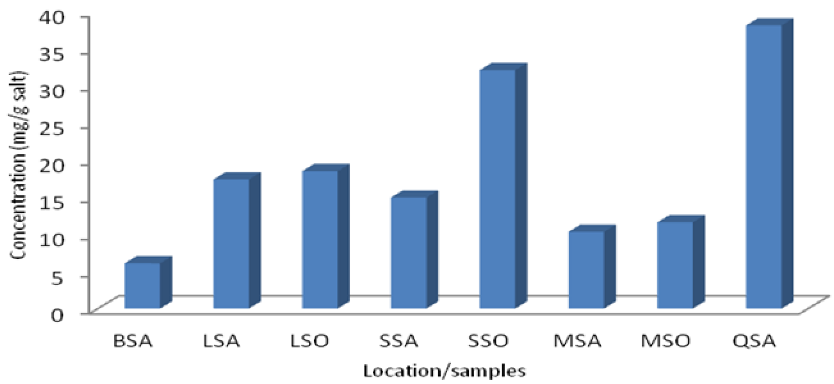

Figure 2: Levels of Calcium in the Samples of Salts and Soils

Figure 3 shows the levels of cobalt in the different samples of salts and soils analyzed. MSO had the highest level (11.61mg/kg sample) followed by LSO (7.74mg/g sample) and followed by SSO (6.86mg/g sample). The salt levels were lower with BSA (1.48mg/g sample) the least while MSA 2.40mg/g sample) had the highest.

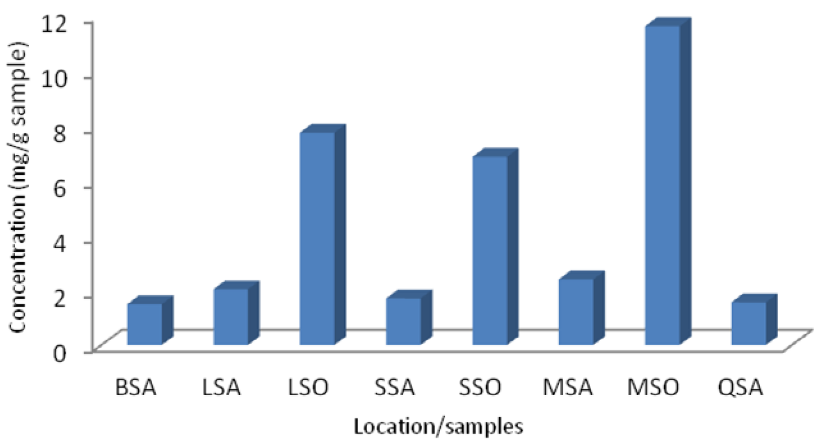

Figure 3: Levels of Cobalt in the Samples of Salts and Soils

In Figure 4, levels of chromium in the samples were presented. The soil samples from MSO, SSO and LSO had higher levels of chromium (3.33 x 10^{-2}mg/g, 1.77 x 10^{-2} mg/g and 1.32 x 10^{-2}mg/g sample respectively) while the salt samples recorded lower levels. Among the salt samples, QSA had the highest of 3.91mg/g sample while LSA had the least (3.40mg/g sample).

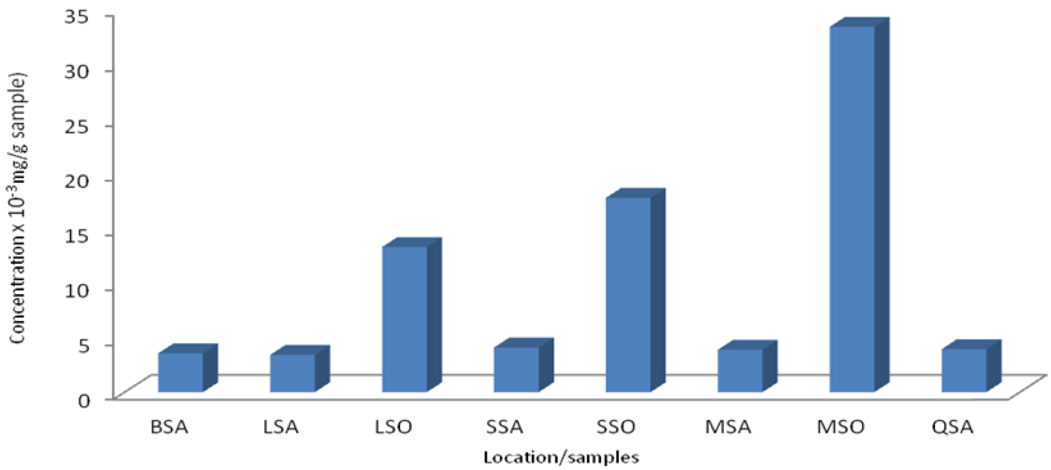

Figure 4: Levels of chromium in the samples of salts and soils

Figure 5 presents the various levels of copper in the samples. The MSO, SSO, and LSO had higher levels of the ion than the levels in their respective salts. MSO and SSO had over 1.8 x 10^{-2} mg/g sample while LSO had over 1.4 x 10^{-2} mg/g sample. SSA had the least level of about 5 x 10^{-3}mg/g sample.

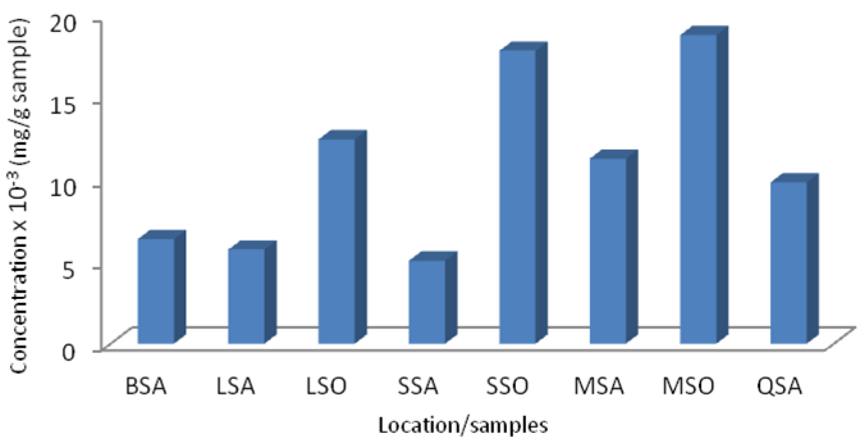

Figure 5: Levels of Copper in the Samples of Salts and Soils

Figure 6 presents the various levels of iron in the samples. The soil samples had higher levels of the ions than the levels in their respective salts. The levels of the ion in the salt samples were really low averagely 1.3 x 10^{-1}mg/g sample.

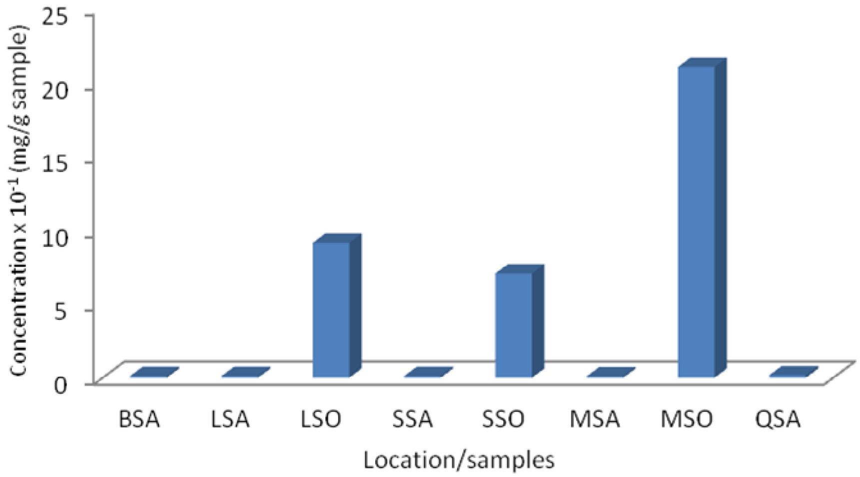

Figure 6: Levels of Iron in the Samples of Salts and Soils

In Figure 7, levels of manganese in the samples were presented. The soil samples had higher values than the salt samples. MSO and LSO had higher levels of (3.92mg/g and 3.43mg/g sample respectively) while the salt samples recorded lower levels. Among the salt samples, MSA (3.08mg/g sample) had the highest level.

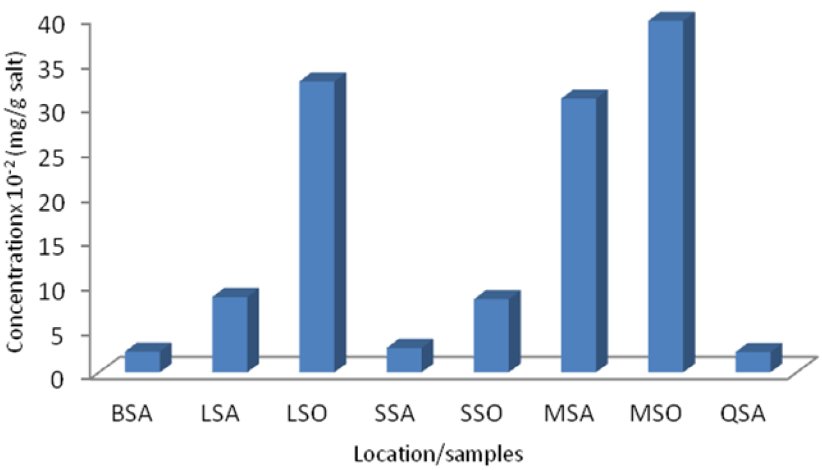

Figure 7: Levels of Manganese in the Samples of Salts and Soils

Figure 8 shows levels of nickel in the samples. The soil samples had higher values than the salt samples. BSA, LSA, LSO, SSA, SSO, MSA, MSO and QSA had values 1.991×10^{-3}, 1.967×10^{-3}, 8.341×10^{-3}, 2.194×10^{-3}, 7.409×10^{-3}, 1.522×10^{-2} and 4.088×10^{-3}mg/g sample respectively..

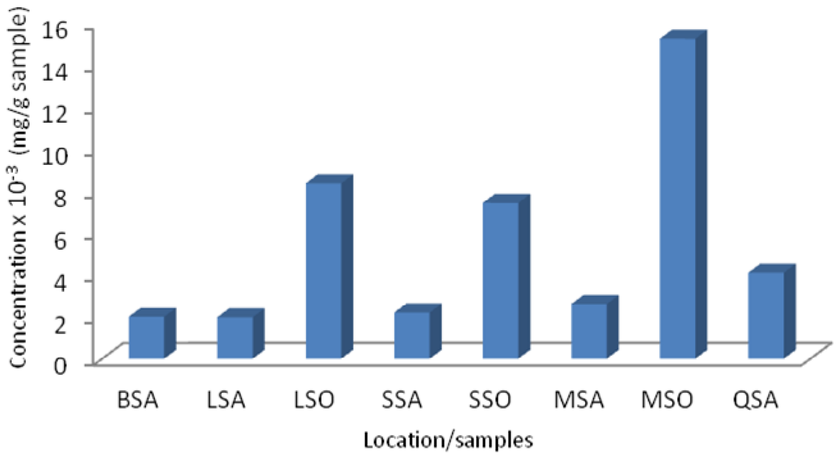

Figure 8: Levels of Nickel in the Samples of Salts and Soils

Figure 9 presents the level of lead in the samples. The distribution of the ion in the samples shows that BSA had 1.16 x 10^{-1}mg/g sample, LSA (1.20 x 10^{-1} mg/g sample), LSO (3.30 x 10^{-1}mg/g sample), SSA (1.07 x 10^{-1}mg/g sample), MSA (2.82 x 10^{-1}mg/g sample), MSO (2.96 x 10^{-1}mg/g sample), and QSA (1.55x10^{-1}mg/g sample).

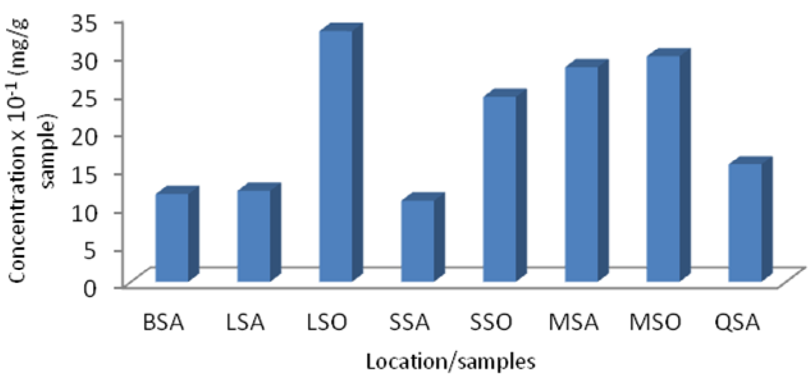

Figure 9: Levels of Lead in the Samples of Salts and Soils

Figure 10 presents the levels of zinc in the samples. The results revealed that the soil samples had higher values followed by the levels of the ion in LSA and BSA as shown. BSA had 4.68 x 10^{-1}mg/g sample, LSA (4.63 x 10^{-1}mg/g sample), LSO (4.65 x 10^{-1}mg/g sample), SSA (3.25 x 10^{-1}mg/g sample), MSA (2.88 x 10^{-1}mg/g sample), MSO (5.39 x 10^{-1}mg/g sample), and QSA (2.94 x 10^{-1}mg/g sample).

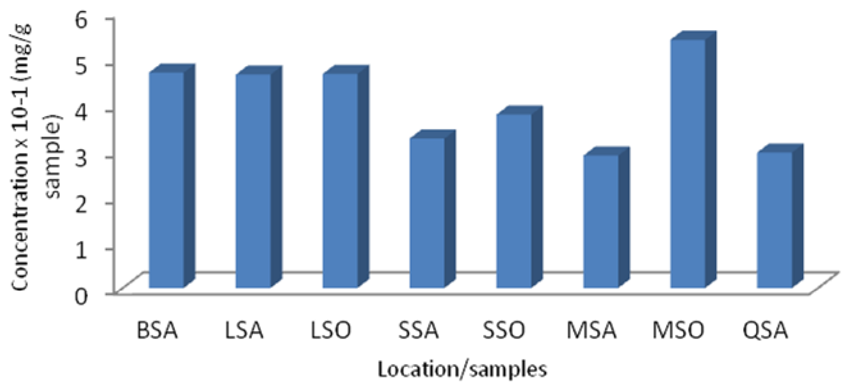

Figure 10: Levels of Zinc in the Samples of Salts and Soils

DISCUSSION

The brownish appearance of the salt samples studied is consistent with observations of locally processed salts as described by Atkins (2012). This was possibly so because of the presence of contaminants. The level (4.321 x 10^{-3} mg/kg salt to 6.107x10^{-3} mg/kg salt) of iodine in the salt samples failed to meet the required standard. It is expected that, in Nigeria 50mg iodine/kg salt should be the level. This has great implication on the health of the consumers that depend solely on these salts without any other substitute. Failure to have adequate iodine leads to insufficient production of thyroid hormones, thyroxine and triodothryonine which affect many different parts of the body resulting in mental retardation, goitre, physical sluggishness, growth retardation, reproductive failure and increased childhood mortality (Mannar and Dunn, 1995). This is why iodine is made one of the supplements in table salts.

The mere presence of some ions in salt constitute contamination examples of such ions that pose health risk because of their toxic tendencies are Arsenic, copper, Lead, cadmium, mercury, nickel, antimony, beryllium, Aluminium, etc. (Wilson, 2012). However, Codex standard (2001) set maximum permitted levels for some of these ions beyond which the salts may not be safe for consumption, examples are Arsenic (0.5mg/kg), Cu (2mg/kg), Pb (2mg/kg), Cd (0.5mg/kg) and Hg (0.1mg/kg). Some of the trace metals are absolutely essential for life. They include Fe, Cu, Mn, Zn, Cr, Se, Li, Co, Si, and probably a dozen others on which much research has not been carried out (Wilson, 2012). As a result the levels of some of these in the samples, since at low levels, may be beneficial. Metals like Cu and lead had higher values in the samples than the Codex permitted levels. Excess of Cu causes depression, fatigue, acne, migraine headaches, moodiness, infertility, menstrual tension, etc. Lead, on the other hand, causes neuromuscular and bone diseases, fractures, hyperactivity, anemia, etc (Wilson, 2012). Therefore, the locally processed salt is unsafe for consumption.

It is therefore, recommended that the consumption of the salts should be stopped; further investigation on the levels of these metals in other food commodities grown and consumed in these areas; and a feasibility study, with the aim of siting a small scale salt processing industry in the zone, be carried out

ACKNOWLEDGEMENTS

We acknowledge TETFUND, FCT, Abuja for the grant to undertake this work; Federal College of Education, Pankshin, Plateau State, Nigeria for their assistance in the course of the work; and members of the Communities visited for their cooperation.

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Reference to this paper should be made as follows: I.Y. Longdet *et al.,* (2013), An Evaluation of the Quality of Locally Processed Salts Consumed in Some Parts of Plateau State, Nigeria, *J. of Environmental Sciences and Resource Management, Vol.5, No.1, Pp. 122 – 131.*