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# YIELD, PHYSICAL CHARACTERISTICS AND MINERAL COMPOSITIONS OF ASH DERIVED FROMEMPTY PALM BUNCH MATERIALS

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**Abstract**
The study evaluated the yield, physical characteristics and mineral composition of ash derived from empty palm bunch samples collected from local oil mills located in the vicinity of Owerri, Imo state. The empty palm bunch were weighed and packaged into polythene bags until needed for ashing. About 20 kg sample of the dried palm bunch was weighed out, and burnt on a clean cement slab to avoid contamination. After proper combustion for about an hour, the remains (ash) was allowed to cool down, and thereafter gathered, weighed and sieved to ascertain the ash yield. Analysis of the physical characteristics of the palm bunch ash (PBA) such as the bulk density, water holding capacity, specific gravity, oil absorption capacity, total solids and the wettability were determined. Selected macro and micro mineral concentrations were also determined. Results revealed that the combustion of 50,000 g of palm bunch materials yielded 4.7% of PBA which is about 2350 g of the ash. The moisture content of the PBA was 10.18%. The Bulk density was 0.60 g/cm$^3$. The water holding capacity (WHC) of PBA was 7.34 g water/g ash. The Specific gravity value recorded in this study was 0.65 g/cm$^3$. An alkaline pH value of 10.5 was determined for the PBA. The quantitative order of minerals in the ash were K>Ca>P>Mg>Na>Mn>Fe>Zn>Cu>Pb>Cr. The Potassium had the highest concentration of 209,683.33 mg/kg. It is concluded that, ashing of empty palm bunch materials resulted in appreciable quantity of palm bunch ash production with quality macro and micro minerals concentrations for monogastrics and ruminant animal's nutrition.

**Keywords:** Ash, Palm bunch, Minerals, Monogastrics, Ruminants

## Introduction

Ash is simply the total mineral content of a diet or forage which is the left over fraction of a diet incinerated above 500ºC for two hours (AOAC, 1995). Ash from plant sources such as palm bunch materials could form a readily available dietary source of mineral supplement in animal ration since reports have shown that empty palm bunch materials are useful not only in terms of its combustive or biofuel value but also because of its high content of minerals (Ukwu, 2021). The biomass materials from which these ashes are derived are usually regarded as waste by farmers and processors, while very simple steps such as gathering, cleaning and open fire combustion are enough to produce them (Okonkwo, *et al*., 2018).

Reports from recent studies at our station have confirmed that plant ashes such as palm bunch ash (PBA) (Duruanyim, 2017), coconut shell ash (CSA) (Iwu, 2013), palm kernel shell ash (PKSA) (Ohanaka, 2016), plantain root ash (PRA), and plantain stalk ashes (PSA) (Nwogu, 2013) are rich in minerals, and could serve as sources of minerals for animals, and possibly humans by extension (Van Ryssen, 2018).

Since palm bunch ash has been found to be rich in many macro and micro minerals (Duruanyim, 2017), they hold a great promise as a source of mineral supplements to livestock nutrition in the tropics.

## Materials and method

**Collection and production of palm bunch ash**

About 20 kg sample of the air dried palm bunch was weighed out, and burnt on a clean cement slab to avoid contamination. After proper combustion for about an hour, the remains which is the ash was allowed to cool down, and thereafter gathered, and weighed to ascertain the ash yield. The ash was further sieved to obtain the finer ash powder according to the methods described by Okafor *et al*. (2018). The palm bunch ash (PBA) was packaged properly in cellophane bags to avoid water absorption since such ash has been shown to be hydroscopic (Iwu, 2013).

Analysis of the physical characteristics of the palm bunch ash

Bulk Density (BD), Water Holding Capacity (WHC), Specific Gravity (SG), Oil Absorption Capacity (OAC), Color Intensity, Total Solids, and Wettability were analyzed and determined.

Analysis of the chemical characteristics of the palm bunch ash

The samples were analyzed for their moisture, and dry matter contents as well as mineral concentrations according to the methods of AOAC (2010).

Mineral analysis using Atomic Absorption Spectrophotometer (AAS).The macro minerals analyzed included Ca, P, Na, Mg and K, while micro minerals were, MN, Fe, Zn, Cu, Co, Cr, and Pb. The pH of the palm bunch ash was also determined with the aid of a pH meter.

**Results and Discussion**

**Ash yield from the combustion of palm bunch**

Combustion of 50,000 g of palm bunch materials yielded 4.7% of palm bunch ash which is about 2350 g of the ash. The loss of 47,650 g of the palm bunch material out of the 50,000 g, represented about 95.30% of combustible materials.

**Physical characteristics of palm bunch ash (PBA)**

Table 1.0 highlights the physical characteristics of PBA. The moisture content at 10.18%, compares favorably with the 10.30% reported by Duruanyim (2017) for PBA.

The bulk density obtained (0.60 g/cm$^3$) is similar to the 0.65g/cm$^3$ reported by Duruanyim (2017), and the 0.65gcm$^3$ reported by Iwu (2013) for coconut shell ash. The variations in figures in all cases are probably reflections of variations in combustion efficiency, and also the intrinsic biophysical characteristics of the combusted biomass materials (Okoli, 2021).

Table 1.0 Physical characteristics of palm bunch ash (PBA)

| Parameters | Values |
|---|---|
| Moisture content (%) | 10.18 |
| Bulk density (g/cm$^3$) | 0.60 |
| Water holding capacity (g water/g ash) | 7.34 |
| Specific gravity (g/cm$^3$) | 0.65 |
| Oil absorption capacity(%) | 119.62 |
| Color intensity | 0.05 |
| Total solids (%) | 81.82 |
| Wettability | 0.00 |
| pH | 10.45 |

The specific gravity value recorded in this study is similar to 0.62 reported by Duruanyim (2017). The ash material produced from the palm bunch is therefore moderately dense, comparatively high in its water holding capacity, and exhibits average specific gravity. The oil absorption capacity result at 119.62% is much higher than the 91.67% reported by Duruanyim (2017) for palm bunch ash (PBA), while the color intensity (0.052), and wettability (0.00) results were similar. The pH value of the PBA is alkaline in nature, and is similar to the 10.80 reported for palm bunch ash by Adjei-Nsiah (2012), although lower than the12.40 and12.50 reported for plantain stalk ash, and plantain root ash by Nwogu (2013). It is however higher than

the 8.30 reported for palm kernel shell ash by Ohanaka (2016).

**Mineral concentrations in palm bunch ash:** The mineral concentrations in palm bunch ash are shown in Table 2.0. The order of mineral in the ash was K>Ca>P>Mg>Na>Mn>Fe>Zn>Cu>Pb>Cr. Akpakpan *et al.* (2012), Okonkwo, (2015), and Duruanyim (2017) also reported higher values of K in palm bunch and kernel ashes in agreement with the results from other biomass derived ashes such as coconut shell ash (Iwu, 2013), plantain peel ash (Duruanyim, 2017), plantain stalk and root base ashes (Nwogu, 2013) and kitchen ash (van Ryssen, 2018). Many plants are therefore natural accumulators of potassium in their shells, and other parts. Calcium, and magnesium concentrations were also very high in the palm bunch ash (PBA) although much lower than the K value. The three elements that predominate as electrolytes in chicken feed are K, Na and Cl and need to be supplied in adequate quantities in other to achieve the desired production goals in all classes of poultry (Mushtaq *et al.*, 2013). The dietary electrolyte balance [$(Na^+) + (K^+) + (CL^-)$] of diets containing high inclusion level of the PBA in its raw form will potentially be very high as a result of its high contents of K, and Na, leading to imbalance, and reduced palatability and intake of feed (Unamba-Opara *et al.*, 2017).

Table 2.0: Mineral characteristics of palm bunch ash (PBA)

| Parameters | Values |
|---|---|
| Calcium (mg/kg) | 55,503.00 |
| Phosphorus (mg/kg) | 30,150.00 |
| Sodium (mg/kg) | 15,766.67 |
| Magnesium (mg/kg) | 26,876.67 |
| Potassium (mg/kg) | 209,683.33 |
| Manganese (mg/kg) | 1,283.02 |
| Iron (mg/kg) | 1,038.92 |
| Copper (mg/kg) | 204.02 |
| Zinc (mg/kg) | 375.25 |
| Cobalt (mg/kg) | 0.00 |
| Chromium (mg/kg) | 4.57 |
| Lead (mg/kg) | 39.83 |
| Ca/P ratio | 1.84 |
| Na/K radio | 0.08 |

The very high value of K in PBA is also of interest because K is often called the alkalizer, and it neutralizes acids, and restores alkaline salts to the blood stream (Ohanaka, 2016). The PBA was also rich in micro-minerals such as Mn, Fe, Cu and Zn which have been implicated in various physiological functions. Dietary plant ash supplementations have specifically been shown to improve hematological profiles of poultry chickens to the effect of high concentrations of these micro-minerals (Nwogu, 2013; Ohanaka, 2016). The calcium/phosphorus ratio of 1.84 and sodium/ potassium ratio of 0.08 were calculated for the PBA obtained in this study. The Na/K ratio is much lower than the range of 2.09 – 3.85 reported for CSA by Iwu (2013), while the Ca/P ratio of 1:1.84 is normal since it indicates that for every gram of P supplied by the PBA, 1.84g of Ca is also supplied.

**Conclusion and Recommendations**

Ashing of empty palm bunch materials resulted in appreciable quantity (4.70%) of palm bunch ash (PBA) production with quality macro and micro minerals concentrations for monogastrics and ruminant animal's nutrition.

It is therefore recommended that more research be directed in the substitution of more expensive minerals and electrolytes with PBA in animal feed formulation. Since PBA has high potassium concentrations, it is also recommended that more studies be carried out on its use as a food/feed tenderizer and also as a blanching powder for anti-nutrient reduction in many animal feed materials in the tropics.

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