Properties and Mineral Contents of Ashes from Some Agricultural Organic Postharvest Residues in Benue, Nigeria

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Abstract

Agricultural organic waste around the environment comes from natural and human activities, cumulating to hazard against living things. Resent research encouraged the use of waste and residues from crops postharvest and processes for human gain. So, postharvest residues from eight common crops namely Cassava Peel (CP), Groundnut Stalk (GSK), Guinea Corn Chaff (GCC), Maize Corn Peels (MCP), Millet Chaff (MCF), Rice Stalk (RS), Soya-beans Stalk (SS) and Yam Peel (YP) from Konshisha LGA, Benue State were processed into ashes at 600^oC. These ashes were assessed using XRF which reveal appreciable quantities of minerals and Oxides. The ashes were also analyzed for physicochemical parameter like; pH, Total Soluble Solid (TSS), Solid Residues (SR), Attrition (Att.), Bulk Density(BD), Swelling capacity(SC), Water Absorption Capacity (WAC) and Titrable Alkalinity/Acidity(TA/A) respectively. Thirty-four (34) minerals were determined in the eight ashes respectively. These minerals are; Potassium (K), Calcium (Ca), Titanium (Ti), Vanadium (V), Chromium (Cr), Manganese (Mn), Iron (Fe), Cobalt (Co), Nickel (Ni), Copper (Cu), Zinc (Zn), Arsenic (As), Selenium (Se), Rubidium (Rb), Strontium (Sr), Zirconium (Zr), Niobium (Nb), Molybdenum (Mo), Silver (Ag), Cadmium (Cd), Tin (Sn), Antimony (Sb), Barium (Ba), Wolfram (W), Gold (Au), Lead (Pb), Bismuth (Bi), Magnesium (Mg), Aluminium (Al), Silicon (Si), Phosphorus (S), Sulfur (S) and Chlorine (Cl). Eleven metallic oxide of CuO, NiO, Fe_2O_3, MnO, Cr_2O, TiO_2, CaO, Al_2O_3, MgO, ZnO, and SiO_2 were determine whereas only MnO and NiO was't in any of the ashes. This property has unveiled the possibilities for application of these ashes in diverse ways.

Keywords: Postharvest, waste, Ashes Properties, Content, potentials.

Propriétés et teneurs en minéraux des cendres issues de certains résidus organiques agricoles post-récolte à Benue, Nigeria

Résumé

Les déchets organiques agricoles dans l'environnement proviennent d'activités naturelles et humaines, représentant un danger pour les êtres vivants. Des recherches récentes encouragent l'utilisation des déchets et résidus post-récolte pour des bénéfices humains. Ainsi, des résidus post-récolte de huit cultures courantes – épluchures de manioc (CP), tiges d'arachide (GSK), balles de sorgho (GCC), enveloppes de maïs (MCP), balles de mil (MCF), tiges de riz (RS), tiges de soja (SS) et épluchures d'igname (YP) – provenant de la zone de Konshisha (LGA) dans l'État de Benue, ont été transformés en cendres à 600°C. Ces cendres ont été analysées par fluorescence X (XRF), révélant des quantités appréciables de minéraux et d'oxydes.

Les paramètres physico-chimiques évalués comprenaient : le pH, les solides solubles totaux (TSS), les résidus solides (SR), l'attrition (Att.), la densité apparente (BD), la capacité de gonflement (SC), la capacité d'absorption d'eau (WAC) et l'alcalinité/acidité titrable (TA/A). Trente-quatre (34) minéraux ont été identifiés dans les huit cendres, notamment : potassium (K), calcium (Ca), titane (Ti), vanadium (V), chrome (Cr), manganèse (Mn), fer (Fe), cobalt (Co), nickel (Ni), cuivre (Cu), zinc (Zn), arsenic (As), sélénium (Se), rubidium (Rb), strontium (Sr), zirconium (Zr), niobium (Nb), molybdène (Mo), argent (Ag), cadmium (Cd), étain (Sn), antimoine (Sb), baryum (Ba), tungstène (W), or (Au), plomb (Pb), bismuth (Bi), magnésium (Mg), aluminium (Al), silicium (Si), phosphore (P), soufre (S) et chlore (Cl). Onze oxydes métalliques (CuO, NiO, Fe_2O_3, MnO, Cr_2O_3, TiO_2, CaO, Al_2O_3, MgO, ZnO et SiO_2) ont été détectés, à l'exception de MnO et NiO, absents dans toutes les cendres. Ces propriétés révèlent des possibilités d'application diversifiées pour ces cendres.

Mots-clés : Post-récolte, déchets, propriétés des cendres, teneur, potentiels.

١٠. خصائص ومحتوى الرماد من المعادن في بعض المخلفات العضوية الزراعية بعد الحصاد في بنوي، نيجيريا

النفايات العضوية الزراعية في البيئة ناتجة عن الأنشطة الطبيعية والبشرية، مما يؤدي إلى تراكمها وتشكلها خطراً على الكائنات الحية. وقد شجعت الأبحاث الحديثة على استخدام النفايات والمخلفات الناتجة عن المحاصيل بعد الحصاد ومعالجتها لفائدة الإنسان. لذلك، تم جمع مخلفات ما بعد الحصاد لثمانية محاصيل شائعة، وهي: قشور الكسافا (CP)، سيقان الفول السوداني(GSK) ، نخالة الذرة الرفيعة(GCC) ، قشور الذرة(MCP) ، نخالة الدخن (MCF)، سيقان الأرز(RS) ، سيقان فول الصويا(SS) ، وقشور اليام (YP) من منطقة الحكومة المحلية كونشيشا في ولاية بنوي، وتمت معالجتها وتحويلها إلى رماد بدرجة حرارة 600 درجة مئوية.
وقد تم تحليل هذه الرماد باستخدام تقنية التحليل بالأشعة السينية(XRF) ، حيث أظهرت نتائج التحليل وجود كميات معتبرة من المعادن والأكاسيد. كما تم تحليل الرماد من حيث بعض الخصائص الفيزيوكيميائية مثل: الرقم الهيدروجيني (pH)، المواد الصلبة الذائبة الكلية(TSS) ، المواد الصلبة المتبقية(SR) ، التفتت(.Att) ، الكثافة الظاهرية (BD)، قدرة الانتفاخ(SC) ، قدرة امتصاص الماء(WAC) ، والقلوية/الحموضة القابلة للمعايرة.(TA/A)
وقد تم تحديد أربعة وثلاثين (34) معدناً في الرماد الناتج عن المحاصيل الثمانية، وهي: البوتاسيوم(K) ، الكالسيوم(Ca) ، التيتانيوم(Ti) ، الفاناديوم(V) ، الكروم(Cr) ، المنغنيز(Mn) ، الحديد(Fe) ، الكوبالت(Co) ، النيكل(Ni) ، النحاس(Cu) ، الزنك(Zn) ، الزرنيخ(As) ، السيلينيوم(Se) ، الروبيديوم(Rb) ، السترونشيوم(Sr) ، الزركونيوم(Zr) ، النيوبيوم(Nb) ، الموليبدينوم(Mo) ، الفضة(Ag) ، الكادميوم(Cd) ، القصدير(Sn) ، الأنتيمون(Sb) ، الباريوم(Ba) ، التنجستن(W) ، الذهب(Au) ، الرصاص(Pb) ، البزموت(Bi) ، المغنيسيوم (Mg)، الألمنيوم(Al) ، السيليكون(Si) ، الفوسفور(P) ، الكبريت(S) ، والكلور.(Cl)
وقد تم تحديد أحد عشر أكسيداً معدنيًا وهيCuO :، NiO، Fe_2O_3، MnO، Cr_2O_3، TiO_2، CaO، Al_2O_3، MgO، ZnO، وSiO_2، في حين لم يتم العثور على MnO و NiOفي أي من الرماد. وقد كشفت هذه الخصائص عن إمكانيات متعددة لاستخدام هذه الرماد بطرق متنوعة.
الكلمات المفتاحية: **ما بعد الحصاد، النفايات، خصائص الرماد، المحتوى، الإمكانيات.**

Introduction

Environmental Waste comes from natural and human activities, cumulating to hazard against living things. Human being cannot do without food which at the processes of food production generated waste. Resent research is so encouraging for the use of waste and residues from crops harvest and processing processes for human gain. It is therefore important to search for the appropriate handling practices and treatment methods to convert postharvest residues waste for useful applications (Gomez-Barea et al 2009). It is obvious that postharvest residues or waste will have some compounds and minerals for industrial use and environmental applications (Selema and Farago, 1996; Tarun et al., 2003 ;Adewuyi et al., 2008) It is possible that such minerals will constitute properties like pH for remediation of soil, preservation of fresh fruits and etc. According to Anhwange *et al* (2009) some postharvest materials like banana peels (*Musa sapientum*) ash contained many minerals like Potassium, Calcium, Sodium, Iron, Manganese, Bromine Rubidium, Strontium, Zirconium and Niobium to a reasonable amount for potential uses. Such minerals may constitute some preservative properties (Olanders and Steenari, 1994; Babayemi et al., 2011; Ivana et al., 2017), like pH needed for crops preservation treatment to reduce postharvest losses thereby increasing profitability from crops yield. Recently Burundi Famer found crude techniques for preserving tomatoes by using ash from woods (yet to identify the exact wood) (Watkins, 2006). Such minerals could be refined for potential industrial applications

Materials and method

Collection and identification of residues material for ashes

Materials for ashes were sourced from eight crops residues of specific species. These materials were collected from farmers in Konshisha Local Government Area of Benue State.

The residues were identified at the Department of Crop and Environmental Protection, Federal University of Agriculture Makurdi as Cassava Peels *Manihote sculalenta* (Pro-vitamin A) (CP), Groundnut Stalk *Arachishypogaea* (Samnut 21) (GSK), Guinea Corn Chaff *sorghum bicolor* (Brown Corn) (GCC), Maize corn peels *Zea mays* (Yellow Maize)(MCP), Millet Chaff *Penninsetum americanum*(MCF), Rice Stalk *Oryza sativa* (Sipi)(RS), Soya beans Stalk *Glycine max* (SS) and Yam Peels *Dioscorea species* (White Yam)(YP) consecutively.

Preparation of the Ashes

Materials collected were dried under the sun to a constant weight to reduce the bulkiness of the residues. One kilogram (1kg) of the sample materials were weighed into a partially closed system with a vent to permit air for combustion and to prevent wind from blowing the mixed product of carbon and ash. The process continued to obtain at least ten kilograms (10 kg) of the carbon and ash mixture for each sample materials. Only 250 g of samples were weighed into open porcelain crucibles and arrange into preheated muffle furnace and heated at 600 ^oC (3 hours) otherwise until white or gray pure ash observed. The process was repeated till one kilogram (1 kg) of ash was obtained for each sample residue. The ashes were stored in airtight glass bottles and later use for various properties analysis appropriately.

Determination of Physicochemical Properties of Ashes

Determination of pH

The processed ash sample of 1 g was dissolved in 10 mL of distilled water in 100 mL beaker and mixed thoroughly. A pH meter was activated in distilled and deionised water and calibrated with buffer solutions of pH 4.2 and 9.2. The pH of the sample was measured at the ambient temperature of solutions by deeping the pH meter electrodes into the solution till a stable readings observed and recorded. This was repeated three times to have triplet readings (AOAC 2005).

Determination of titrable acidity (TA)

Exactly1 g of the processed ash sample was dissolved in 20 mL of deionized water in the conical flask, two drops of phenolphthalein indicator was added. A prepared solution of 0.1 M of sodium hydroxide was filled in the burette and titrated against the sample prepared in the flask until pink endpoint observed. The TA was calculated as: (H_2Ta g/L) = 0.75 x Titer mL (of 0.10 M NaOH) (AOAC 2005).

Determination of titrable alkalinity (TA)

The processed ash sample of 1 g was dissolved in 20 mL of deionized water in the conical flask, two drops of phenolphthalein indicator was added. A prepared solution of 0.1 M of hydrochloric acid was filled in the burette and titrated against the ash sample prepared in the flask until pink endpoint observed. The TA was calculated as: (H_2Ta g/L) = 0.75 x Titer mL (of 0.10M HCl) (AOAC 2005).

Determination of bulk density (BD)

A 15 mL measuring cylinder was weighed and gently filled with the sample just above 8 mL. By gently tapping the bottom of the cylinder on laboratory bench until there was no further diminution of sample level, then the sample volume and weight was measured (AOAC 2005). Then Bulk Density was calculated as

$$BD = \frac{weight\ of\ sample\ (g)}{Volume\ of\ sample\ (cm3} \quad (1)$$

Determination of swelling capacity (SC)

Exactly15 mL of distilled water and 1 g of sample was measured, both in 15 mL measuring cylinders. The 15 mL water was added bit by bit into the 1 g sample measured until water saturates the sample. The increase in the volume of the sample was measured and swelling capacity calculated as:

$$SC = \frac{\text{Increased in volume of sample (mL)}}{\text{Initial volume of sample (mL)}} \quad (2)$$

Determination of attrition(Att.)

Exactly1g of the ash sample was added into 25 mL deionised water in a 50 mL beaker, stirred at 500 rpm for 2 hours with a mixer and was screened through a dry weighed screen filter paper (nominal opening size of 0.25 mm). The material retained by the screen was dried and reweighed. The amount lost after contact with water was calculated as the attrition value of the ash samples. Attrition is calculate as

$$Att. = \frac{(1-(\text{Sample weight retain on screen filter (g)}}{(\text{Initial Sample weight (g) x 1.}} \quad (3)$$

Determination of residual solid (SR)

Just 1 g of the ash sample was added into 25 mL deionised water in a 50 mL beaker, stirred at 500 rpm for 2 hours with a mixer and was screened through a dry weighed screen filter paper (nominal opening size of 0.25 mm). The amount of sample weight retained on the weighed screen filter was dried and reweighed. The sample weight retained on screened filter is the residues weight.

Determination of total soluble solids (TSS)

Only 1 gram of sample was weight into 100 mL and 10 mL deionized water was added. The solution was mixed thoroughly on a magnetic stirrer for 2 hours at ambient temperature of 32 °C. The solution was filtered on a screen filter paper into a cleaned grease free weighed Pyrex beaker. The filtrates was evaporated on a water bath, dried in the oven at 60 °C, was cool in desiccators avoiding stain and the beaker was reweighed. The gained in weight of beaker is equal to the total soluble solid per one gram of sample (TSS) (AOAC 2005).

Determination of water absorption capacity (WAC)

A 10 mL test tube was weighed, 1 g of the sample was weighed into the test tube, then distilled water was added to saturation and it was mixed gently. The sample stands for 30minute at ambient temperature of 31 °C and was centrifuged at 500 rpm for 30 minutes. The supernatant gently decanted from the sediment in the test tube and was reweighed. The gained in weight by sample from water retained is the water absorption capacity [36]. This was calculated as:

$$\text{WAC:} = \frac{Increase\ in\ weight\ of\ sample}{Initial\ weight\ of\ sample} \quad (4)$$

Determination of Minerals and Oxides Composition of Ashes

A handheld Thermo Scientific NITON XL3t X-Ray Fluorescence (XRF) machine wasused to analysed the mineral form eight (8)
samples of Ash process from residues of crops.After fixing the battery into the machine battery holder, the machine was switch on. The“Mining Cu/Zn” testing mode was selected on the machine menu. The powder sample wasmeasured in the XRF sample cup provided with the machine. The cup was placed on thetable to stand then, the machine was placed directly on the sample. It was ensured that themachines measurement window gauged flushes with the sample and the trigger was heldfor the testing time of 180 seconds. The XRF machine displayed the reading which wastransferred electronically to computer and was printed to a hard copy, although thereadings are available from the machine’s flip-up, touch-screen display

Result and discussion

Table 1: The Ashes Yield from One Kilogram of Crop Residues

ID	Crops Residues (1 kg)	Carbon/Ash Mixed (g)	Ash Yield (g)	% Yield.
A	Cassava Peels (CP)	548	127	12.7
B	Groundnut Peels (GSK)	396	111	11.1
C	Guinea Corn Chaff (GCC)	357	108	10.8
D	Maize Corn Peels (MCP)	201	47	4.7
E	Millet Chaff (MCF)	234	79	7.9

F	Rice Stalk (RS)	517	113	11.3
G	Soyabeans stalk (SS)	511	102	10.2
H	Yam peel (YP)	592	109	10.9

The ashes yield from one kilogram of crops residues

The amount of ash produced from a material residual waste represents the estimated amount of inorganic composition from that material at it ashing temperature. The percentages of these various inorganic matters present in these ashes are mostly minerals [9], which constitute the physicochemical properties of the ash. The eight crops residues materials yield these percentages of ashes from one kilogram of constant dried weight of each material of Cassava Peels ash 12.7 %, Groundnut Stalk ash 11.1 %, Guinea Corn chaff ash 10.8 %, Maize corn Peels ash 4.7 %, Millet Chaff ash 7.9 %, Rice Stalk ash 11.3 %, Soya bean Stalk ash 10.2 % and Yam Peels ash 10.9 %. This result revealed moderate percentages of ash from one kilogram of residues. These yields give the estimate of various amounts of postharvest residues that could be required to produce the desired amount of ashes.

Table 2: Physical Properties of Ashes

S/Id.	Crops Residues	Initials	pH	WAC(cm^3/g)	BD (g/cm^3)	TA,H^+/OH^-	SC(cm^3/g)	TSS (g)	RS (g)	Att. (g)
A	Cassava Peels *manihotesculalenta* (Pro-vitamin A)	CP	8.2±.1	0.753±.09	11.99±.01	2.796±.04	0.006±.01	0.040±.03	0.936±09	0.064±.03
B	Groundnut Stalk*Arachishypogaea* (Samnut 21)	GSK	8.5±.1	1.193±.2	8.67±.02	2.853±.09	0.200±0	0.040±.01	0.949±.001	0.051±.001
C	Guinea Corn Chaff *sorghum bicolor* (Brown Corn)	GCC	8.1±.0	2.420±.08	3.78±0.3	1.646±.01	0.193±.01	0.123±.1	0.873±.08	0.127±.03
D	Maize corn peels *Zea mays* (Yellow Maize)	MCP	8.0±.0	0.963±.04	9.15±1.6	1.296±.2	0.206±.1	0.213±.09	0.790±.01	0.210±.01
E	MilletChaff *P. americanum*	MCF	6.7±.1	1.616±.1	6.31±.02	0.100±.0	0.203±.09	0.066±.01	0.936±.002	0.064±.02
F	Rice Stalk *Oryza sativa* (Sipi)	RS	7.2±.1	2.926±.01	3.82±.02	0.366±.09	0.003±.001	0.043±.09	0.951±.001	0.049±.01
G	Soya beans Stalk *Glycine max*	SS	9.0±.0	1.853.±.01	3.91±.02	8.233±.09	0.010±.01	0.236±.04	0.835±.03	0.165±.02
H	YamPeels*Dioscorearotundata* (White Yam)	YP	8.6±.1	1.036±.03	9.60±.03	5.566±.5	0.043±.06	0.056±.03	0.947±.001	0.053±.01

Note: Water Adsorption Capacity (WAC), Bulk Density (BD), Titreable Acidity/ Alkalinity (TA/A), Swelling Capacity (SC), Total Soluble Solids (TSS), Solid Residues (SR) and Attrition (Att.) Per Gram.

Physicochemical properties of ashes

The results in Table: Two (2) show the physicochemical properties of ashes.

Water absorption capacity for Guinea Corn Chaffs (GCC) ash, Rice Stalk (RS) ash and Soyabeans Stalk (SS) ash were 2.420, 2.926, and 1.853 cm^3 per gram while Groundnut Stalk (GSK) ash, Millet Chaff (MCF) ash and Yam Peel (YP) ash water absorption capacity was 1.193, 1.616 and 1.036 cm^3/g which is fair for water absorption capacity requirement in a packaging. Cassava Peel (CP) ash and Maize Corn Peel (MCP) ash have low water absorption capacity of 0.753 and 0.963 cm^3/g less than a 1 cm^3/g which could easily package of material with little water contents and other suitable applications.

Bulk Density of Cassava Peels (CP), Maize Corn Peel (MCP) and Yam Peel (YP) occupied 11.99, 9.15 and 9.60 cm^3/g, respectively. Only 1 gram of Groundnut Stalk (GSK) ash occupied 8.67, Guinea Corn Chaff (GCC) ash 3.78, Rice Stalk (RS) ash 3.83 and Soyabeans Stalk (SS) ash 3.91 cm^3/g. These bulk values in three ashes will cover the product without adding much weight in a package system and other suitable applications.

The Swelling Capacity of all the ashes ranges from 0.000 to 0.006, 0.200, 0.193, 0.206, 0.203, 0.003, 0.010 and to 0.043 cm^3/g of Cassava Peels (CP) ash, Groundnut Stalk (GSK) ash, Guinea Corn Chaffs (GCC) ash, Maize Corn Peel (MCP) ash, Millet Chaff (MCF) ash, Rice Stalk (RS), Soyabean Stalk (SS) ash and Yam Peel (YP) ash samples, respectively. These swelling capacity values are fair volume to be controlled with a package size to avoid expansion of the container that will lead to bursting and breakage during storage preservation duration as well as for other suitable applications.

Solid Residues retained from wet Cassava Peel (CP) ash, Groundnut Stalk (GSK) ash, Guinea Corn Chaff (GCC) ash, Maize Corn Peel (MCP) ash, Millet Chaff (MCF) ash, Rice Stalk (RS) ash, Soybeans Stalk (SS) ash and Yam Peel (YP) ash were 0.936, 0.949, 0.873, 0.790, 0.936, 0.951, 0.835 and 0.947 grams, respectively per 1 gram of each ash. This result shows less soluble minerals are eluted into the aqueous solvent whereby some may do elute in other solvent for a primary separation of mineral content for suitable purifications and applications.

Total Soluble Solid (TSS) is the amount of solvent soluble minerals in material that could be recrystallized by evaporation. The TSS give the estimate amount of lost in the original properties of the material. Hence, some ashes lost significant minerals in aqueous solvent at 0.05 different per gram, they include Guinea Corn Chaff (GGC) ash 0.123, Maize Corn Peel (MCP) ash 0.213, Soybeans Stalk (SS) ash 0.236 Maize Corn Peel (MCF) ash 0.066 and Yam Peel (YP) 0.056 being an indication they may not be good to reused as a whole known content if it is being wet. TSS from Cassava Peel (CP) ash 0.040, Groundnut Stalk (GSK) ash 0.040, and Rice Stalk (RS) ash 0.043, may be dried and reused even if wet. This result shows little soluble minerals dissolved into the aqueous solvent whereby some may do dissolved in other solvent for a primary separations of mineral content for suitable purifications and applications.

Attrition gives the value of mineral from material that may react with water reducing the effective qualities from the material into solutions. Squeezing the absorbed water from the ashes, the attrition mineral activity values for Cassava Peels (CP) ash, Groundnut Stalk (GSK) ash, Guinea Corn Chaff (GCC) ash, Maize Corn peel (MCP) ash, Millet Chaff (MCF) ash, Rice Stalk (RS) ash Soyabeans Stalk (SS) ash and Yam Peels (YP) ash were 0.064, 0.051, 0.127, 0.210, 0.064, 0.049, 0.165 and 0.053, which indicate the low quantity of escape mineral that can interact with the walls of storage containers and the product, reducing the chances for undetermined reactions when use as Pad in packaging products.

The Titrable Alkalinity levels in various ashes were Cassava Peels (CP) 2.796, Groundnut Stalk (GSK) 2.853, Guinea Corn Chaff (GCC) 1.646, Maize Corn Peel (MCP) 1.296 and Rice Stalk (RS) 0.366 for 0.1M hydrochloric acid; this is an indication of low hydroxide ions concentration for seven ashes with low potential of triggering ions exchange between ashes containers and the products when used as absorbents. It will be also used for suitable applications as well as pad in packaging of products. Soybeans Stalk (SS) ash and Yam Peel (YP) ash has the hydroxide ions values of 8.233 and 5.566 with a high potencyfor soil remediation from high alkalinity and other suitable applications.

Titrable Acidity in Millet Chaff (MCF) ash indicates low levels of hydrogen ions with 0.100 with 0.1M sodium hydroxide in the system, it can be used for suitable applications as well as pad in packaging of products.

The pH results from the processed ashes shows alkalinity in seven samples of Cassava Peel (CP) ash, Groundnut Stalk (GSK) ash, Guinea Corn Chaff (GCC) ash, Maize Corn Peel (MCP) ash, Rice Stalk (RS) ash, Soya-beans Stalk (SS) ash and Yam Peel (YP) ash is 8.2, 8.5, 8.1, 8.0, 7.2, 9.0 and 8.6 while 4.2 for Millet Chaff (MCF) ash indicates weak acidity as shown in Table 2. These ashes could be use as absorbents and Pad for packaging of delicate products, soil remediation's, sources of some minerals and other suitable application.

Table 3: Mineral Composition of Ash Samples

Ash:→ Element↓	MCF (mg)	RS (mg)	GCC (mg)	YP (mg)	CP (mg)	MCP (mg)	GSK (mg)	SS (mg)
LOI	99.848	72.34	74.309	98.744	77.885	96.83	74.409	74.463
K	< LOI	9.707	16.501	0.107	5.954	1.659	4.065	14.917
Ca	0.075	2.079	5.326	0.096	6.416	0.322	12.3	8.551
Ti	0.015	0.041	0.139	0.011	0.234	0.031	0.24	0.042
V	ND	ND	ND	ND	ND	ND	ND	ND
Cr	ND	ND	ND	ND	ND	ND	ND	ND
Mn	ND	1.085	0.128	ND	0.021	ND	0.072	0.029
Fe	0.045	0.258	0.456	0.14	0.346	0.137	0.402	0.184
Co	ND	ND	ND	ND	ND	ND	ND	ND
Ni	ND	ND	ND	ND	ND	ND	ND	ND

Cu	ND	ND	0.018	0.002	0.002	ND	0.004	0.013
Zn	0.005	0.037	0.1	0.009	0.008	0.019	0.008	0.014
As	ND	ND	ND	ND	ND	ND	ND	ND
Se	ND	ND	ND	ND	ND	ND	ND	ND
Rb	ND	0.025	0.008	ND	0.003	0.002	0.003	0.004
Sr	ND	0.009	0.012	0.002	0.015	0.002	0.039	0.034
Zr	ND	0.003	0.019	0.003	0.025	0.009	0.045	0.003
Nb	ND	ND	ND	ND	ND	ND	ND	ND
Mo	ND	ND	ND	ND	ND	ND	ND	ND
Pd	ND	ND	ND	ND	ND	ND	ND	ND
Ag	ND	ND	ND	ND	ND	ND	ND	ND
Cd	ND	ND	0.002	0.002	0.002	0.003	ND	ND
Sn	ND	ND	0.002	ND	< LOD	0.002	0.002	ND
Sb	ND	ND	0.002	ND	ND	0.002	ND	ND
Ba	ND	0.015	ND	ND	0.007	ND	0.033	ND
W	ND	ND	ND	ND	ND	ND	ND	0.026
Au	ND	ND	ND	ND	ND	ND	ND	ND
Pb	0.007	0.007	0.019	0.002	0.002	0.002	0.003	0.012
Bi	ND	0.003	0.003	ND	ND	ND	ND	0.003
Mg	ND	ND	ND	0.161	ND	ND	1.085	<ND
Al	ND	ND	0.517	0.1	0.472	0.14	0.374	0.262
Si	ND	12.715	1.93	0.587	7.114	0.787	6.152	0.943
P	ND	ND	ND	ND	0.895	ND	0.298	0.261
S	ND	0.484	0.062	0.01	0.465	0.017	0.35	0.119
Cl	ND	1.187	0.086	0.018	0.128	0.034	0.109	0.118
TOTAL	99.995	99.995	99.639	99.994	99.994	99.998	99.993	99.998

Note: Loss on ignition (LOI) , Not detected (ND), Maize corn peel ash (MCP), Rice stalk ash (RS), Guinea corn chaff ash (GCC), Yam peel ash (YP), Cassava peel ash (CP), Millet chaff ash (MCF), Groundnut stalk ash (GSK), Soya beans stalk ash (SS).

Potassium (K), Calcium (Ca), Titanium (Ti), Vanadium (V), Chromium (Cr), Manganese (Mn), Iron (Fe), Cobalt (Co), Nickel (Ni), Copper (Cu), Zinc (Zn), Arsenic (As), Selenium (Se), Rubidium (Rb), Strontium (Sr), Zirconium (Zr), Niobium (Nb), Molybdenum (Mo), Silver (Ag), Cadmium (Cd), Tin (Sn), Antimony (Sb), Barium (Ba), Wolfram (W), Gold (Au), Lead (Pb), Bismuth (Bi), Magnesium (Mg), Aluminum (Al), Silicon (Si), Phosphorus (S), Sulfur (S) and Chlorine

Mineral Composition of Ash Samples

The result in Table Three (3) indicates the quantity of available minerals in various ashes processed from postharvest residuesWaste at 600 ^{0}C. This is in line with the report by Anhwange*et al* about the presences of useful minerals in banana peels ash (Anhwange et, al). Thirty-four (34) minerals were determined in the eight ashes respectively. These minerals are; Potassium (K), Calcium (Ca), Titanium (Ti), Vanadium (V), Chromium (Cr), Manganese (Mn), Iron (Fe), Cobalt (Co), Nickel (Ni), Copper (Cu), Zinc (Zn), Arsenic (As), Selenium (Se), Rubidium (Rb), Strontium (Sr), Zirconium (Zr), Niobium (Nb), Molybdenum (Mo), Silver (Ag), Cadmium (Cd), Tin (Sn), Antimony (Sb), Barium

(Ba), Wolfram (W), Gold (Au), Lead (Pb), Bismuth (Bi), Magnesium (Mg), Aluminium (Al), Silicon (Si), Phosphorus (S), Sulfur (S) and Chlorine (Cl). Guinea corn chaffs (GCC) ash, Groundnut stalk (GSK) ash and Soybeans stalk (SS) ash contained nineteen (19) minerals as shown in Table Three (3) down. The amount present in GCC ash range from 0.002-16.501 g which gives a total of 25.3226 minerals from 99.639 g samples while 74.309 g loss on ignition.
Minerals in GSK ash ranges from 0.003-12.3 g minerals from 99.998 g of sample in which 74.409 g loss on ignition. Minerals in SS ash ranges from 0.003-14.917 g out of 99.998 g sample while the 74.463 g loss on ignition.
In Cassava Peel (CP) ash eighteen minerals present within the range of 0.002-6.416 g making a total of 21.7666 g of minerals out of 99.994 g sample used and 77.885 g lost on ignition.
Maize Corn Peel (MCP) ash, Rice Stock (RS) ash and Yam Peel (YP) contain sixteen (16) minerals. Minerals in MCP ash range from 0.002-1.659 g out of 99.998 g of sample while 96.83 g loss on ignition. Ash of Rice Stalk (RS) contained minerals within the range of 0.003-9.707 g out of 99.995 g of sample, losing 72.34 g of sample on ignition.

Table 4; Minerals Oxides composition of ashes

ASH→ OXIDE↓	MCF (mg)	RS (mg)	GCC(m)	YP (mg)	CP(mg)	MCP(m)	GSK(m)	SS (mg)
CuO	ND	0.002	0.023	0.003	0.002	0.002	0.005	0.016
NiO	ND	ND	ND	ND	ND	ND	ND	ND
Fe_2O_3	0.065	0.368	0.652	0.201	0.495	0.196	0.575	0.263
MnO	ND	1.4	0.165	ND	0.028	ND	0.093	0.037
Cr_2O_3	ND	ND	ND	ND	ND	ND	ND	ND
TiO_2	0.025	0.068	0.232	0.019	0.391	0.052	0.4	0.07
CaO	0.105	2.91	7.456	0.134	8.983	0.451	17.22	11.971
Al_2O_3	ND	ND	0.977	0.189	0.892	0.265	0.706	0.496
MgO	ND	ND	0.596	0.267	ND	ND	1.802	ND
ZnO	0.006	0.047	0.125	0.011	0.01	0.024	0.01	0.018
SiO_2	ND	27.211	4.131	1.255	15.224	1.684	13.166	2.017
TOTAL	0.201	32.006	14.357	2.079	26.025	2.674	33.977	14.888

Note: Loss on ignition (LOI), Not detected (ND), Maize corn peel ash (MCP), Rice stalk ash (RS), Guinea corn chaff ash (GCC), Yam peel ash (YP), Cassava peel ash (CP), Millet chaff ash (MCF), Groundnut stalk ash (GSK), Soya beans stalk ash (SS).

Oxides composition of ashes

On Table 4 , eleven metallic oxide of CuO, NiO, Fe_2O_3, MnO, Cr_2O, TiO_2, CaO, Al_2O_3, MgO, ZnO, and SiO_2 were determine whereas only MnO and NiO were not detected in any of the ashes. Metal oxides play a key role in environmental remediation and pollutant sensing and are also strategic in several other *applications* including nanoparticles forms of applications like; microelectronics, energy, storage, environmental decontaminations, gas sensing, ceramic fabrication, biomedicine, catalysis, etc. This is a clear indication that the organic parts of postharvest waste from agricultural crops could be use to produce these metallic oxides for the existing uses and potentia applications.

Conclusion

This study revealed minerals and oxide in ashes from postharvest residues waste of eight crops namely; Maize corn peel ash (MCP), Rice stalk ash (RS), Guinea corn chaff ash (GCC), Yam peel ash (YP), Cassava peel ash (CP), Millet chaff ash (MCF), Groundnut stalk ash (GSK), Soya beans stalk ash (SS) which are of great applications. This property has unveiled the possibilities for application of these ashes in diverse ways. It is obvious that postharvest residues or waste have some compounds and minerals for industrial use and environmental remediation applications. It is possible that such minerals will constitute properties like pH for remediation of soil, preservation of fresh fruits and etc.

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