Analysis of Chemical Composition of Three Variants of Potash in North Central Nigeria: Implication on Public Health and Attainment of SDG No. 3

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***Abstract*: Despite the relevance and use of potash for cooking various types of food over a long period of time in north central Nigeria, a serious gap exist in the non-analysis north central Nigeria. There has been a worrisome trend of increase in carcinogenic ailments in Nigeria. The research analysed the chemical components of three types of potash variants: red (Jan kanwa), white (Farin Kanwa) and Brown (Tokan Sanyi) potash. The samples were analysed for presence or otherwise of some heavy metals (Lead (Pb) Iron (Fe), Manganese (Mn) and Nickel (Ni)). Three samples of potash were obtained from Benue, Nassarawa and Plateau states. The metals were analysed using the Atomic Absorption Spectrophotometer (AAAS). The results were compared with the World Health Organisation standard. The three samples were subjected to digestion and qualitative and quantitative analysis carried out on them. Ions tested for in the qualitative analysis include: Cl^-, SO_4^{2-}, NO_3^-, and CO_3^2. Percentage purity of the samples were also calculated. From the analysis the alkali concentration of red, white and brown potash was found to be 0.344, 0.272 and 0.795 moldm^3 respectively. Their percentage purity was found to be 38.53, 30.46 and 89.04% respectively. The concentration of lead in the three samples (Red = 0.156, white = 0.076 and Brown 0.058 mg/L) These are higher than the WHO standard of 0.05mg/L. The concentration of Fe for the three samples of potash was (red = 4.192, white = 31.329 and Brown = 2.072). This was found to be well above the WHO standard of 1.0mg/L useful: The concentration of Mn in the three samples were found to be (red=ND, white = 0.118, brown =ND). The Ni was not detected in all the three samples. Based on this result it was recommended among others that since potash has very high percentage impurities, there is need for its purification before consumption.**

***Key Words*: Chemical Composition, Potash, Public Health, SDG**

I. INTRODUCTION

Must foods around north central Nigeria when cooked under normal temperature consume a lot of energy or may not get enough tendering for consumption. These food require the use of catalyst to conserve energy. The most commonly used catalyst in cooking is the potash. Potash is an inorganic chemical substance used by people in northern Nigeria for cooking almost every type of food. In north central Nigeria particularly in Benue, Nassarwa and Plateau States, there are some local foods that are always cooked using potash eg local bens, okra soup, lalo soup karkashi soup, cow leg or pomo among others. It is thus instructive to mention that almost every household in those states use potash for cooking on a daily basis. According to Wikipedia (2021) potash is the common name of potassium hydroxide (KOH), a substance which has been found to be very useful for many purposes. Red and brown potash is found in the earth's crust as mineral deposits around Maiduguri area of Borno state and some parts of north central Nigeria. Heavy metals may get into this mineral from its ore by both natural and artificial means. The natural conditions occur through the weathering of rock by chemical or mechanical processes. These rocks contain high amount of the heavy metals which are washed into the earth crust by surface water. Other sources of heavy metals in red (Jan Kanwa) and white (FarinKanwa) potash which are found in the earth's crust as minerals include agricultural practices, petroleum extraction, mining and industrial effuellents. The disposal of these wastes by these sources deposits heavy metals which contaminate the environment and the mineral deposits within the earth crust. The problem of concern to this research is that some forms of potash have been implicated in growth of cancerous cell (Jedy-Agba, Curado, Ogunbiyi, & Oga, 2014; Pahwa & McDuffe, 2008). Brown potash (TokanSanyi) is for instance made locally from ash. The process of making this type of potash is so crude that it may also contain some impurities that are not safe for human consumption. Although the presence of heavy metals is important for the growth of plants in trace quantity, it also has an adverse effect on them when the required concentrations are above certain levels. The health and wellbeing of a populace is important as stipulated in SDG no 3, since potash is consumed on a daily basis by almost every household in the study area. The analysis of its safety is therefore important. It is at the backdrop of this that the present study sets out to analyse the chemical composition of three variants of potash as it implication on public health and attainment of SDG no. 3 in north central Nigeria.

II. LITERATURE REVIEW

This work is hinged on Johnson and Johnson (2003) Knowledge attitude behaviour theoretical model. The theory states that impacts of nutrition education in term of knowledge, attitudes, and behaviour are most commonly measured variables and can lead to positive change in attitudes. Their meta-analysis of 303 studies found that nutrition education resulted in overall improvements of 33% in knowledge, 14% in attitudes, and 19% in dietary practices. However, they noted

that "a shortcoming of the research is the failure to base the research on theoretical models. Thus theory is helpful as they could have been in providing communities knowledge attitude and beliefs about the purity and use of potash as food additive in north central Nigeria and attainment of SDG no 3.

According to Wikipedia (2021) potash is a major industrial chemical. It is used as a base in a wide variety of chemical processes. It is used as a catalyst in reaction like the production of biodiesel, the advantage of using KOH and not NaOH is that, NaOH "clumps" while KOH does not. Potash is also used in acrylate ester copolymer coating and as deforming agents used in the manufacture of paper. It is used as a PH control agent, polyethylene resins and textile processing. In local industries, it used in making soap and also used as solvent in processes such as glass making, pharmaceuticals and food industry. Also, nitrate of potash (KNO_3) are used as fertilizer and it can react with H_2SO_4 to produce HNO_3 acid which is used in industries (HIS, 2019). In the same vein, nitrate of potash is an essential constituent of gun powder as asserted by (Hill and Holman 1995).

Potash also has an essential role to play in the addition or increase of crop yield. According to Macintosh (2020) potash can be used in preparation of farmland before planting any crop. When this is done, it will go a long way in controlling the fungal pathogen and hence leads to high yield of crops for our society. More so, potash is usually given to livestock for their health status in terms of de – worming the animals and this creates in the livestock the ability to increase their rate of eating grasses. As a result the animals tend to grow fat and produce well. Again, it is uses as veterinary medicine in dis-budding calves' horns and so dissolve scales and hair manufacture of cleansers in wart removal and as an article solvent. In the production of N.P.K. formulation, potash is use as a feedstock in the chemical production of fertilizer. Lastly, McDuell (2019) in his study maintained that sulphate of potassium is used in the production of flowers and seeds in plants.

` Potash is commonly used domestically in the area of washing or chemical peeling of fruits and vegetables, chocolate and cocoa processing caramel colour production, poultry scaling and forming a skin on pretzels before baking, soft during processing, ice cream thickener and olive agent (Wikipedia, 2021). It also serves as a traditional ingredient in the making of soap and cooking of local beans which is very hard to cook. The function potash plays here is to fasten the rate of cooking thus reducing the time/economic waste of cooking it. Potash has medicinal value in treating catarrh (Fwatshak, 2007).

Potash also has some disadvantages to the health of an organism when taken a large quantity. Therefore proper care must be taken in using potash. When potash is ingested i.e. taken into our body system most of especially at high rate, it becomes a burden to our tissues, it can cause permanent G.I damage which can even lead to death. Impure potash along with other chemicals has been fingered in some dangerous ailments such as cancer and a long term hazards. When potash come in contact with our skin, it causes burns to our skin, from the burns it develops to rashes in our skin which can proceed to deep cancer when not treated in the early state(Science and Technology, 1987). Since potash continues to be used for centuries as part of cooking ingredients, it worthwhile to investigate if it has some elements that could be harmful or not. It is at the backdrop of this that this research intends to analyse the chemical composition of three variants of potash and its impact on public health and attainment of SDG no. 3 in north central Nigeria.

Statement of the Problem

Despite the use of various variants of potash as a catalyst for food preparation in Nigeria over the years, little efforts seems to be placed on its analysis and purification for safety and healthy consumption. The variants: Red potash (Jan kanwa), white potash (Farinkanwa) and Brown potash (Tokansanyi) are mostly used in homes in Nigeria for the cooking of soup and a wide variety of other food items. Whereas Red potash and white potash are dug directly from the earth crust, brown potash is made from ashes of hay from food crops. The two types of potash that are found in the earth crust are usually taken directly to the market after digging from the ground. There seems to be no industry in this region that is involved in the purification of this potash to make it safe for human consumption. The focus of this research therefore is to analyse these three types of potash in terms of their percentage purities and some heavy metal contents to ascertain how safe they are for human consumption towards attaining Sustainable Development Goal No. 3 on health.

Purpose and Objectives of the Study

The purpose of this study is to analyse the chemical component of three variants of potash in terms of their concentration, percentage purity and some heavy metals. This is with a view of ascertaining whether these types of potash are safe for human consumption or not. Specifically the research did the followings:

i. Ascertained the anions present in the potash.
ii. Determined the concentration of potash.
iii. Determined the percentage purity of the three potash samples.
iv. Determined the presence or otherwise of heavy metals in the three variants of potash

Research Questions

The study sets out to answer the following research questions:

1. What are the anions present in the three types of potash selected for this study?
2. What are the concentration of the three variants of potash?
3. What is the percentage purity of each of the three variants samples of potash?
4. What are the heavy metals present in the three variants of potash?

III. METHODS

The design used in this research was the experimental design. In this research three variants of the potash samples were analysed. The potash variants samples are: red, white, and brown potash randomly purchased from different sellers in markets from three states in North central Nigeria. 5g of each of the samples were used for the analysis. Analysis was done using qualitative and quantitative techniques. Atomic absorption spectrophotometer (A A S) was used to determine presence or otherwise of heavy metals in the samples.

Sampling Technique

Six states in north central Nigeria formed a sampling frame. Three states were then selected by simple random sampling. Three markets were randomly sampled for collection of three variants of potash for analysis. Some quantity of red, white and brown potash was randomly purchased from different sellers in the selected states (Plateau, Benue and Nassarawa). The sample was mixed together according to their types and was grinned. Samples were analysed for anions, percentage purity, concentrations and presence or otherwise of heavy metals. The findings were used to answer the research questions as follows:

Research Question one: What are the anions present in the three types of potash selected for this study?

Table 1: Anions present in the Potash Samples

SN	Type of Sample	Anions Detected
1	Red Potash	Cl^{-}, SO_4^{2-}, CO_3^{2}
2	White Potash	Cl-, CO_3^{2-}
3	Brown Potash	Cl-, SO_4^{2-}

Table 1 revealed that all the three variants of potash analysed contain chloride ion (Cl-). Sulphate ions (SO_4^{2-}) was found in red potash (Jan Kanwa) and Brown potash (Tokkan Sanyi). Only red potash and white potash contains carbonate ion (CO_3^{2-}) while Nitrate ion (NO_3^{-}) was absent in the three samples.

Research Question Two: What are the concentration of the three variants of potash?

Research Question three: What is the percentage purity of each of the three variants samples of potash?

Table 2: Percentage purity and Concentrations of the three Potash Variants

SN	Sample	Percentage purity	Concentrations in Mol.dm^3
1	Red Potash	38.53	0.344
2	White Potash	30.46	0.272
3	Brown Potash	87.04	0.795

Table 2 show that the alkali concentration in red (Jan Kanwa), White (Farin Kanwa) and Brown (Tokkan Sanyi) potash was 0.344 moldm^3, 0.272 moldm^3 and 0.795 moldm^3 respectively. The red potash (Jan Kanwa) only have a percentage purity of 38.53%, white potash (farin Kanwa) has 30.46%, and brown potash (Tokkan Sanyi) has 87.04%.

*Research Question Four***:** What are the heavy metals present in the three variants of potash?

Table 3: Results of AAS Test for Heavy Metals

SN	Sample	Ni	Mn	Fe	Pb
1	Red	ND	ND	4.142	0.150
2	White	ND	0.118	31.329	0.075
3	Brown	ND	ND	2.072	0.058

Key: ND Not Detected

Table 3 indicate that the iron (Fe) concentration in the red, white and brown potash was 4.142, 31.329 and 2.072 mg/L respectively. The concentration of lead (Pb) in the three samples is 0.15mg/L, 0.075mg/L and 0.058mg/L.).118g of manganese (Mn) was only detected in white potash while Nickel (Ni) was not detected in all the samples. The reddish thread in red potash may be from iron impurities from the soil.

IV. DISCUSSION OF RESULTS

This research sets out to analyse three different types of potash that are commonly used in north central Nigeria for domestic purpose (cooking). The samples were analyses to find out the concentration of alkali in the samples and the percentage purity of each of the samples. A test was carried out to find out if the samples contain some heavy metals and in what quantity. Data from Table 1 revealed that all the three variants of potash analysed contain chloride ion (Cl-). Sulphate ions (SO_4^{2-}) was found in red potash (Jan Kanwa) and Brown potash (Tokkan Sanyi). Only red potash and white potash contains carbonate ion (CO_3^{2-}) while Nitrate ion (NO_3^{-}) was absent in the three samples.

Data from Table 2 indicate that there exist some slight differences in the alkali concentration of red (Jan Kanwa), White (Farin Kanwa) and brown (Tokkan Sanyi) potash. The reason why brown potash is more concentrated than the red and white potash may be because it is made from the filtrate of ash. Some of the impurities may have been removed during the process of filtration. The alkali concentration in red (Jan Kanwa), White (Farin Kanwa) and Brown (Tokkan Sanyi) potash was 0.344 moldm^3, 0.272 moldm^3 and 0.795 moldm^3 respectively. In addition to these above concentration, some heavy metals were tested for. In the three samples, Manganese, Iron, and Lead were found in the samples selected for the study as shown above in Table 3.

Regarding the purity of the samples, the result show a variation in the percentage purity of the three sample types. The variation in the percentage purity was due to the different alkali concentration of the three samples. The red potash (Jan Kanwa) only have a percentage purity of 38.53%, white potash (farin Kanwa) has 30.46%, and brown potash (Tokkan Sanyi) has 87.04%. These samples contain some levels of impurities and as such may not be safe for human consumption. Variation also exists in the concentration of the heavy metals in the three sample types. 1g of red potash contains 0.150 mg/l of lead and 4.142 mg/L of iron (Fe). 1g of white potash contains 0.118

mg/L of manganese (Mn), 31.32mg/L of iron (Fe), and 0.075mg/L of lead (Pb). 1g of brown potash contains 2.072mg/L of iron (Fe) and 0.058mg/L of lead (Pb).

As revealed on Table 3, the iron (Fe) concentration in the red, white and brown potash was 4.142, 31.329 ad 2.072 mg/L respectively. This is above the World Health Organization (WHO) standard of 1.00mg/L. Therefore any quantity above this standard may be considerable harmful. The high concentration of iron in the white potash may be due to the occurrence of the iron in the form of its ores as haematite (Fe_2O_3) or due to leaching of sewage and refuse. Although iron is important in human nutrition for the formation of haemoglobin, intake of excess iron causes hemochromatosis a condition characterized by tissue damage. The reddish thread in red potash may be from iron impurities. This position is supported by Michaelson (2012) who opine that traces of iron ore as impurities in red potash, is responsible for its reddish or pink hue.

The concentration of lead (Pb) in the three samples is 0.15mg/L, 0.075mg/L and 0.058mg/L. This is above the WHO limit of 0.05mg/L. Thus any quantity of lead (Pb) above this standard is also considerable harmful. The concentration of lead in the red potash is higher. This may be due to leaching of refuse, sewage and agricultural activities such as fertilizer application. In high concentration Lead (Pb) causes brain disease (Arhezema). It also makes water to taste sour and unfit for drinking. High concentration of lead causes lead poisoning by producing an organic metal complex (lead acetate). The mechanism of lead poisoning is its inhibition of some important metabolic activities such as reduction of enzymes activities. It also has a tendency to bind to mitochondria leading to interference in the regulation of oxygen transport and generation. Post-mortem studies shows that lead has a tendency to accumulate with time and therefore skeletal burden of lead increases with age (Puzas et al, 2004).

Finally, as stated earlier that 1g of red potash contains 0.15mg/L of lead, 1g of white potash contain 0.075mg/L of lead and 1g of brown potash contains 0.058mg/L of lead. The quantity of potash used for cooking of soup or other food items may be approximately 3 – 5g. This implies that for every pot of soup or meal that is cooked using red, white or brown potash will contain an appreciable amount likely to be between 0.5g – 0.7g as it is the red potash that is commonly used. This has serious implication for public health and attainment of SDG 3 of adequate health for all.

V. CONCLUSION

The following conclusions are drawn from the findings of the study: There is a remarkable difference in the alkali concentration of red, white and brown potash. The red, white and brown potash contained some heavy metals. The lead and iron content of red, white and brown potash was higher than the recommended WHO (1994) standard values. The red, white and brown potash contained some impurities. Potash has health implication. This is because lead accumulations in the body affect mental performance and cause brain disorder. Too much of iron also causes hemochromatosis. The research has shown that processing of Potash can improve purity as seen in the higher percentage purity in brown potash. The growing rate of cancer and related disease is a pointer that attention should be paid to the kind of foods Nigerian take. More so a research by nature an international health journal discovered that an abundance of potassium inside tumours dampens immune responses, helping the tumours evade the body's defences. In animal experiments, genetically equipping immune cells rid themselves of potassium made them more effective at fighting cancer.

VI. RECOMMENDATION

The following recommendations are made in the light of this finding:

1. Since potash has very high percentage impurities, there is need to open up industries that will purify the potash to sieve out some of the unwanted elements.
2. People should be discouraged from using too much of potash particularly Red and white potash this is because their percentage impurity is higher and their lead content is also higher of heavy metals such as lead in them.

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