Comparative Study of Proximate and Elemental Composition of Banana Peels and Palm Bunch as Substitutes for Preparing Alkaline Ash for Domestic Consumption

Imeh J. Okop*, and Richard A. Ukpe

Received 26 January 2021/Accepted 02 April 2021/Published Online 08 April 2021

Abstract*: Potash is commonly used in numerous traditional dishes and is majorly prepared using limestone, which may be relatively scarce in some region. This study seeks to produced and analysed potash from banana peel and palm bunch in order to compare their proximate and elemental composition. The results of the analysis revealed that* ***i****norganic (ash) contents were 12.78, 21.40 and 18.60 mg/l for potash produced from banana peel, palm bunch and limestone. Corresponding values for fibre (3.65, 2.41, 18.60 mg/l), lipid (17.87, 16.50 and 13.56 mg/l), carbohydrate (5.23, 6.03 and 6.00 mg/l) and energy value (423.73, 387.26 and 342.28 J) were also estimated. The samples showed high concentration of calcium and potassium (which are essential elements), relatively low concentrations of iron and manganese (which are trace elements) and low concentrations of lead and cadmium, which are toxic metals. Although potash from banana peel and palm bunch waste displayed comparative nutrient and elemental functions, their usefulness maybe limited by the presence of heavy metals if not properly processed or checked.*

Key words: *Banana peels, palm bunches, elemental composition, Atomic Absorption Spectrophotometer (AAS).*

Imeh J. Okop*
Department of Chemistry,
Akwa Ibom State University, Ikot Akpden, Mkpat Enin Local Government Area
Akwa Ibom State, Nigeria
Email: imehokop@aksu.edu.ng
Orcid Id: 0000-0002-1487-6711

Richard A. Ukpe
Department of Chemistry,
Federal University Otuoke,
Bayelsa State, Nigeria
Email: ukpera@fuotuoke.edu.ng
Orcid Id: 0000-0002-1010-4933

1.0 Introduction

Potassium is one of the most essential elements needed by plants and animals because of its nutritional roles. In human, potassium is the third most abundant elements after phosphorus and calcium while in plants potassium and nitrogen are the elements that are needed in significant concentrations (Eddy *et al*., 2004). However, potassium is a very active metal and cannot be found in isolated state. The commonest form of potassium is in form of potash. Potash has become one of the most widely needed product in the world because of its application in fertilizer production, as food additives, in recycling of aluminum, as explosives, in pharmaceutical products, for water softening, for the clearance of snow and ice from roads, in glass making and others (Eddy, 2007; Eddy and Ukpong, 2006; Kostick, 2006; Okareh *et al.,* 2015). However, most of the available potash are produced through chemical means indicating that the production process may not be entirely green. Over the decades green production of potash was a common practice among rural women. This was achieved ignorantly. For example, burning of palm oil tree waste to ash, followed by filtration leads produces potash. In present dispensation, the technology of potash production from plant materials has some future hopes and environmental sustainability. For example, Olufemi *et al*. (2017) reported the production of potash from some plant materials and found that sunflower stalks, palm inflorescence, corn stalks contain potassium oxide ranging from 28.01 to 43.01 %,

Literature reveals that there are several plant materials that has potential as raw materials for potash production (Adewuyi *et al*., 2006; Afrane, 1992; Kevin, 2002, 2003). Banana and platan peel has been found to be rich in potassium and can thus be a good source of potash (Babavemi *et al*., 2011; Eddy and Ebenso, 2008; Eddy *et al*., 2008; Hassan *et al*., 2018;Taiwo *et al*., 2008). Since the approach for green synthesis has enormous environmental benefits and utilization of banana and plantain peel can boast waste management through resource recovery (Eddy and Udoh, 2006), the present study is aimed at utilizing banana and plantain peel wastes to produce potash and analysed potash in the form commonly consume in some Nigeria homes.

2.0 Materials and Methods

Materials used for the study were unripe banana Peels, Oil palm bunches, di potassium trixocarbonate iv (K_2CO_3), The plantain peel wastes were collected from some restaurants and homes within Ikot Ekpene Local Government Area of Akwa Ibom State. The peels were sun dried to constant weight and were combusted to obtained the ash. Potash solution was obtained as a filtrate from the ash.

2.1 Methodology

The samples were analysed for their moisture content by oven drying method, ash content. The oven method of destroying organic matter in order to obtain the ash content gravimetrically was adopted for the determination of the ash content.

Concentrations of metals in the sample was estimated using atomic absorption spectrophotometer while total dissolve solid (TSS) was estimated using TSS test probe. pH was measured directly using a pre-calibrated pH meter while salinity and conductivity was also estimated using their respective meter.

2 g of sample material was defatted with petroleum ethers and boiled under reflux for 30 minutes with 200 ml solution containing 1.25g of H_2SO_4 per 100 ml solution. The solution was filtered through a linen cloth on the flutter funnel, washed with boiling water until the washing was no longer acidic. The residue was transferred to beaker and was boiled for another 30 minutes with 200 ml solution containing 1.25g NaOH per 100 ml solution. The final residue was filtered and the residue was washed with boiling water several times until it is base (NaOH) free. The residue was finally washed twice with methanol, and quantitatively transferred into a pre-weighed crucible oven dried at 105°C (1o). Finally, the residue was incinerated in a furnace at 55°C, cooled in a desiccator and weighed. The loss in weight after incineration was used to estimate the crude fibre content of the sample

2.3.4 Determination of Crude (Fat) Lipid

2.0 g of the sample which was washed and dried in an oven and weighed into the extracting timble and plugged lightly with cotton wool.

150 ml of petroleum ether (boiling point 60–80^0 C) was poured into 500 ml capacity round bottom flask and extracted using the soxhlet extractor for about four hours. The extract was poured into a dry pre-weighed crucible (w_1) and the thimble was rinsed with a little quantity of the ether back to the beaker. The beaker was then heated on steam bath to drive off the excess of the solvent and then cooled in the desiccator and weigh (w_2) to obtain the lipid content.

3.0 Results and Methods

Results obtained for the analysed samples (i.e A = Banana peel, B = palm bunch ash and C = control, which was limestone) are presented in Table 1. The proximate parameters included their content of moisture, ash, fibre, lipid, protein and energy value. .

Table 1: Proximate composition of potash from banana peel, palm bunch and limestone (control)

Sample	Moisture Content (%)	Ash Content (%)	Fibre Content (%)	Lipid Content (%)	~~Protein Content (%)~~	CHO Value (%)	Energy Value (%)
A	70.91	12.78	3.65	17.87	60.45	5.23	423.73
B	57.72	21.40	2.41	16.50	53.66	6.03	387.26
C	54.00	18.60	2.38	13.56	50.52	6.00	342.28

The proximate content of potash from banana peels, palm bunch and limestone indicated initial moisture content to be highest in the potash from banana peels and least in the one from limestone. Th ash content which is a proportional parameter to inorganic content is highest in potash from palm bunch and least for the one from banana peel. Fibre and lipid contents were highest in potash from banana peels and least for potash from limestone, However, carbohydrate was highest for potash from palm and least for potash from banana peel (which also has the highest energy value).

Table 2 presents elemental composition of potassium, calcium, manganese, iron, lead and cadmium in potash from banana peel, palm bunch waste and limestone. This information is also shown in Fig. 1, which compares the levels of the metal ions in the various sources. Calcium and potassium are essential elements needed by plants and animal. Manganese and iron are trace metals needed by the body in trace concentrations. Lead and cadmium are heavy metals indicating that they could be toxic if their concentrations exceed safe limits. The results show the gradation in needs and essentiality of these metals in that calcium and potassium were present in sufficient concentration while manganese and iron were present in trace concentrations. Concentrations of lead and cadmium (although they were relatively low) could be regarded as high when compared with their potentials to cause effects especially is bioaccumulation and biomagnification set in.

Table 2. Elemental composition of potash from banana peels (A), palm bunch (B) and limestone (C)

Sample ID	Pb	K	Ca	Cd	Mn	Fe
A	0.204	50.76	37.40	0.246	1.024	1.326
B	0.212	62.42	34.20	0.210	1.087	1.242
C	1.042	48.64	33.36	0.849	0.660	0.658

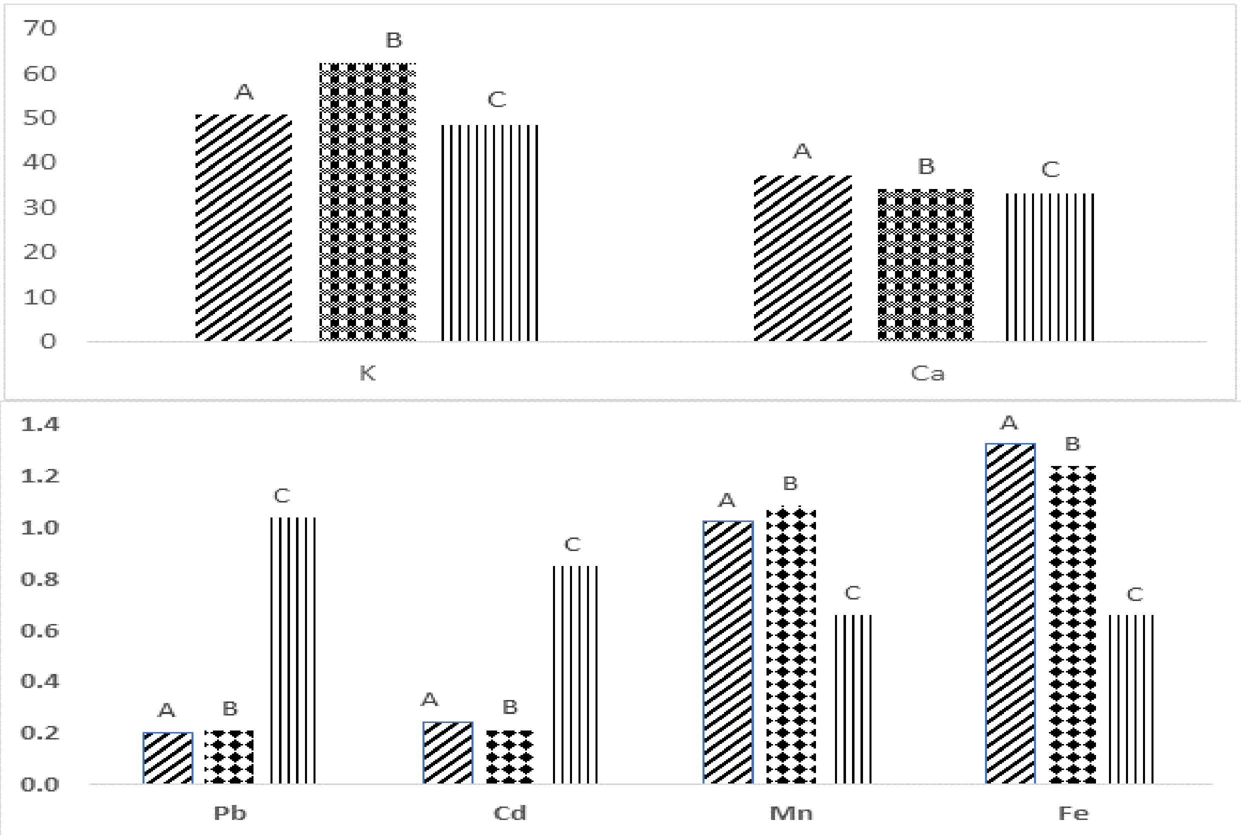

Fig. 1: Bar Chart showing the distribution of metal ions im banana peels (A), palm bunch (B) and limestone (C)

The results of essential mineral content in sample showed that the concentrations of potassium, calcium, iron, manganese, lead and cadmium are 50.76, 37.40, 1.236, 1.024, 0.204, and 0.246 respectively. Table 2 records the percentage concentrations of protein, crude lipid, carbohydrate and crude fibre, ash, moisture, energy value (kcal) as 60.45, 17.89, 5.23, 3.65, 12.78, 70.91 and 423.73 respectively. The results indicate that if the peels are properly exploited, accessed and processed, they could offer high-quality and cheap source of carbohydrates and minerals for human, livestock and plants.

The results of heavy metals analysis of the three samples revealed that iron (Fe) is high in both banana and palm bunch recording concentrations of 1.236 and 1.242 mg/l respectively.

Lead and cadmium concentrations were relatively high in the samples as reveal by the results indicating that potash may contain a high concentration of some heavy metal ions depending on the source. However, the samples are rich sources of calcium and potassium which are essential elements for plant and animal. Potassium concentrations were 50.76, 62.42 and 48.64 mg/l in potash solutions from banana, palm fruit and control respectively while the corresponding concentrations of calcium were 37.40, 34.20 and 33.36 mg/l.

4.0. Conclusion

The results of the present study reveal that potash solutions from banana peel NS palm bunch have some proximate and elemental composition that are comparable. Therefore, extract from banana peel and palm bunch ashes can also be used to prepared traditional in place of limestone. However, there is need to check their heavy metal content, since this may exert toxic effect is higher than expected.

5.0 References

Adewuyi, G. O., Obi-Egbedi, N. O. & J.O. Babayemi, (2008). Evaluation of ten different African wood species for potash production. *International Journal of Physical Science*., 3, pp. 63-68.

Afrane, G., 1992. Leaching of caustic potash from cocoa husk ash. *Bioresources Technology*., 41: 101-104.

Akinmutimi, A. H., Ojewola, G. S., Abasiekong, S. F. & Onwudike, O.C. (2008). Evaluation of toasted, cooked and akanwu-cooked sword bean meal in place of soya bean meal in broiler starter diets. *International Journal of Poultry Science*, 7, pp. 480-484.

Aribido, S. O., Ogunmodede, B. K. & Lakpini, C. A.M. (2001), Nutritional assessment of Gwanwarasa‟ Type of Natural Potash (Kanwa), *Nigerian Journal of Chemical Research*, 6,3, pp. 27-30.

Babayemi, J. O., G.O. Adewuyi, K.T. Dauda & A.A.A. Kayode (2011). The ancient alkali production technology and the modern improvement: A review. *Asian Journal of Applied Science*, 4, pp. 22-29.

Babayemi, J.O,. Dauda, K.T, Nwude, D.O. & Kayode, A.A.A. 2010. Evaluation of the Composition and Chemistry of Ash and Potash from Various Plant Materials: A Review. *Journal of Applied Sciences*, 10, pp. 1820-1824.

Bankole J. K., Ngokere A. A., Ajibade O. M., Igunbor C. M. & Eloka C. C. V. (2015), Degenerating effects of potash (Kaun-K_2CO4) on the kidney: Unabated continental challenge to human health in Nigeria. *Annals of Biological Research*, 2015, 6 (3) pp.12-17.

Eddy, N. O**.,** Udofia, P. J. & Ukpong, I. J. (2004). *The roles of leguminous plant in mineral nutrition*. Published in the proceedings of the Chemical Society of Nigeria 27th International Conference (a supplement of the Journal of Chemical Society of Nigeria), pp. 329-332.

Eddy, N. O. (2007). Applied statistics in designing special organic mixtures. *Journal of Pure and Applied Science*, 9, pp. 78-88.

Eddy, N. O. & Ukpong, I. J. (2006). Possible relationship existing between the distribution of electrolyte between soap and lye. *Journal of Applied Sciences*, 8, 1, pp. 60-64.

Eddy, N. O. & Ebenso, E. E. (2008). Adsorption and inhibitive properties of ethanol extract of *Musa sapientum* peels as a green corrosion inhibitor for mild steel in H_2SO_4. *African Journal of Pure and Applied Chemistry*, 2, 6, pp. 1-9.

Eddy, N. O., Odoemelam, S. A. & Odiongenyi, A. O. (2008). Ethanol extract of *Musa acuminate* peel as an eco-friendly inhibitor for the corrosion of mild steel in H_2SO_4. *Advances in Natural and Applied Sciences*, 2, 1, pp. 35-42.

Eddy, N. O. & Udoh, C. L. (2006). *Introduction to Environmental Chemistry*. Patom Press, Nigeria.

Hassan, H. F., Hassan, U. F., Usher, O. A., Ibrahim, A. B. & Tabe, N. N. (2018). Exploring the potentials of banana (*Musa sapientum)* peels in feed formulation. *International Journal of Advanced research in Chemical Science*, 5, 5, pp. 10-14.

Kevin, M.D., 2002. A primitive alkali: Potash. Caveman Chem. A. Sofowora (1982), Medicinal Plants and Traditional

Medicine in West Africa. JohnWiley and Sons, New York, USA.

Kostick, D. (2006). *Mineral handbook*. United State Geological Survey. P. 58.

Mikkelsen, Rob (2020) https://www.cropnutrition.com/resource-library/what-is-potash.

Nwoko, V.O. (1980). Chemical processing development. *Proceedings of the 10th Annual Conference of the Nigerian Society of Chemical Engineers, (NSCE`80), Nigeria*, pp. 40-53.

Ochei, K. C., Omeh, Y. N., Obeagu, E. I. & Obarezi, T. N. (2014), Effect of Potash on the Hearts of Rabbits, *Journal of Pharmacy and Biological Sciences*, 9, pp. 33-37.

Okareh, O. T., Adeolu, A. T. & Adepoju, O. T. (2015), Proximate and mineral composition of plantain (Musa Paradisiaca) wastes flour; a potential nutrients source in the formulation of animal feeds, *African Journal of Food Science and Technology*., 6, 2, pp. 53-57.

Olabanji,I. O, Oluyemi, E. A. & Ajayi,O. S. (2012), Metal analyses of ash derived alkalis from banana and plantain peels (Musa spp.) in soap making, *African Journal of Biotechnology* 11, 99, pp. 16512-16518.

Olufemi, A. S., Olayebi, O. O. & Makpah, D. E. (2017). A novel process for the production of potash from ash: leaching technique. *Journal of Advancement in Engineering and Technology*, 5, 1, doi: 10.15297/JAET.V5I1.02.

Taiwo, A. A., Oluwadare, I., Shobo, A. O. & Amolegbe, S. A. (2008). Extraction and potential application of caustic potash from kolanut husk, ugwu pod husk and plantain peels, *Scientific Research and Essay,* 3,10, pp. 515-517.

Conflict of Interest

The authors declared no conflict of interest