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Evaluation of the Chemical and Nutritional Constituents of Potash from Some LGA's in the Northern Zone of Plateau State

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Abstract

Potash, an impure form of potassium salts such as potassium carbonate (K_2CO_3), has significant applications in agriculture and food preparation. Derived from sources like wood ashes, maize cobs, and Acha hay, potash is used in Nigeria for various local purposes, as food tenderizer and supplement in traditional medicine. This study aimed to evaluate the chemical and nutritional constituents of potash from some Local Government areas in the Northern zone of Plateau State, Nigeria. The study employed a Laboratory-based analytical approach to determine the chemical and nutritional components of four potash varieties: maize cob, Acha hay, white, and red potash. Samples were randomly collected from Vom Market in Jos South LGA, Fan Market in Barkin Ladi LGA, and Terminus Market in Jos North LGA of Plateau State. The chemical analytes, including sodium, potassium, calcium, iron, magnesium, copper, zinc, phosphorus, manganese, chloride, and cobalt, were measured in ppm using Atomic absorption spectrophotometer (AAS) machine (Buck Scientific 205), ultra-violet visible photometer machine and muffle furnace. Additionally, proximate analysis for moisture, crude protein, crude fiber, lipids, ash, Nitrogen-Free Extract (NFE) and Metabolizable Energy (ME) was conducted. The analysis revealed significant variations in the chemical and nutritional components among the different potash varieties. Maize cob potash exhibited high potassium (600,000 ppm) and sodium (6,666.7 ppm) levels, while white potash showed substantial amounts of potassium (500,000 ppm) and chloride (115 ppm). Acha hay potash had high potassium (600,000 ppm) and calcium (250 ppm) contents, and red potash contained notable levels of potassium (500,000 ppm) and chloride (110 ppm). Nutritional analysis indicated varying levels of moisture, crude protein, crude fiber, lipids, ash, NFE & ME, highlighting the distinct profiles of each potash variety. The study underscores the diverse biochemical and nutritional profiles of different potash varieties, highlighting their potential health benefits and risks. These findings lay the Background work for further research into the health implications of potash consumption and its role in dietary supplementation.

Keywords: Potash, chemical & nutritional components, proximate analysis, health benefits and risks.

1.0 INTRODUCTION

Potash generally means a variety of collected inorganic crystalline salts having potassium as its major component. It is referred to as impure form of potassium salt- mostly potassium carbonate (K_2CO_3) in water soluble form. Potash originally is gotten from wood ashes. Potash can be in the form of potassium chloride (KCl), potassium oxide (K_2O) and potassium hydroxide (KOH). Literarily, potash is derived from "Pot – ash", which refers to plant ashes soaked in water in a pot (Katuzu *et al.,* 2016; Ogunwede *et al.,* 2018; Uba *et al.,* 2016). Potash which is potassium (K) in water-soluble form is one of the three primary nutrients for plants, along with nitrogen and phosphorus, with about 90% potash being used in the production of fertilizers (Cruz *et al.,* 2018). The making of potassium carbonate (K_2CO_3)

otherwise called potash is usually done by collecting or producing wood ash (mostly by ash burners), leaching the ashes and then evaporating the resulting solution in large iron pots, and leaving the white residue (pot ash) as described by Babayemi *et al.,* (2010b) and Katuzu *et al.,* (2016).

Notably, Maize and Acha are major crops that are cultivated massively in Plateau State. In the State and North Central Nigeria in general, local potash derived from Acha hay and Maize cobs are common and highly utilized for various local reasons ranging from use for human, animal and crop production. This study proposed to evaluate the chemical components of potash from Acha hay (Ranon-Acha) and Maize cobs (Toturwar masara). Within the North Central Region of Nigeria, the following Tribes have been found to use one form of local potash or the other to make soups or cook other food. They are: Berom, Bura, Ganawuri, Gbagi, Kataf, Mwagavwul, Mushere, Ngas, Tarok etc. Local Potash products are commonly used as "food tenderizers" in Nigeria and Plateau State in particular, to the extent that most soups, cereals and beans are cooked with the addition of such potash as condiment (Kutshik *et al.,* 2018). There are other forms of potash which are different from local potash of plant origin. These are Red Potash (Jan Kanwa), white Potash (Farin Kanwa) are gotten from the earth crust directly while local Potash from Maize hay and Acha cobs are produced from Maize and Acha respectively. These Potash are mostly used in Northern Zone of Plateau State.

The term "potash" serves as an umbrella encompassing a diverse array of materials containing potassium, with its chemical composition primarily contingent upon the source and the methods employed during processing. Scholars have extensively studied the nuances of potash composition, emphasizing the importance of understanding these variations for effective utilization in various applications (Johnston, 2003). Potash as a natural mineral deposit contains a mixture of various salts such as Potassium carbonate (K2CO3), Potassium bicarbonate (KHCO3), Potassium chloride (KCl), Sodium chloride (NaCl), Sodium bicarbonate (NaHCO3), Magnesium carbonate (MgCO3), Calcium carbonate (CaCO3), Iron oxide (Fe2O3), Silica (SiO2) and Aluminum silicate (Al2SiO3). The chemical composition of local potash can vary depending on the source and location, but it typically contains a combination of these salts, with potassium carbonate and potassium bicarbonate being the main components (Haddad *et al.,* 2016).

The realm of agricultural practices is enriched by an array of potassium fertilizers, each with its distinctive biochemical and proximate compositions. A study delved into the intricate analyses of Muriate of Potash (MOP), Potassium Nitrate (KNO_3), Wood Ash Potash, and Potassium Bicarbonate ($KHCO_3$), and unraveled the nutritional components that shape their impact on soil health and plant growth. MOP, widely recognized as potassium chloride (KCl), took center stage as a preeminent potassium fertilizer, boasting a biochemical profile dominated by KCl, while minor components such as sodium chloride (NaCl) and magnesium chloride (MgCl2) played a crucial role. Moving to KNO_3, commonly known as saltpeter, its composition presents a unique blend of potassium and nitrate ions, diverging from the characteristics of MOP and necessitating careful consideration of factors like nitrate levels and chloride content. Wood ash potash, with its historical significance, emerges as a complex material influenced by the type of wood burned, encompassing potassium carbonates, calcium and magnesium oxides, and trace minerals, demanding a nuanced approach to its use. Finally, potassium bicarbonate ($KHCO_3$) stands out as a relatively pure source of potassium, offering advantages such as a non-chloride nature and minimal impact on soil salinity, positioning it as a valuable choice despite potential cost considerations. The insights provided guide us through the complexities of these potassium sources, underscoring the need for precision in fertilizer application practices for sustainable agricultural outcomes. KNO_3 presents a distinctive combination of readily available potassium and nitrogen, offering the potential to boost plant growth and yield. However, the presence of nitrate and chloride warrants careful consideration to avert potential environmental and crop health concerns. Scholarly contributions underline the nuances in KNO_3's composition, emphasizing the need for precision in fertilizer application practices. Additional points raised by scholars highlight the variability in KNO_3 composition, analytical methods, and the crucial role of understanding soil and environmental factors in optimizing its application for sustainable agricultural practices (Brown *et al.,* 2017).

The nutritional composition of potash is estimated to be Moisture (81.90 to 94.90%mg/L), Ash (0.06 to 3.51mg/L), Fat (0.05 to 1.3mg/L), Protein (0.18 to 1.14mg/L), Carbohydrate (10.0 to 15.8 mg/L), Vitamins (0.78 to 21 mg/L), and some Mineral elements like Ca (35.675 to 124.725 mg/L), Cu (0.025 to 2.700 mg/L), Mn (0.350 to 3.700 mg/L), Mg (53.900 to 298.425 mg/L), Fe (4.750 to 99.930 mg/L) and Pb (ND to 0.550 mg/L) (Ogunwede *et al.,* 2018). It is dependent on the nature, type and production of such potash. Katuzu *et al.,* (2016) among other things discovered that there is presence of moisture (3.17mg/L) in potash locally made that is called Mangul in Yobe State. Wood ash potash, a historically significant source of potassium (K), emerges as a complex material with diverse nutritional components, contingent upon the type of wood burned and the intricacies of the burning process. Unlike well-defined fertilizers such as Muriate of Potash (MOP) or Potassium Nitrate (KNO_3), its composition lacks predictability, necessitating meticulous analysis for informed agricultural applications.

Several studies have been conducted to ascertain the effects and toxicity of use of local potash. Iweka *et al.,* (2016) on "the effect of potash on liver function of wistar rats" revealed acute toxicity in rats as tests showed that LD_{50} was greater than 2.5g/kg body weight. In their results as presented showed that the activities of GGT, AST, ALT, and ALP increased in laboratory rats under study. Therefore, it shows that Potash has altered the liver functions in wistar rats and that the effect was dose dependent. Kutshik *et al.,* (2018) in Jos carried out a comparative investigation of the effects of Kanwa (Trona) and Tokansenyi (plant potash) on liver and kidney of albino rats which indicated that liver and kidney enzymes concentration for both treatments showed a significant difference ($p < 0.05$) as compared with the control. The total bilirubin concentration for blood of albino rats treated with Kanwa showed significant difference ($p < 0.05$). The concentrations of urea in both treatments also showed significant difference ($p < 0.05$) when compared with control. The histological results for liver treated with kanwa revealed a sinusoid with bodies stained with deep red colouration, enlarged nuclei and distorted cord-like arrangement of hepatocytes. The histological results for kidney treated with Kanwa also revealed a degenerated collecting duct and inflamed glomeruloid. The study showed some elements like Mn and Co with higher concentrations in Tokansenyi as compared to Kanwa and concluded that Tokansenyi is safer for the liver and kidney as compared with Kanwa (Trona). Rabiu & Malami (2019) toxicity study on Jan kanwa revealed sub-chronic toxicity on animals at higher doses and discouraged high doses intake and on a long-term basis too due to its lethal effects on animal studies. Some physiological parameters can be affected by red potash. There could be a reduction in red blood cell count, hemoglobin concentration and packed cell volume. There was an increase in mean corpuscular volume and mean corpuscular hemoglobin, white blood cell count, lymphocytes, neutrophils, aspartate aminotransferase, alanine aminotransferase and alkaline phosphatase. No wonder Achukwu *et al.,* (2009) through their research championed the exclusion of potassium bromate in bread production in Nigeria following impacts on hematological parameters. Airaodion *et al.,* (2021a) posited that "Consumption of Potash Adversely affects Sperm Quality and Sex Hormones of Male Wistar Rats". Sequel to the administration of potash at 500, 750 and 1000 mg/kg body weight when compared with the control group of the wistar rats showed that potash significantly reduced ($p<0.05$) the sperm count, motility and morphology in a dose-dependent manner when compared with the control group. Also, there was significant increase in the concentration of serum follicle stimulating hormone (FSH); significant reduction in the concentration of serum Luteinizing hormone (LH); serum testosterone and seminal pH. Also, a study found out that consumption of potash has a little effect on sexual desire among experimental animals (Abubakar & Rabiu, 2019).

2.0 MATERIALS AND METHODS

2.1 Study Area and Sample Population

Analysis of samples was carried out at the Chemistry Laboratory Nigeria Institute of Mining and Geoscience Jos while the proximate analysis was done in the Biochemistry Department of National Veterinary Research Institute, vom (NVRI, Vom). The samples were sourced from Selected Markets in three LGAs of Plateau State. They included the following: Vom Market in Jos South LGA, where the Acha hay potash was purchased, Fan market in Barkin Ladi LGA, where the maize cobs potash was purchased and Terminus market in Jos North LGA where the white and red potash were purchased.

2.2 Sampling Method

Random sampling among the marketers of local potash was used for the purchase of the 4 varieties of potash.

2.3 Sample Size

The total sample size for the study was four (4) with one (1) each for the 4 varieties of potash including Maize cobs, Acha hay, White and Red Potash. This is so because each was purchase from the different Local Government Areas and so many parameters were run on all respectively to know there chemical and nutritional constituents.

2.4 Procedure

The elemental and metals, and nutritional components were adequately followed in line with AOAC (1990) and Badamosi *et al.,* (1995) and Harbone (1998) methodologies.

For nutritional components (proximate analysis) like Carbohydrates, Proteins, Fat, Ash, Moisture, Crude Fiber and Energy were carried out according to the AOAC (2002) standards and available reagents.

2.5 Analysis Procedures

Procedure for Analysis of Copper (Cu), Zinc (Zn), Manganese (Mn), Cobalt (Co), Phosphorus (P), Sodium (Na), Potassium (K), Calcium (Ca), Iron (Fe), Magnesium (Mg) using AAS

Equipment/Apparatus: The equipment and apparatus used are as follows: electronic weighing balance, glass, beakers (Pyrex), fume cupboard equipped with hot plate, Atomic Absorption spectrophotometer (AAS) machine (Buck Scientific 205), Ultra-violent visible Photometerr, (UV machine), Muffle furnace, four 100ml and 1000ml volumetric flasks.

Chemical / Reagents: The chemical / reagents used were, Concentrated Hydrochloric acid (HCl), Concentrated Nitric acid (HNO_3), Reference Standards of Copper (Cu), Zinc (Zn), Manganese (Mn), Cobalt (Co), Phosphorus (P), Sodium (Na), Potassium (K), Calcium (Ca), Iron (Fe), and Magnesium (Mg), respectively.

2.51 Procedure for the Elemental Analysis of Potash Using Atomic Absorption Spectrophotometer (AAS)

1. One gram (1g) of each Sample was accurately weighed into the glass beakers.
2. An aqua regia (15 ml of Conc. HCl and 5 ml of HNO_3) was added to each of the samples is the beaker.
3. The beakers and their contents were covered with glass lids and placed on hot plate inside fume cupboard for digestion at 80°C for 15 mins.
4. The beakers' content was removed from the hot plate after digestion and 10ml of Conc. HNO_3 and 50ml of distilled water was added to the samples and put back on the hot plate in the fume cupboard to boil for 5min.
5. The Samples were then filtered into 100ml volumetric flasks and made up with distilled water to the mark and run on AAS machine for each of the elements except phosphorus.
6. Each of the elements has its lamps (cathode lamp) and reference standards.
7. For each of the element's reference standards of concentrations 3.5 and 10 ppm were run on the machine to generate absorbance with which a straight-line graph was plotted, also the samples were equally run for each of the elements.
8. However, K and Na were not analyzed using absorption mode rather the emission mode was used. That is the Cathode ray lamps were not used for the two.

2.52 Determination of Crude Fat by Gravimetric Method

Principle of The Test

The ether extract method is based on the principle that non-polar components of the sample are easily extracted into organic solvents, e.g. petroleum ether and diethyl ether. Direct extraction gives the proportion of "free" lipid constituents. This method of extraction can only be done on the dried sample.

Equipment/Apparatus: Soxhlet extractor, Quick fit extraction flasks (250ml), filter papers, Analytical balance, Extraction thimbles, Desiccators, hot air oven.

Reagents: Petroleum spirit (40°C – 60°C)

Sample Pre-Treatment: The (fresh) wet sample should be dried in a hot air oven at 60°C overnight.

Sample preparation: The sample should be ground using laboratory milling machine to pass through sieve of required mesh size before analysis.
Sample storage for laboratory analysis was done using polythene bags at room temperature.

Procedure:

1. Two grams of ash were weighed unto a previously weighed filter paper.
2. The extraction flask was weighed. The wrapped sample was put into the extraction thimble and fixed unto the Soxhlet extractor with 100ml of solvent in the flask and extracted for about 4 hours at condensation rate of about 5 – 6 drops per second.
3. The flask was Removed with sample and distilled off solvent leaving the extracted fat with 10ml of solvent in the flask. The solvent was gently evaporated in an oven transferred to a desiccator, cooled and weighed.
4. Weight of extracted fat was calculated as weight of thimble containing the sample before extraction minus weight of thimble and sample after extraction.

Calculation

$$\text{Crude fat (\%) by weight (\%/w)} = \frac{\text{weight loss of samle}}{\text{weight of sample}} = 100$$

$$= \frac{\mathbf{w2-w3}}{\mathbf{w2-w1}} \mathbf{\ x\ 100}$$

Where W_1 = Weight of empty thimble
W_2 = Weight of thimble + sample
W_3 = Weight of thimble + exhausted sample

2.6 Data Analysis/Statistical Methods

The results and data gathered from the study were presented in descriptive statistics on tables and figures.

3.0 RESULTS

3.1 Presentation and Comparison of Result

Table 1 provides an analysis of the chemical composition of Maize Cobs, White Potash, Acha Hay, and Red Potash in parts per million (ppm). The result showed that varieties of potash such as Maize cobs potash, Acha hay potash, white and red potash, have different concentrations of the biochemical components – Sodium, Potassium, Calcium, Iron, Magnesium, Copper, Zinc, Phosphorus, Manganese, Chloride, and Cobalt in the different concentrations (ppm) as presented in Table 1.

Table 1: Results of Chemical Analytes using Atomic Absorption Spectrophotometer (AAS) with concentration in Part per million (ppm)

Potash Samples	Cu	Zn	Mn	Co	P	Na	K	Ca	Fe	Mg	Cl

Maize Cobs	23.316	148.44	2.2936	22.314	0.4682	6666.7	600000.0	375.0	103.05	3677.3	95.0
White Potash	10.363	74.219	52.752	17.355	0.6215	500000.0	20000.0	166.67	534.35	1829.6	115.0
Acha Hay	12.953	22.461	11.468	22.314	0.2668	6666.7	600000.0	250.0	80.153	305.94	200.0
Red potash	10.363	44.141	45.871	17.355	0.3445	500000.0	25000.0	208.33	583.97	1145.8	110.0

Key: Copper (Cu), Zinc (Zn), Manganese (Mn), Cobalt (Co), Phosphorus (P), Sodium (Na), Potassium (K), Calcium (Ca), Iron (Fe), Magnesium (Mg), and Chloride (Cl)

Table 2 presents the proximate analysis of nutritional components of Maize Cobs, White Potash, Acha Hay, and Red Potash showing moisture content, crude protein, crude fiber, lipids, ash, Nitrogen-Free Extract (NFE), Metabolizable Energy (ME), calcium, and phosphorus. The concentrations are measured in g/100g which is equivalent to % in unit except for metabolizable energy, which is measured in calories (Cal).

Also, the Proximate Analysis for the nutritional component of the Maize cobs potash, Acha hay potash, white and red potash that are sold in markets in Plateau Northern Zone, revealed the Moisture, Crude Protein, Crude Fibre, Lipids, Ash, Nitrogen Free Extract (NFE), Metabolizable energy (ME), Calcium, and Phosphorus contents in various concentrations (ppm) as presented in table 2 and compared in figures 6 to 8.

This analysis highlights the significant variation in chemical composition among different potash samples. Maize Cobs is notably rich in Copper, Zinc, Potassium, Calcium, and Magnesium, making it a potent source of these nutrients. White Potash and Red Potash have exceptionally high sodium levels, while White Potash also stands out for its manganese content. Acha Hay potash, while lower in some nutrients, has the highest Chloride content. These differences can influence the choice of potash sample depending on specific agricultural or industrial needs.

This analysis reveals that Acha Hay stands out for its high protein, lipid, calcium, and ash content, making it a rich source of nutrients. White Potash, despite having the highest moisture content, provides a balanced profile with a notable phosphorus content. Red Potash, with its high fiber and ash content, is particularly beneficial for those seeking high dietary fiber and mineral content. Maize Cobs offers a moderate profile with notable moisture and ash levels. These differences can guide the selection of potash samples based on specific nutritional requirements and applications.

Table 2: Nutritional and Proximate Analytes from Various Potash Samples (g/100g)

Potash Sample	Moisture	Crude Protein	Crude Fibre	Lipids	Ash	NFE	ME	Calcium	Phosphorus
Maize Cobs	7.71	2.55	2.23	0.63	86.86	0.02	0.43	0.43	0.020
White Potash	13.41	3.37	5.01	0.48	77.71	0.02	0.30	0.30	0.030
Acha Hay	2.87	3.84	3.21	1.12	88.94	0.02	0.75	0.75	0.010
Red potash	1.45	0.41	6.74	0.46	90.92	0.02	0.25	0.25	0.002

Key: ME – Metabolizable Energy, NFE – Nitrogen Free Extract

4.0 DISCUSSION

The Biochemical Components of Studied Potash

The Maize cobs potash, Acha hay potash, White and Red Potash have different concentrations of the biochemical components of Sodium, Potassium, Calcium, Iron, Magnesium, Copper, Zinc, Phosphorus, Manganese, Chloride, and Cobalt. These elements and heavy metals are contained in the Periodic table and can be released by commercial and industrial activities; as majority are found in in water, soil, and rocks (Mitra *et al.,* 2022) which are major part of Northern parts of Plateau State.

For Sodium (Na), Maize cobs and Acha hay potash had 6666.7ppm respectively while white and red potash had 500000ppm respectively. While Na is very important in the body, there is a need to reduce the daily intake of it on a daily basis to less than 2000ppm (WHO, 2022), because of the health implications. It therefore implies that the potashes under study had Na concentration in excess of daily recommendation per day which is more than 2000ppm (WHO 2022). Though in this study, Maize cobs and Acha hay had far less concentration of sodium than red and white potash. This local potash study supports the work of Ogundiran *et al.,* (2011) that Na concentration is usually lower in local potash though their study was on local potash from Cashew nut seeds. For Potassium (K), Maize cobs and Acha hay potash had 600000ppm respectively while white potash had 20000ppm and red potash had 25000ppm in concentration. The increase in consumption of potassium is encouraged knowing fully well that the element reduces kidney stones, and high blood pressure occurrences, cardiovascular issues like stroke and other cardiovascular disease risk (Weaver, 2013). WHO (2022) recommends increase in dosage intake daily through consumption of vegetable such as spinach, cabbage, and parsley and fruits especially banana, papayas, and dates that have higher content of the element not forgetting beans, nuts and pears for at least 3,510 ppm of potassium per day. It is noticeable that the potash from maize cobs and Acha hay has a very high component of potassium and could be a very good and quick alternate source of potassium in our food. Cruz *et al.,* (2018) showed that 5700ppm of potassium is acceptable in adults as daily recommended dose.

The concentration of Potassium in local potash studied supports high concentration in the study carried out by Sariem *et al.,* (2016) on local dietary Salts in Plateau State. Okop & Ukpe (2021) disclosed the presence of potassium in potashes produced from banana peels and palm bunch in Akwa Ibom State. In another study involving local potashes gotten from Musa species in Ota, Ogun State, Babayemi *et al.,* (2010a) showed that potassium was having highest concentration among all other elements discovered with highest potassium concentration found in Musa ‘Gross Michel’ (Igbo banana) and least found in Musa ‘Wild Banana’ (Omini).

For Calcium (Ca), Maize cobs and Acha hay potash had 375ppm and 250ppm respectively while white and red potash had 166.67ppm and 208.33ppm respectively. While Ca is very important in the body, there is a need to manage the daily intake of it to be up to 200ppm depending on the status of the subject (WHO, 2022). The presence of Ca in this study for Maize cobs, Acha hay, white and red potashes shows that potash found in Northern Plateau has good concentration of Ca. This supports the work of Sariem *et al.,* (2016) on local potash in Plateau State and Okop & Ukpe (2021) in Akwa Ibom State showing high concentration of Calcium.

For Iron (Fe), Maize cobs and Acha hay potash had 103.05ppm and 80.153ppm respectively while white and red potash had 534.35ppm and 583.97ppm respectively. While Fe is very important in the body, there is a need to maintain 0.30ppm dosage limit (WHO, 2022). The presence of Fe in this study for Maize cobs, Acha hay, white and red potashes shows that potash found in Northern Plateau has good concentration of Fe. This supports the work of Babayemi *et al.,* (2010a) on local potash in Ogun State and Okop & Ukpe (2021) in Akwa Ibom State and Cirfat *et al.,* (2022) that specified that Fe concentration in the potashes tested were far much higher than WHO recommended value in North Central Nigeria and same is this study showing some very high concentration of Fe in varieties of potash in the Northern Plateau markets.

For Magnesium (Mg), Maize cobs and Acha hay potash had 3677.3ppm and 305.94ppm respectively while white and red potash had 1829.6ppm and 1145.8ppm respectively. While Fe is very important in the body, The World Health Organization (WHO) has not established a specific concentration limit for magnesium in food materials and water. The presence of Mg in this study for Maize cobs, Acha hay, white and red potashes shows that potash found in Northern Plateau has good concentration of Mg. This supports the work of Babayemi *et al.,* (2010a) on local potash in Ogun State and Sariem *et al.,* (2016) on local potash in Plateau State showing high concentration of Magnesium in varieties of potash in the market. Such concentration is expected in Maize cobs or Acha hay in consideration that Sugarcane has good concentration of Mg (Garcia *et al.,* 2020).

For Copper (Cu), Maize cobs and Acha hay potash had 23.316ppm and 12.953ppm respectively while white and red potash had 10.363ppm respectively. The Cu is very important in the body, with the FAO/WHO, (2022) giving a limit of 2ppm to food and water. The presence of Cu in this study for Maize cobs, Acha hay, white and red potashes shows that potash found in Northern Plateau has good concentration of Cu. This supports the work of Zanna *et al.,* (2018) in Yobe State about the presence of Cu in Potash, and Babayemi *et al.,* (2010a) on local potash in Ogun State.

For Zinc (Zn), Maize cobs and Acha hay potash had 148.44ppm and 22.461ppm respectively while white and red potash had 74.219ppm and 44.141ppm respectively. The Zn is very important in the body, with the FAO/WHO (2022) giving a limit of 5ppm to food and water. The presence of Zn in this study for Maize cobs, Acha hay, white and red potashes shows that potash found in Northern Plateau has good concentration of Zn. This supports the work of Zanna *et al.,* (2018) in Yobe State about the presence of Zn in Potash, and Babayemi *et al.,* (2010a) on local potash in Ogun State.

For Phosphorus (P), Maize cobs and Acha hay potash had 0.4682ppm and 0.2668ppm respectively while white and red potash had 0.6215ppm and 0.3445ppm respectively. Phosphorus has a complicated story. Pure, "elemental" phosphorus (P) is rare. In nature, phosphorus usually exists as part of a phosphate molecule (PO4) leading to measuring very low concentrations down to 0.01 milligram per liter (mg/L) or even lower. The limit in the body is still not concluded, however, the detection in the potash samples in this study is interesting for further studies especially on local Potash.

For Manganese (Mn), Maize cobs and Acha hay potash had 2.2936ppm and 11.468ppm respectively while white and red potash had 52.752ppm and 45.871ppm respectively. The Mn is very important in the body, with the FAO/WHO (2022) giving a limit of 0.08ppm to food and water. The presence of Mn in this study for Maize cobs, Acha hay, white and red potashes shows that potash found in Northern Plateau has good concentration of Mn. This supports the work of Zanna *et al.,* 2018) in Yobe State and Cirfat *et al.,* (2022) in North Central Nigeria on local potash in Ogun State. This study agrees with Okoye *et al.,* (2016) that found Manganese in high quantity in "Tokansenyi" gives hope that locally prepared potash is safer.

For Chloride (Cl), Maize cobs and Acha hay potash had 95ppm and 200ppm respectively while white and red potash had 115ppm and 110ppm respectively. The Cl is very important in the body and occurs mostly in combined forms with other elements in form of ions as studied by Cirfat *et al.,* (2022) and Ogunwede *et al.,* (2018). The Chloride as an essential element of life in water and food, should not exceed 250ppm (FAO/WHO, 2022). The presence of Cl in this study for Maize cobs, Acha hay, white and red potashes shows that potash found in Northern Plateau has good concentration of Chloride.

For Cobalt (Co), Maize cobs and Acha hay potash had 22.314ppm respectively while white and red potash had 17.355ppm respectively. The presence of Co in this study for Maize cobs, Acha hay, white and red potashes shows that potash found in Northern Plateau has good concentration of Cobalt. This is the first study discovering Cobalt in Potash in Northern Plateau. The variation in the biochemical composition in the various potash types could be due to the variation in the composition of the natural ground minerals from which the minerals were absorbed by the plants. It could also be due to the different processing methods.

The Proximate Analysis for the Nutritional Component of Potash

The Maize cobs, Acha hay, White and Red Potash that are sold in markets of Plateau Northern Zone revealed the concentrations of Moisture, Crude Protein, Crude Fibre, Lipids, Ash, Nitrogen Free Extract (N.F.E), Metabolizable energy (M.E), Calcium, and Phosphorus.

For Moisture (g/100g), Maize cobs and Acha hay potash had 13.41 and 7.71 respectively while white and red potash had 2.87 and 1.45 respectively. The moisture content is not very different from the other potash studies such as Ogundiran *et al.,* (2011) who got moisture in the potash of cashew nut seed; moisture remains one of the proximate nutritional analytes. Babayemi *et al.,* (2010b) in their studies on banana peels potash found more moisture up to 86g/100g. When Maize prepared, local food was subjected to such analysis carried out on maize hay, moisture was also found as the case of Baiwa *et al.,* (2018) studies in Jigawa. Variation in moisture content could be explained by the hygroscopic nature, geographical and climatic as well as the processing and storage of the potash.

For Crude Protein (g/100g), Maize cobs and Acha hay potash had 3.37 and 2.55 respectively while white and red potash had 3.84 and 0.41 respectively. This study showed lower crude protein content when compared to 60.45% seen in the study of Okop and Ukpe (2021).

For Crude fibre (g/100g), Maize cobs and Acha hay potash had 5.01 and 2.23 respectively while white and red potash had 3.21 and 6.74 respectively. The values gotten from the potash under study falls within the range as gotten from local potash from banana peels in the case of Okop & Ukpe (2021) that had 3.65%.

For Lipids (g/100g), Maize cobs and Acha hay potash had 0.48 and 0.63 respectively while white and red potash had 1.12 and 0.46 respectively. This study showed a low lipid content when compared to the study of Okop & Ukpe (2021) that 17.87% in local potash studied in Akwa Ibom.

For Ash (g/100g), Maize cobs and Acha hay potash had 77.71 and 86.86 respectively while white and red potash had 88.94 and 90.92 respectively. The Ash content in this study is much higher than the Ash content gotten from Babayemi *et al.,* (2010b) study on Banana peels potash reached 12% and that of Okop & Ukpe. (2021) that reached 18.6%. The Ash gotten from Cashew nut potash have the least content of Ash so far in the potash studies in the literatures used in this study as seen in Ogundiran *et al.,* (2011) with the value of 3%. It is therefore imperative to examine the health implications of Ashes use to humans, animals and plants that utilize the Ash found in Potash.

For N.F.E (g/100g), Maize cobs and Acha hay potash had 0.02 respectively while white and red potash had 0.02 respectively.

For M.E (g/100g), Maize cobs and Acha hay potash had 0.03 and 0.43 respectively while white and red potash had 0.75 and 0.25 respectively.

For Calcium (g/100g), Maize cobs and Acha hay potash had 0.03 and 0.43 respectively while white and red potash had 0.75 and 0.25 respectively. This study result is far less than the value gotten from Ogundiran *et al.,* (2011) on the Potash from cashew nuts that had 38.7g/kg. However, Okoye *et al.,* (2016) found Calcium in high quantity in another local potash called "Tokansenyi".

For Phosphorus (g/100g), Maize cobs and Acha hay potash had 0.03 and 0.02 respectively while white and red potash had 0.01 and 0.002 respectively. This study agrees with Okoye *et al.,* (2016) that found Phosphorus in high quantity in "Tokansenyi".

4.1 CONCLUSION

Based on the results of this study, which underscores the diverse biochemical and nutritional profiles of different potash varieties, highlighting their potential health benefits and risks. These findings have laid the foundation work for further research into the health implications of potash consumption and its role in dietary supplementation. These findings suggest that consumption of these potash varieties could lead to excessive intake of certain elements and nutrients which have potentials for adverse outcomes on health if not taken with moderation. Therefore, it is essential to consume these potash varieties in moderation and as part of a balanced diet.

Disclaimer

The products used for this research are commonly and predominantly use products in our area of research and country. We do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the researchers were not funded by the producing company rather it was funded by personal efforts of the authors.

Author Contributions

All authors made a significant contribution to this work from the conception through the study design, execution, acquisition of data, analysis and interpretation of results. They equally took part in drafting, revising and critically reviewing the manuscript and gave final approval of the version to be published.

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