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Proximate Analysis and Functional Activities of African Pear Fruit *(Dacryodes edulis)* Grown in Makurdi, North Central Nigeria

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Abstract

Dacryodes edulis (African Pear Fruit) is an indigenous edible fruit that is used for both food and medicine in North Central Nigeria. The nutritional composition and functional properties of Dacryodes edulis were studied using standard analytical techniques. The fruits were analyzed for Physico-chemical characteristics (pH, Titratable acidity and Total insoluble solids), proximate analysis (Crude protein, Ash content, dry matter content), Mineral analysis (Se, Mn) and antioxidant activity (TBARS). The analyzers showed the results of the Pulp and Seed, respectively, as pH (7.12 ± 0.1, 5.92 ± 0.1), Tritatable acidity (0.068% ± 0.01, 0.143% ± 0.02), Total Insoluble Solids (11.68% ± 0.5, 24.92% ± 0.5), Crude protein (6.52% ± 0.4, 5.82% ± 0.4), Ash content (4.62 ± 0.01, 4.35 ± 0.01), Dry matter content (92.82% ± 0.05, 76.15% ± 0.05), Selenium (0.0247 ± 0.03, 0.0109 ± 0.03), Manganese (3.7852 ± 0.01, 1.4751 ± 0.1), TBARS (0.48 ± 0.02, 0.60 ± 0.02). The results revealed that values of Nutritional indicators were higher than the general thresholds for Pulp and Seed. While the non-nutritional values were, however, higher than pH, but lower in Tritatable acidity. The trace elements investigated showed the concentrations at minimum general ranges. Generally, the results of the fruit demonstrate high food application potentials with possible health benefits. This investigation highlights the necessity of conserving these fruits to present the depletion of this valuable resource. The identification of these wild species possessing medicinal properties underscores the significance of conducting further research or the sufficient nutritional and antioxidant activity of these wild fruits provide healthy food sources for the residents, just the same as many cultivated fruits and vegetables.

Keywords: *Dacryodes edulis*, functional properties, minerals, quality parameters, Vitamins, Minerals, Antioxidants

INTRODUCTION

Fruits are nature's gift to humankind. They are vegetal organs which grow from the flowers and cover seeds. Fruits are indeed important commodities in our daily diet since they formed part of life-enhancing medicines that contain Vitamins, Minerals, Antioxidants and many Plant-derived micronutrients called Phytonutrients [1].

Nutritionally, fruit and vegetables occupy the top position of healthy foods, and their regular consumption has a range of health benefits [2]. A closer chemical characterization of these fruits slowed an array of chemical compounds among which are capable of nutraceutical effects on Consumers [3].

Polyphenols are among several Phytonutrients embedded in these wild fruits which explain the links between their consumption and disease

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management [4]. With the new age of "The natural, the better", it becomes impermeable to explore some of these indigenous fruits for their phenolic contents and in-vitro antioxidant properties.

Phytochemicals also referred to as phytonutrients are found in fruits, vegetables, whole grains, legumes, beans, herbs, nuts and seeds are classified according to their chemical structures and functional properties [5].

The African Pear Fruit (*Dacryodes eludis)* is a native fruit to Africa, sometimes called "Ube" in Nigeria (Higgin, 2018). It is also known as Bush Pear or Plum. The main use of *Dacryodes eludis* is its fruit, which can be eaten raw, cooked in salt water or roasted [6].

The fruit comes in various shapes, texture, size, taste, weight and chemical compositions. The edible portion is made up of 22% Oils, 4% Protein, 5% Carbohydrate and 8.7% Dietary fiber.

Consumption of decocted part of the *Dacryodes eludis* in conjunction with other locally sourced herbs has been traditionally attributed to several therapeutic effects [7]. Similarly, enough intake of the fruit has been medicinally implicated in correcting visual impairment in diabetic patients. Other studies have shown in-vivo and in-vitro antioxidant and inhibitory effectiveness of the fruit's polyphenols against several digestive enzymes [8]. These functional properties of the plant have been attributed to its Polyphenolic compounds.

Although many pieces of research have been done on the nutritional health benefits of the African Pear fruit, yet there is the need for increased utilization and awareness about its health and nutritional and industrial benefits. This research work is aimed to justify pharmacological and nutritional attribute of African Pear fruit. However, combined proximate physicochemical and mineral analysis of this fruit has not been found in Literature. This informs the objectives of this study which is to investigate the proximate analysis, physicochemical analysis and mineral analysis. This study complements the existing information that could aid commercial production and eventual domestication of essential fruit.

MATERIALS AND METHODS

Sample Collection: Sampling and Sample preparation

The African Pear Fruits were purchased from Makurdi, Benue State, and North Central Nigeria. The plant fruits collected were identified and authenticated botanically in the Department of Plant Science and Biotechnology Laboratory, Federal University of Lafia and assigned the Voucher Number FUL/SC/PSB/H.LAB/0095 in accordance with [9].

The fruit samples were transported in a cool box to the Plant Science and Biotechnology where they were washed with clean tap water to remove dirt and dust. The clean fruits were then stored at –4℃ until analyses were carried out.

Figure 1. African pear (*Dacryodes edulis*).

Analytical Reagents

The reagents required to cover the entire analysis include: distilled water, sodium hydroxide solution, acetic acid, chloroform, potassium iodide, sodium thiosulphate, Starch solution, ethyl alcohol, Sodium hydroxide solution, 15% Potassium hydroxide solution, iodine solution, n-hexane, 2.5 mL of 1%

potassium ferrocyanide, Liquate of methanolic extract of each sample at 4 different concentrations: 0.1, 0.5, 1, and 2 mg/mL; sample and concentration, phosphate buffer solution at pH 6.6, incubator, 10% trichloroacetic acid, centrifuge machine and 0.1% $FeCl_3$, UV-30 spectrophotometer, methanol and Quercetin, acetic acid, chloroform, potassium iodide, sodium thiosulphate, Starch solution, ethyl alcohol, 15% Potassium hydroxide solution, iodine solution, test vials, extraction bottles, Beaker, n-hexane.

ANALYSIS OF PHYSICOCHEMICAL PROPERTIES

Physico-Chemical Non-Nutritious Indicators (Functional Properties)

Determination of pH

The pH of the Pulp and seed sampled extract of African Pear Apples will be determined using the AOAC (2010) method. It will be determined by measuring 10 ml of the extracts from the fruits sample into a dry 250ml beaker. Thereafter, the electrode of the digital pH meter (HI 96107 model) will be dipped inside the beaker containing the sample which will be left for 10 minutes, after it must have been calibrated using standard buffer solutions of pH 5.0 and 7.0. The electrode will be removed from the sample, and the reading will be taken accurately. This procedure will be repeated for the pulp and seed samples of Atili fruits, African star Apple fruits, Soursop fruits, *Raphia hookeri* fruits and Ackee fruit, respectively (AOAC, 2010)

Determination of Titratable Acidity

Twenty milliliters (20 ml) of the extract samples from the pulp and seeds of African pears, respectively, will be pipetted and transferred to a cleaned conical flask, followed by 3 drops of phenolphthalein indicator and will be carefully swirled together. The burette will be filled with 0.1N NaOH solution and will be titrated against the extract sample. The end point when the solution turned pink will be recorded. The titratable acidity will be calculated using the formula below:

% Acidic Content = mL of Sodium Hydroxide Used x *0.1 N Sodium Hydroxide* x *0.064.*

This procedure will be repeated for the pulp and seed samples of Atili fruits, African star Apple fruits, Soursop fruits, Raphia Hookeri fruits and Ackee fruit, respectively.

Total Insoluble Solids

Determination of Moisture Content of African Pear Fruits

Moisture and Ash. Moisture and Ash content of selected samples will be determined by adopting AOAC (2004) method. First weight of empty crucible with cover (previously dried at 100 °C for 1 hour) will be taken and 3 g of sample will be placed into it. Then the crucible will be placed in an air oven (thermostatically controlled) and dried at temperature of 105ºC for 24 hrs. After drying, the crucible will be removed from the oven and cooled in desiccators. Drying, cooling and weighing will be performed repeatedly until the two consecutive constant weights attained. The moisture content of the rice sample will be calculated by applying the following equation:

Moisture content (g%) = $A - B$ / W × 100

where, A = Initial weight of crucible and sample, B = Final weight of crucible and sample, W = Weight of sample. This procedure will be repeated for the pulp and seed samples of Atili fruits, African star Apple fruits, Soursop fruits, Raphia Hookeri fruits and Ackee fruit, respectively.

Determination of Ash Content

The ash content is a measure of the inorganic residue that remains after a sample is completely burnt and is calculated as percentage ash content. It will be determined using the weight reduction method (AOAC, 2010). It will be determined by weighing 10 ml of the African pear fruits' pulp and seed samples separately into a dry pre-weighed crucible. This will transfer to a muffle furnace at 500°C and

will be allowed to spend 3 hrs to burn off the nutrient and fiber present in the juice to obtain white ash in the crucible. After ashing the sample, the ash will be allowed to cool and will be weighed to access the values required for its calculation using the expression below.

$$\% \, Ash \, Content = \frac{Ash \, content}{Mass \, of \, the \, sample} \text{ x } 100$$

This procedure will be repeated for the pulp and seed samples of Atili fruits, African star Apple fruits, Soursop fruits, Raphia Hookeri fruits and Ackee fruit, respectively. Ash content of selected sample will be determined adopting AOAC (2004) method. Clean, dry and empty crucible will be taken and weighed with the help of electrical balance. Three grams of each sample will be weighed out upon polythene paper and will be poured into the crucible. The crucible with the samples will be kept in an electrical oven at a temperature of 105°C for 24 hours. After drying, the crucible will be transferred to the muffle furnace and will be ignited at 600°C for 5 hrs. After burning, the crucible will be removed and cooled in desiccator and subsequently weighed the crucible and ash. Ash content of the rice samples will be calculated by applying the following equation:

Ash content (g%) = $A - B$ / W x 100

where, A = Final weight of crucible and sample, B = Weight of empty crucible, W = Weight of sample. This procedure will be repeated for the pulp and seed samples of Atili fruits, African star Apple fruits, Soursop fruits, Raphia Hookeri fruits and Ackee fruit, respectively.

Determination of Protein Content in African Pear Fruits

Protein content was determined by adopting AOAC (2004) method. Two grams of sample, 3 g digestion mixture and 25 ml H_2SO_4 were taken in a Kjeldahl digestion flask. It will be heated for 4 hours in Kjeldahl digestion and distillation apparatus. If the color of the substance is pale yellow the digestion is complete [10]. Following distillation, the ammonia collected will be titrated with 0.1N HCl solution and titer value will be recorded. The percentage of protein content in the sample will be computed using protein factor 5.7 as follows.

%Nitrogen = [(TS −TB) × Normality of acid × meq. N 2 / $weight \; of \; sam$] × 100

where, TS = Titer value of the sample (ml), TB = Titer value of the Bank (ml), Meq. of N2 = 0.014% protein = % Nitrogen × 5.7

This procedure will be repeated for the pulp and seed samples of Atili fruits, African star Apple fruits, Soursop fruits, Raphia Hookeri fruits and Ackee fruit, respectively.

DRY MATTER COMPOSITION OF AFRICAN PEAR FRUITS

Minerals Composition of African Pear fruits

This was carried out after the digestion of samples: Analysis of the minerals of rice will be carried out with inductively coupled plasma optical emission spectrometer (ICP–OES) after digestion with nitric acid. For these purposes, approximately 2.0 g of dehulled African Pear pulp will be weighed accurately and transferred into a digestion flask, to this 5.0 mL nitric acid HNO3 (conc.) will be added [11]. The flasks will be subjected to preliminary digestion by heating on a heating chamber at temperature of 80–90ºC for about 2 h. The temperature will then be raised to 170–180ºC and during this second phase of heating 3–5 mL of each of the hydrogen peroxide (H2O2) and sulphuric acid (concentrated) were occasionally added and heating continued until the whole organic matter completely digested/oxidized [12]. The digested material will be transferred to a 50 mL measuring flask, and the volume will be made up to the mark with deionized water (FAO, 2002). The analytical solutions thus obtained will be analyzed analyzed by inductively coupled plasma optical emission spectroscopy

(ICP–OES). The concentration of sodium and potassium will be determined using flame photometer [13]. Primary standard solutions of Na, K, Mg, Ca, Fe, Mn, Zn, Cu, Al and Cr, will be prepared and diluted successively to obtain required series of solutions for construction of standard calibration curve. The operational parameters for ICP–OES instrumental analysis will be used to calculate the mineral composition of the samples [14]. This procedure will be repeated for the pulp and seed samples of Atili fruits, African star Apple fruits, Soursop fruits, Raphia Hookeri fruits and Ackee fruit, respectively.

RESULTS AND DISCUSSION

The Pulp and Seed are acidic, but the Seed is slightly more acidic. The pH values of fruits are indicators of its organic acid content, hence an important parameter in determining fruit quality [15]. The acid content present in fruits can serve as an index for detecting maturity stage for fruits and can potentially be a key analytical measurement for evaluating flavor quality [16]. This measurement can also be utilized to determine the ripening age of the fruit and assist in determining the optimal harvesting time (Table 1).

Table 1. Proximate composition, mineral analysis and functional activities of pulp and seed of African pear fruit.

Parameter	Concentration	
	Pulp	Seed
Ph	7.12 ± 0.1	5.92 ± 0.1
Titratable Acidity (%)	0.068 ± 0.01	0.143 ± 0.01
Total Insoluble Solids (%)	11.68 ± 0.5	24.92 ± 0.5
Crude Protein (%)	6.52 ± 0.4	5.82 ± 0.4
Ash Content	4.62 ± 0.01	4.35 ± 0.01
Dry Matter Content (%)	92.83 ± 0.05	76.15 ± 0.05
Selenium (mg/100g)	0.0247 ± 0.03	0.0109 ± 0.03
Manganese (mg/100g)	3.7852 ± 0.01	1.4751 ± 0.01
TBARS (mgMDA/kg)	0.48 ± 0.02	0.60 ± 0.02

Titratable Acidity (TTA) is an indicator of the Total Acid Content, related to pH and fruit maturity, influencing taste and preservation. The TTA values obtained for Pulp (0.068%) and Seed (0.143%) is low compared to general range of (0.98%–2.12%) expressed as Citric acid Concentration. The low TTA values imply a higher pH reduced natural preservation capabilities of shorter shelf life increase perishability and potential impact on Sensory qualities.

The Total Insoluble Solids of Pulp (11.68%) and Seed (24.92%) refer to Total Suspended Solids. This implies a reduced amount of dietary fiber, which is important for digestive health. The low Total Insoluble Solids are primarily associated with a reduction in a healthy Fiber Content.

The values of Crude Protein, Pulp (6.52%) and Seed (5.82%) are lower values compared to other sources which might depend on processing of example, dry meal. This is an indication that fruit is a poor source of protein for human nutrition and animal feed [15].

The Ash Content of Pulp (4.62%), and Seed (4.35%) is related to the Mineral. (16). Composition of the fruit. The values also suggest poor sources of essential minerals such as K, Ca, Na, Mg and P. The low ash (and Crude fiber) values are considered important indicators in terms of the suitability of the fruit cake for compounding animal feeds [16].

The Dry matter Content of Pulp (92.82%), and Seed (76.15%) are high compared to general range of values. Dry matter is influenced by moisture content, which is high in fresh fruit. This suggests a higher concentration of nutrients per unit of weight, including fats (oils), protein and minerals. High Dry Matter often correlates with high oil content in the Pulp, and improving storage stability (FAO/WHO, 2004). The mineral element composition (Mg/100g) of the Pulp and Seed reveal the presence of Selenium; Pulp

(0.0247), Seed (0.0109); while the concentration of Manganese, Pulp (3.7852), Seed (1.4751). Selenium and Manganese are Trace elements. The low concentration of these minerals affects its nutritional value for human consumption and the plant's ability to tolerate environmental stresses. Manganese functions as a cofactor for several enzymes, such as arginase, pyruvate, and carboxylase, is also required for the formation of bone, proper reproduction and normal function of the nervous system [12].

Thiobarbituric Acid and Reactive Substances (TBARS) are typically used as an indicator of antioxidant activity. Though no specific range is documented in literature, however, a low level of oxidation means the pulp and oil are fresh and safe for consumption or industrial use [11].

CONCLUSION

The study or highlights further information the Physicochemical, Proximate, Mineral analysis and antioxidant property of Pulp and Seed of *Dacryodes eludis* (African Pear Fruit). The quality properties of the fruits provide an indicator to expand their production and utilization. It shows promises for sustainable applications in animal feed and as a source of bioactive compounds for pharmaceutical development. The research provides valuable information that could be utilized to promote consumption of these fruits and to develop strategies to preserve their diversity and cultural significance. The study recommends conducting clinical trials to assess their safety and efficacy as well as exploring their potential for use in traditional medicine and as a source for natural health promoting compounds.

The results suggest that consumption of fruit thus enhances human nutritional requirements. Except for pH, Dry matter Content values of Crude Protein, Ash Content, Titratable Acidity, Se, Mn, Total Insoluble Solids and TBARS were slightly lower. This information is essential for the formulation and production of healthier food and medicinal products.

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