NIGERIAN AGRICULTURAL JOURNAL
ISSN: 0300-368X
Volume 53 Number 1, April 2022 Pg. 91-102
Available online at: http://www.ajol.info/index.php/naj
https://www.naj.asn.org.ng

Effect of Different Drying Method on the Quality Characteristics of African Pear (*Dacroydes edulis*) Mesocarp Flour

***Onwuzuruike, U. A., Iguh, B. N., Uzochukwu, U. C. and Ezuma, V.**

[*]Department of Food Science and Technology, College of Applied Food Sciences and Tourism, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria
*Corresponding Author's email: iguhblessing29@yahoo.com

Abstract
The effect of different drying methods (sun drying, oven drying, microwave drying and Toasting) on the quality characteristics of African pear (*Dacroydes edulis*) mesocarp flour was investigated and assessed for functional, proximate, mineral, dietary fibre, vitamin compositions and peroxide value. Toasting gave better functional properties. Sun dried samples had the highest fat (32.44%), protein (13.25%) and moisture content (10.03%), while toast dried samples had the highest crude fibre (1.26%) and carbohydrate (48.28%) contents. Microwave dried samples recorded the highest concentration of minerals with respect to calcium (0.03 - 0.05 mg/100 g), magnesium (0.02 - 0.03 mg/100 g), iron (0.00 - 0.01 mg/g), sodium (0.00 - 0.01 mg/100 g) and potassium (0.06 - 0.09 mg/100 g) contents. Oven dried samples had the highest total dietary fibre (2.66%) and insoluble dietary fibre (1.79%), while sun dried samples had the highest soluble dietary fibre (0.93%). Sun drying resulted to samples with better vitamin contents; pro-vitamin A (1.06 mg/100 g), vitamin C (8.86 mg/100 g), vitamin E (197.00 mg/100g) and lowest peroxide value (2.99 meq O_2/kg). Therefore, African pear mesocarp can be dried using different drying methods with respect to the desired properties of the end product.

Keywords: African pear, Drying methods, Flour, Mesocarp, Quality characteristics

Introduction

African pear (*Dacroydes edulis*) belongs to the family *Burseraceae.* In this family, there are resinous trees and shrubs with alternate leaves composed of many leaflets. According to Jecinta *et al*. (2015), they are of the order *Sapindales*, subclass *Rosidae* and class *Magnoliopsida.* African pear is a fruit tree native to Africa, sometimes called *Safou* (Cameroon), *Atanga* (Gabon), *Ube* (Nigeria) (Wikipedia, 2020). African pear tree can attain heights of 18-40 meters in the forest but generally not exceeding 12 meters in plantations and it is an evergreen tree. It generally has low branches and has a dense crown (Ajibesin, 2011). Although the preferred habitat for African pear is shady, humid tropical forests, it adapts well to changes in soil type, humidity, temperature, and day length. The fruit is the major part utilized for food and it is widely used among Yoruba and Igbo speaking people of Nigeria (Conrad, 2012). It can be eaten alone or with a number of other foods. It has been touted to have medicinal properties and locally, the plant has been used alone or combined with other plants to treat some illnesses and diseases some of which include malaria, dermatological issues, oral and ear conditions, hypertension, leprosy, labor pain, retarded growth and epilepsy in children (Conrad, 2012). African pear has some socio-cultural and religious uses in some areas where it is viewed as a symbol of fruitfulness, and of peace. In such areas the plant parts are used for both religious and socio-cultural activities including warding off evil spirits, worship of gods, communal festivals, marriage and naming ceremonies (Conrad, 2012). Other sectors where the plant has been very useful include in carpentry, road and shelter construction. According to (Ajibesin, 2011) exudates from the stem act as glue, and can be used for production of cosmetics alongside the fruit oil. African pear has the potential to boost food security as it rich in edible oil and other essential food nutrients (Ajibesin, 2012). Improved cultivation and utilization of the plant can foster rural development by improving the economic status of local farmers and support sustainable land-care. The most utilized part of the African pear plant is the fruit, which can be eaten raw, cooked in salt water or roasted. Cooked flesh of the fruit has a texture similar to butter. The pulp contains 48% oil. The fat content of this fruit is higher compared to fruits such as apple, guava and pawpaw (Omogbai and Ojeaburu, 2010). Kengue (2011) reported that it is highly perishable with a shelf-life of 2-3 days after harvest at ambient conditions. It is mostly consumed after roasting or boiling with little or no commercial value. Processing it into other forms which will improve its utilization, industrial value, reduce postharvest losses and make African pear derived product available all year round. Poor harvesting, handling and storage of the fresh fruit is complicated since value chain actors have limited knowledge and resources to ensure product quality and increased shelf life (Ndindeng *et al.,* 2012). Production of flour from African pear will be an alternative way of prolonging its shelf life. However, some drying procedures are believed to accelerate the process of product rancidity, therefore, it is necessary to investigate the best drying method that would be suitable for obtaining flour from African pear fruit with the intent of creating valuable raw materials for domestic and commercial purposes.

Materials and Methods

Source of raw materials

African pear fruit used for this study was procured from Ubani market in Umuahia, Abia State. All reagent used for the analytical procedures were procured from a certified stock dealer at Aba, Abia State, Nigeria.

Preparation of raw material

African pear fruits were cleaned and sorted to remove undesirable ones, washed, and the seed removed. The fruits were cut into small pieces to aid drying and was divided into four different parts and oven dried [(61.6°C for 30 min; hot air oven (Model No.SX3-4.5-15: made in China) (Figure 1)], sun dried [(28 - 30°C for 27 h) (Figure 2)], toasted [(93°C for 10 min) (Figure 3)] and microwave-dried [(950 MHz for 15 min; Midea microwave oven (Model No. MM720 CA-7 PM: made in China) (Figure 4)] (Arinola *et al.,* 2016). The dried samples were allowed to cool to 25°C, milled into flours using a hammer mill and sieved using 500 µm mesh size. Codes for each sample are represented as SD for sundried samples, OD for oven dried samples, TD for toast dried samples and MWD for microwave dried samples.

Figure 1: Sundried sample

Figure 2: Oven dried sample

Figure 3: Toast dried sample

Figure 4: Microwave dried sample

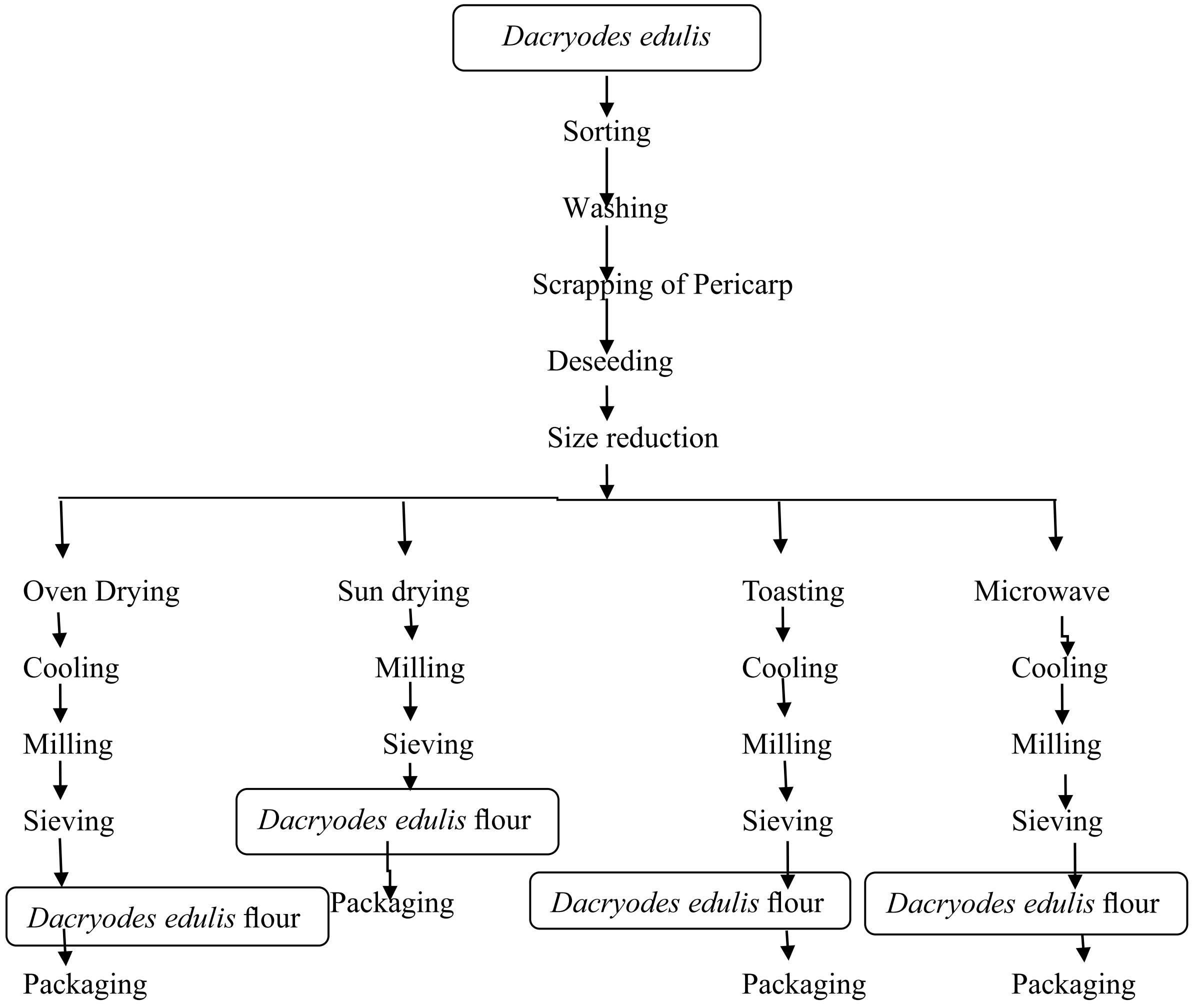

Figure 5: Flow chart for African pear flour production.

Determination of Functional Properties

The bulk density, water absorption capacity, oil absorption capacity, swelling index, gelation temperature and wettability were determined using the method described by Onwuka (2018). Foam capacity was determined as described by Coffman and Garcia (2017). All functional properties were determined in triplicates.

Proximate Analysis

Moisture and ash contents were determined according to the method of AOAC (2010). Crude fiber was determined using the method described by Onwuka (2018). The micro Kjeldahl method as described by AOAC (2010) was used to determine crude protein. Soxhlet extraction method described by AOAC (2010) was used in determining the fat content of the samples. Carbohydrate content was determined by difference.

Mineral Content Determination

The mineral contents were determined by the dry ash extraction method described by AOAC (2010). The EDTA titrimetric method of AOAC (2010) was used to determine calcium and magnesium. O-phenanthroline method was used to determine iron. Sodium and Potassium was determined by flame photometry as described by AOAC (2010).

Determination of Vitamins

The pro-vitamin A was determined by the method described by AOAC (2012), while vitamin C and vitamin E was determined by the method described by Onwuka (2018).

Dietary Fibre Determination

The total dietary fibre, soluble dietary fibre and insoluble dietary fibre were determined by the method described by AOAC (2012).

Determination of Peroxide Value

The peroxide value was determined by the method described by Ankapong (2010).

Statistical Analysis

The experimental data was expressed as mean ± SD (standard deviation). The data was subjected to one-way analysis of variance (ANOVA), while the Duncan Multiple Range Test (DMRT) method was used to compare the means of experimental data at 95 % confidence interval when a significant difference was observed from the One-way ANOVA. All statistical analysis was done using the Statistical Product of Service Solution version 20.0 software (Iwe, 2014).

Results and Discussion

Functional properties

The results of functional properties of differently dried African pear *(Dacroydes edulis)* mesocarp flour samples are presented in Table 1**.** Bulk density access the suitability of a flour to be easily packaged in order to facilitate the transport of a large amount of food (Oppong *et al.,* 2015). Nutritionally, low bulk density promotes the digestibility of food products, especially in children because of their immature digestive system. It has been reported that bulk density is influenced by the structure of the starch polymers and loose structure of the starch polymers could result in low bulk density (Malomo *et al.,* 2012). The value of bulk density ranged from 0.71 g/mL to 0.75 g/mL. Except TD, no significant difference ($p<0.05$) existed among the samples, possibly because the particle size of SD, OD and MWD may be smaller than that of TD. The result obtained using the aforementioned drying techniques are comparable to values (0.65- 0.78 g/mL and 0.68-1.07 g/mL) reported by Oppong *et al.* (2015), for sun dried and oven dried African pear mesocarp flours respectively, but higher than the values (0.55 g/mL and 0.57 g/mL) reported by Siddiq *et al.* (2010), for sun dried and microwave dried flours respectively. Low bulk density is advantageous for the infants as both calorie and nutrients density in enhanced per feed of the child (Onimawo and Egbekun, 2018). The findings of this study showed that, African pear mesocarp flour samples have low bulk density which suggested their possible suitability for infant food formulation.

Water absorption capacity is the ability of flour to absorb water and swell for improved yield and consistency during food preparation. High water absorption capacity had been reported to improve yield and consistency, and give body to food (Onimawo and Egbekun, 2018). Apart from starch, non-starchy component (fibre, protein and fat) of flour also contribute to water absorption capacity. There was significant difference ($p < 0.05$) in the water absorption capacity of the samples which may depend on the amount and nature of hydrophilic constituents (Seena and Sridhar, 2015). The increased WAC in TD may have been attributed to the effect of critical loss of moisture which increases hygroscopic potentials of flour if exposed to moisture. The values obtained for OD was lower than 7.6 mL/100 g reported by Siddiq *et al*. (2010) for flour dried in the oven at 70°C for 14 h. Water absorption capacity of 1.25 g/g (125 mL/100 g) and above is an indication of good bakery properties that required high water imbibition (AOAC, 2000a). Hence, African pear mesocarp flour samples may not give improved yield, consistency and body to food products that require high water absorption. However, the results obtained suggests that African pear mesocarp flour samples may be desirable for dough used in the production of biscuit, sausages, minced pie as these products incorporate water without dissolution of protein thereby attaining body thickening and viscosity (Sengev *et al.,* 2012).

Oil absorption capacity (OAC) measures the ability of food material to absorb oil. The OAC is an important property in food formulation because fats improve the flavor and mouth feel of foods. They are also important because of storage stability in the rancidity development (Siddiq *et al.,* 2010). SD had the lowest value (22.26 mL/g) while TD had the highest value (28.12 mL/g). The difference in oil absorption capacity observed in the flour samples depends on the intrinsic factors such as protein conformation, amino acid composition, and surface polarity or hydrophobicity (Suresh and Samsher, 2013). The oil absorption capacities of OD (26.11 mL/g) and SD (22.26 mL/g) were comparable to 26.91 mL/g and 21.94 mL/g respectively for pigeon pea flours reported by Oppong *et al.* (2015). High oil absorption capacity observed in the flour samples indicate desirable flavor retention ability and palatability. Foams are used to improve texture, consistency and appearance of foods (Akubor and Badifu, 2014). The foaming capacity (FC) of the flours samples ranged from 5.03 mL/g to 6.19 mL/g. TD had the highest value while SD had the lowest value. The difference could be attributed to protein quality in the flour samples, since FC is assumed to be dependent on the configuration of protein molecules. Flexible proteins have good foaming capacity, but a highly ordered globular molecule gives low foaming ability (Timothy and Bassey, 2019), hence, the different forms of drying may have affected the flexibility of the protein molecules differently. The values obtained in this study are lower than 60% and 80% reported for wheat flour and African breadfruit kernel flour (Akubor and Badifu, 2014) respectively. Good foam capacity and stability are desirable qualities for flours used for the production of various baked products. Food products such as cakes, sponges, ice creams, marshmallows, whipped creams, and bread require food ingredients with high foaming capacity (Atuonwu and Akobundu, 2010). However, food ingredients with low foaming capacity like African pear flours may suitably be applied in biscuits, crackers, and cookies (Borja *et al.* 2013).

Wettability is a measure of reconstitution of flour in water. The flour samples had wettability values ranging from of 117.50 mL/g to 124.50 mL/g with SD having the highest wettability. TD showed significantly ($p<0.05$) low wettability than SD, OD and MWD. These findings is in agreement with the findings of Tagodoe and Nip (2014) who reported that toast dried flour samples had lower wetting time compared to oven dried, sun dried and air dried flour samples of taro starch. This implies that TD would reconstitute slower than SD, OD and MWD in water. There was no significant ($p<0.05$) difference in the wettability capacity of the OD, SD and MWD. The low wettability observed in the TD is most likely due to the effect of temperature on the gelatinization of flour which occurs typically in the range of 53 to 64°C (Fennema, 2016) and the interaction between starch and water proteins which can form films when heated (Potter, 2016). The lower wettability observed in TD indicated that it may be a very useful raw material in making dough for bread and biscuit production. Swelling power show the degree of exposure of the internal structure of starch granules to action of water, that is, a measure of hydration capacity (Arinola *et al.* 2016). The results of swelling power in the present study indicated that the different drying methods caused slight aggregation of starch granules to different degrees and subsequently affect the level of its exposure to water and its swelling power. The swelling index value ranged from 1.01 to 1.18. SD flour had the highest swelling index value, probably because heating produces higher amount of insoluble material and so results in a low water retention feature (Varo *et al*., 2007). Hence giving OD, TD and MWD lower swelling index. A simple correlation was observed between swelling index and drying temperature, the lower the drying temperature the higher the swelling index. The result is in disagreement with the report of Suresh and Samsher (Suresh and Samsher, 2013), who reported increase in swelling capacity with increase in drying temperature. The swelling capacity (index) of flours are influenced by the particle size, species variety and method of processing or unit operations (Suresh and Samsher, 2013). The high swelling power in SD suggested that it could be useful in food systems (spaghetti, noodles) where swelling is required. Swelling index provide suitable predictive method for identifying noodle-quality flours. The values obtained in this study are higher than 0.53 to 0.71 g/mL recommended for wheat flour (Eastern African Standard, 2011).

Gelatinization temperature (GT) is the critical temperature at which about 90% of the starch granules have swelled irreversibly in hot water and start to lose crystallinity and birefringence (Khush *et al.,* 1998). The lower the GT the better the gelation ability of the protein ingredient (Akintayo *et al.,* 2011). The gelatinization temperature of samples varied from 62.35 to 73.45°C with SD having the lowest value while TD had the highest value. The result is in agreement with the findings of Rwubatse *et al.* (2014), where increase in gelatinization time with increase in drying temperature was reported. Flour with low value of least gelation concentration could be a good thickening agent, hence, SD may exhibit better gelling potential than other samples and may find more use in food applications such as pudding production that require significant thickening since the gel structure of such food systems provides a matrix for retaining moisture, fat and other added ingredients.

Proximate Composition

The results of proximate composition of differently dried African pear *(Dacroydes edulis)* mesocarp flour samples are presented in Table 2. The moisture content of the samples ranged from 8.36 to 10.03% with TD flour having the lowest moisture content while SD had the highest. The lower moisture content of the TD could be due to effect of heat on the samples during drying, since moisture content decreased with increased drying temperature. This is essentially due to thermal decomposition of biomass in absence of oxygen, or air. Generally, the moisture content of all studied samples were lower than the maximum limit (15.50%) for moisture content of flour according to FAO (2014) which makes the flour safe. Food products with high moisture content are susceptible to microbial attack as well as spoilage and therefore have limited shelf life (Hassan and Umar, 2014). Although, the studied flour samples had low moisture content, however, the moisture content of TD suggested that African pear mesocarp flour samples that have been dried through toasting may have better shelf stability. Fat contributes to the total energy content of a food product. Hence, its value is important in estimating the caloric value of a food product (Savage *et al.,* 2012). The fat content of the flour samples ranged from 29.84 (TD) to 32.44% (SD).

It has been suggested that oxidation of linoleic and linolenic acid as a result of direct heat decreases crude fat content during processing (Lilja and Lingert, 2011), hence the lower fat content of TD. The fat content obtained in this study was higher than the findings of Ondo-Azi *et al.* (2013) who reported 11.29% and 12.17% of lipid contents in safou (African pear) flour from Nigeria and Gabon, respectively and the values (1.50 to 3.90%) reported by Adepoju et al. (Adepoju *et al.,* 2012). The high fat content of the flours indicated low stability against rancidity via lipolytic reactions, especially SD and needs to be used fresh, and stored properly. However, the high lipid content of the samples suggested that the samples may have the capability of serving as a viable vehicle for fat soluble vitamins as well as improving mouth-feel, caloric level and palatability of the biscuit samples.

The ash content of a food product is an indication of its mineral content and quality. The ash content of the samples ranged from 1.90% (TD) to 2.52 % (OD). The differences in the mean ash content for all the flour samples were not significant. The ash content of 1.56 to 2.98% reported by Sefa-Dede and Agyr-Sackey (2014) for African pear flour vary from that reported in the present research. Based on acceptable standard (0.48 to 0.54%) published by Didier (2011) for baking flour, African pear mesocarp flour ash content may be considered to be high. Also African pear mesocarp flour contains more of the germ and outer endosperm which contains appreciable mineral content as evident in the obtained result. Hence, African pear mesocarp flour may yield bakery products that are a bit darker in colour.

A significant difference in crude fiber content ($P<0.05$) was observed among the flour samples. The crude fibre content ranged from 1.02% for OD to 1.26% for TD. The variation in crude fibre content during the heating process can be attributed to formation of Maillard reaction products thus adding to the lignin content, and formation of resistant starch fractions. Agunbiade *et al.* (2015) reported 10% of the crude fiber in wheat flour. This result is higher than the value obtained in the current study. The crude fiber in the flour samples is lower than 1.5% which is a maximum allowable fiber content of bread flour as stated by Omole (2017). The crude fibre of African pear flour is within the allowable limit and may be suitable for bread making since it was within the recommended daily intake of 0.25% per day. Fibre has been reported to offer a variety of health benefits and is essential in reducing the risk of chronic diseases such as diabetes, obesity, cardiovascular diseases and diverticulitis. Crude fiber benefits people by aiding in peristalsis movement of foods, helping in bowel movement, lowering blood cholesterol, and reducing the risk of colon cancer (Akubor and Badifu, 2014). The result obtained suggested that TD may provide better dietary needs of the body.

The crude protein content of the flour samples ranged from 10.36 to 13.25%. Ojo *et al*. (2014) studied the protein content in different types of drying and detected no significant difference between SD (13.25%) and OD (11.56%) and MWD (11.71%). The crude protein of the flour samples studied was similar to values reported in literature for wheat flour (10.23-14.70%) (Oppong *et al.* 2015) but higher than the values obtained for banana flour (2.78%) (Ezeokeke and Onuoha, 2016), and cassava flour (0.56-1.26%) (Maziya –Dixon *et al*., 2015). The high protein content implied that the flour samples might be able to contribute significantly towards achieving the daily human protein requirements, usually about 23-56 g as recommended by FAO/WHO/UNU (1994). Based on the recommended protein content for flour (Cake and Pastry Flour: 7 – 9 % protein, All-Purpose Flour: 10 – 12%, protein Bread Flour: 12 – 16% protein, Whole-Wheat Flour: 16% protein), SD may be best suited for bread production (Oppong *et al*. 2015).

The carbohydrate content of the flour samples ranged from 45.26 to 48.28%. These values are lower than the FAO recommended carbohydrate content (73.3%) for flour (Ghosh *et al*., 2015) as well as lower than that of banana flour (76.68%), maize flour (71.87-85.64%), cassava flour (75.50-75.90%) and millet flour (89.19%) (Adebowale *et al*., 2011) but higher than 26.14% reported by Ezeokeke and Onuoha (2016) for soy bean flour and 13.10% reported by Hart *et al.* (2016) for African pear flour. The relatively high carbohydrate content indicate that the mesocarp flour samples may be good source of energy for the body.

Mineral Composition

The results of mineral composition are presented in Table 3. Calcium is important mineral in the formation of teeth and bones. The calcium (Ca) content ranged from 0.03 to 0.05 mg/100g. There was no significant differences ($p<0.05$) in the calcium content of OD and MWD. The calcium contents of the samples are considerably low and below the recommended calcium daily intake of 525 mg for infants, 450 mg for children, 700 mg for adults and 1250 mg for lactating mothers as well as below those obtained by Pamela *et al*. (2012) (74.0 to 229.2 mg/kg). The drying methods did not significantly influence the calcium content of the samples except sample TD which showed significant difference with other samples. The flour samples in this study should be used in combination with other flour products with appreciable calcium content to make up for the lack.

Magnesium is an essential component of all cells and is necessary for the functioning of enzymes involved in energy utilization and it is present in the bone (Ayuk *et al*., 2019). The magnesium content ranged from 0.02 mg/100g for TD to 0.03 mg/100g for OD, SD and MWD flour samples. This is lower than the value obtained for cassava flour 0.89 to 2.76 mg/100g (Adepoju *et al*., 2012. Soya flour contain more than 500 mg/kg while fruits flours contribute little dietary magnesium (<100 mg/kg) (FAO, 2014). The low values suggested that the flour samples are not good sources of magnesium and can be composited with flours with high magnesium contents.

Iron is required for the synthesis of hemoglobin and myoglobin, which are oxygen carriers in the blood and muscle respectively. Very low iron content (0.01 mg /100 g) was observed in the OD, SD and MWD while no iron was found in the TD. The iron content of the flour samples (0.00-0.01 mg /100 g) was lower than that of cassava flour (32 mg/100 g) (FAO, 2014) and below the recommended daily allowance of iron which is between 8-18 mg /100 g as stated by National Academy of Science (National Academy of Sciences, 2014) and may not contribute significantly to the dietary iron needs of the body.

Sodium is important in the maintenance of osmotic balance between cells and interstitial fluids. High intake of sodium increase the risk of hypertension (Soetan *et al*., 2010). The sodium content of the flour was not affected by any of the drying methods thus there was no significance difference among the sodium contents of African pear flour. While the MWD had 0.01 mg/100g sodium content, no sodium content was found in the other flour samples. Consequently, the values obtained are lower than that of cassava flour (0.36-0.50 mg/100g) as reported by Charles *et al*. (Charlse *et al*., 2015) and lower than the <2 g/day sodium (5 g/day salt) in adults recommended by WHO (2018). The low sodium content might be beneficial since low sodium diet has been reported to be beneficial in the prevention of high blood pressure (Onwuka, 2018).

Potassium is necessary for the normal functioning of all cells. It regulates the heartbeat, ensure proper function of the muscles and nerves. However excessive intake of potassium may upset homeostatic balance and cause toxic side effects (Parr *et al*., 2012). The potassium content of the samples ranged from 0.06 to 0.09 mg/100g. There was significant difference ($p<0.05$) among the samples with respect to their drying methods. These values were higher than that of tigernut flour (0.50 mg/100g) and white maize flour (0.32 mg/100g) (Shaista *et al.*, 2017).

Dietary Fibre Composition

The result of dietary fibre of the differently dried African pear mesocarp flour is presented in Table 4. Total dietary fibre (TDF) of the flour samples ranged from 2.33% to 2.66%. The flour samples differed significantly ($p<0.05$) from each other relative to the drying method. Notably, drying processes involving higher temperature resulted to samples with increased total dietary fibre (Elluech *et al*., 2011). Consequently, SD had the lowest value while OD and TD had the highest value. The increase of TDF with increased temperature can be due to fragmentation of polysaccharides because of increased thermal heating and/or precooking process. Thermal treatments such as (oven drying, microwave drying or toasting resulted in an increase of total fibre that is not due to new synthesis, but rather to the formation of fibre-protein complexes that are resistant to heating and are quantified as dietary fibre (Caprez *et al*., 2016). The total dietary fibre of the African pear flour samples were within the recommended limit (0.53–2.50%) per day per person and may be beneficial towards enhancing the dietary fiber of other foods or by aiding in the formulation of diets for people with diabetes.

TD and OD had higher TDF which suggested that, the TDF of African pear flour samples can be improved by employing oven drying and toasting methods as a choice of drying. Soluble dietary fibre of the flour samples ranged from 0.87% to 0.93%. SD had the highest soluble dietary fibre content while the TD and OD had the lowest. The content of soluble dietary fibre in this study did not change significantly for the OD, TD and MWD, which suggested that these drying methods did not cause any significant change in the SDF of the flour samples. The values obtained in this study were lower than 0.82-4.80% and 0.92-3.74% for banana and plantain flours respectively (Awedem *et al*., 2015). Soluble dietary fiber dissolves in water and turns to gel during digestion. The gel forming characteristics allows the food to be slowed down as digestion takes place and this contributes to many health benefits such as postprandial blood glucose, serum cholesterol and insulin levels (Jenkins *et al*., 2000). The findings of this study suggested that, drying African pear flour through oven, microwave or toasting drying processes may negatively influence the soluble dietary fibre and may not contribute significantly to the beneficial health associated with soluble fibres (Badejo *et al*., 2017).

The insoluble dietary fibre ranged between 1.41% to 1.79%. The content of insoluble dietary fibre increased during the drying process with increased temperature. No significant difference ($p<0.05$) was observed when the samples were dried using the oven dried method and through toasting. These findings correspond with the findings of Thed and Phillips (2015) who reported that microwave drying (MWD) and toasting (TD) significantly increases insoluble dietary fibre (IDF). Insoluble dietary fibers are unable to digest and poorly metabolized in the small intestine (Englyst *et al*., 2007). They have passive holding characteristics that can reduce the risk of constipation, diverticular disease and hemorrhoids (Anderson and Cydedale, 1980).

Vitamin Composition

The results of vitamin composition of the differently dried African pear mesocarp samples are presented in Table 5. The pro-Vitamin A content of the flour samples ranged from 0.00 mg/100g for TD to 1.06 mg/100g for SD. Pro-Vitamin A deficiency in the body causes epithelial tissues to become keratinous (Omoti, 2017). The pro-vitamin A content of OD, TD and MWD was significantly reduced which might be related to the heat sensitivity of vitamins. During sundrying, the temperature of the product is low, which limits degradation reactions (Ratti, 2011) unlike in OD, TD and MWD where higher temperatures are applied, resulting to higher loss (Benhardt and Schlich, 2016). The pro-vitamin A content of the samples was considerably low and are also below the recommended daily intake of 700 mcg to 900 mcg for adults.

Vitamin C is thermally sensitive and any treatment involving heat can reduce it significantly (Ratti, 2011). The vitamin C content of the samples were significantly affected by the different drying methods. The vitamin C content ranged from 2.05 mg/100g (TD) to 8.86 mg/100g (SD). SD had the highest vitamin C retention after drying while toasting resulted to samples with lowest vitamin C. MWD and OD content had no significant difference ($p<0.05$) in their vitamin C retention. These observations could be attributed to the intensity of heat treatment. However, this does not corroborate with the findings of Gallali *et al*. (2010) who reported appreciable loss of ascorbic acid content in SD (32.05 mg/100g) flour powder than OD (34.38 mg/100g) and TD (35.06 mg/100g). The findings of this study showed that sun drying would result to better vitamin C retention and might be suitable for food formulation that require more availability of vitamin C. The values in this study are below the recommended daily intake for adults = 90 mg and lactating mothers = 120 mg (FAO, 2014).

The vitamin E content of the African pear flour samples ranged from 73.10 mg/100g for TD to 197.00 mg/100g for SD. The differences in vitamin content were significant except for microwave and oven dried flour samples that recorded 97.45 mg/100g and 97.15 mg/100g respectively, indicating that, increase in drying temperature increased the loss of vitamin E content of the flour samples. Consequently, sun drying may be suitable for those with iron deficiency as it favours the absorption of iron (Adejumo, 2012), although, the flour samples from the different drying process had appreciable vitamin E content. However, this does not agree with the findings of Gallali *et al*. (2010) who reported appreciable loss of vitamin E content in SD (71.88 mg/100g) than OD (84.67 mg/100g).

Peroxide Value

The result of peroxide value (PV) of differently dried African pear mesocarp flour samples are presented in

Table 6. PV is an important indicator of oxidative rancidity, as it reflects the degree of lipid oxidation by indicating the level of primary oxidation products (Fu *et al*., 2018). Peroxides are the main primary oxidation products. High amounts of peroxides amount to low oxidative stability (Yang *et al*., 2016). PV decreases as secondary oxidation products appear as such, low PV could suggest the occurrence of advanced oxidation (Chakraborty, 2016). Therefore, a low PV does not indicate that the flour is good, it only gives an indication of the current state of oxidation of the sample (Frank *et al*., 2011). Significant differences were observed among the drying methods ($p<0.05$). The peroxide value ranged from 2.99 meq O_2/kg for SD to 4.84 meq O_2/kg for TD. The result indicated a direct relationship between temperature used in drying and peroxide value. High temperature influence the development of hydrogen peroxides, consequently, toasting resulted to samples with high development of hydrogen peroxides. The values obtained in this study are low compared to 18.75 meq O_2/kg reported for sun dried flour samples by Taiwo *et al*. (2018) and 19.54 meq O_2/kg reported by Ebuehi and Avwobobe (2016). The sun-dried sample had the lowest rancidity index value, therefore sun-drying might be suitable for the production of African pear flour with better oxidative stability.

Conclusion

This study successfully evaluated the effect of different drying methods on the quality characteristics of African pear. Toasting gave better functional properties. Sun dried samples had the highest fat, protein and moisture content while higher fibre and carbohydrate compositions were recorded for the toast dried samples. African pear prepared by microwave drying recorded the highest concentration of minerals. Oven dried flour had the highest total dietary fibre and insoluble dietary fibre while sun dried flour had the highest soluble dietary fibre. Sun drying resulted to samples with better vitamin contents and lowest peroxide value. Microwave dried samples recorded the highest concentration of minerals This study has shown that potential for African pear flour in the food industry.

References

Adebowale, A.A., Sanni, S.A. and Koleoso, Y.S, 2011. Chemical and functional qualities of high quality cassava flour from different SMEs in Nigeria. *Afri. J. Root and Tuber Crops.* 9(1), 11-16.

Adejumo, B. A., 2012. The Effect of Pretreatment and Drying On Some Vitamin Contents of Tomato Powder. Department of Agricultural and Bioresources Engineering, Federal University of Technology, Minna, Nigeria.

Adepoju, O.T., Oyewole, E.O. and Femi, K. L., 2012. Nutrient composition and acceptability of fortified jam from Spondias mombin (Hog plum, (Iyeye)) fruit pulp. *Niger. J. Nutri. Sci.* 29(2), 180-189.

Agunbiade, S. O., Ojezele, M. O. and Alao, O. O., 2015. Evaluation of the nutritional, phytochemical compositions and likely medicinal benefits of *Vernomia amygdalina*, *Talinum triangulare* and *Ocimum basilicum* leafy-vegetables. *Adv. in Biological Res*. 9(3), 447-452.

Ajibesin. K., 2011. African pear *(Dacroydes edulis)* (G. Don) H.J.Lam: A Review on its Medicinal, Phytochemical and Economical Properties. *Research J. Med. Plants*. 5, 32-41.

Akintayo, H., Osagie, A.U. and Eka, O.U., 2011. Nutritional quality of plant foods. Post harvest research unit, University of Benin press, Benin city. Pp1-31

Akubor, P.I. and Badifu, G.I.O., 2014. Chemical composition, functional properties and baking potential of African pear *(Dacroydes edulis)* flour. *Research J. Med. Plants.* 4, 30-39.

Anderson, N.E. and Clydesdale, F.M., 1980. An analysis of the dietary fiber content of a standard wheat bran. *J. Fd. Sci*. 45: 336

Ankapong, E., 2010. The Influence of Physicochemical Characteristics of Vegetable Oils on the Quality of Biodiesel Produced from Palm Oil, Palm Kernel Oil, Refined Soyabean Oil, Unrefined Soyabean Oil and Jatropha Curcas Oil, MSc. Thesis (Published), Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

AOAC, 2010. Official methods of Analysis (13th edn). Association of Official Analytical Chemists, Washington DC. pp 415-454.

AOAC, 2012. Association of Official Analytical Chemist, Official Methods of Analysis, 19th edition, Washington, D.C., USA, pp. 418-421.

Arinola, S. O., Ogunbusola, E. M. and Adebayo, S. F. (2016). Effect of Drying Methods on the Chemical, Pasting and Functional Properties of Unripe Plantain (Musa Paradisiaca) Flour. *British J. Applied Sci. Tech.* 14 (3), 1-7.

Atuonwu, A.C. and Akobundu, E.N., 2010. Functional and pasting properties of pumpkin (*Cucurbita pepo*). *J. Agric. Veterinary Sci.* 2: 36–49.

Awedem, W. F., Achu, M. B., and Happi, E. T. 2015. Nutritive value of three varieties of banana and plantain blossom from Cameroon. *Greener J. Agric. Sci.* 5 (2), 052-061.

Ayuk, E. T., Duguma, B., Kengue, J., Tiki–managa, T., Zekkeng, P., 2019. Uses, management and economic potential of African pear *(Dacroydes edulis)* in human low-land Cameroon. *Economic Botany*. 53 (3), 292-300.

Badejo, A.A., Osunlakin, A.P., Famakinwa, A., Idowu, A. O., and Fagbemi T.N. (2017). Analyses of dietary fibre contents, antioxidant composition, functional and pasting properties of plantain and moringa oleifera composite flour blends. *Congents Fd. Agric.* 3:1-10

Benhardt, S. and Schlich, N., 2016. Nutritive and Anti nutritive composition of flour. *J. Fd. Tech.* 6(5), 224-226

Borja, R., Ukhun, M. E. and Ukpebor, U. I. E., 2013. Production of instant flour: Sensory evaluation and physiochemical changes during storage. *Fd. Chemistry*. 42,287-299.

Caprez, D., Zakpaa, H.D., Mak-Mensah, E.E., and Adubofour, J., 2016. Production and characterization of flour produced from fruits grown in Ghana. *J. Agric. Biotech. Sus. Dev.* 2(6), 92-99.

Chakraborty, M. M., 2016. Chemistry and technology of oils and fats. Allied Publishers Private Ltd. Pp 752.

Charlse, H.D., Eboh, L. and Nwaojigwa, S.U., 2015. Chemical composition, functional and baking properties of wheat-plantain composite flours. *Afr. J. Fd. Agric. Nutri. Dev*. 7(1), 1-22

Coffman, C.W. and Garcia, V.V., 2017. Functional properties and amino acid content of protein isolate from mung bean flour. *J. Fd Techno*. 12, 473-484.

Conrad, O. A., 2012. Ethnobotany of African pear *(Dacroydes edulis)* (G. Don) H.J. Lam in Southern Nigeria 1: Practices and applications among the Yoruba speaking people. *A J. plants, people and Applied Res*. 10(7), 165-175.

Didier, D., 2011. Functional properties of raw and precooked taro (*Colocasia esculenta)* flour. *Int. J. Fd. Sci. Tech*. 29, 457–482

Eastern African Standard (EAS), 2011. Wheat flour specification. East African Community. Second Edition.

Ebuehi, O. A. T. and Avwobobe, O. K., 2016. Physico-chemical and fatty acid composition of water melon (*citrullus lanatus*) and melon (*Colocynthis citrullus*) Seed Oils, *Nig. Fd. J. 24(1),* 24-33.

Elluech, D., Onuoha, O.N., Eme, P.E., and Ekpo, U.E., 2011. Chemical evaluation of some tropical flour products. Nigeria. *Pakistan J. Nutr*. 13(6), 331-334.

Englyst, H., Wiggins, H. S. and Cummings, J. H., 2007. Determination of nonstarch polysaccharides in plant foods by gas-liquid chromatography of constituent sugars as alditol acetates. Analyst. 107, 307–318

Ezeokeke, C.T. and Onuoha, A.B., 2016. Nutrient composition of cereal (maize), legume (soybean) and fruit (banana) as a complementary food for older infants and their sensory assessment. *J. Fd. Sci. Eng*. 6, 139-148.

FAO, 2014. FAO. Available at: http://www.faostat.fao.org (02⁄2018).

FAO/WHO-UNU, 1994. Energy and Protein Requirements: Report of a Joint FAO/WHO/UNU Expert Consultation, WHO Technical Report Series no.724, Geneva: WHO.

Fennema, O. R., 2016. Food Chemistry, New York: Marcel Dekker Inc. pp 245-370.

Frank, N. E. G., Albert, M. M. E. and Ekwe, D., 2011. Assessment of the quality of crude palm oil from small holders in Cameroon. *Journal of Stored Products Postharvest Reserve.*, 2:52-58.

Fu, M., Qu, Q., Yang, X., and Zhang, X., 2018. Effect of intermittent oven drying on lipid oxidation, fatty acids composition and antioxidant activities of walnut. *Lebensmittel-Wissenschaft + Technologie*. 65, 1126-1132. http://dx.doi.org/10.1016/j.lwt.2015.10.002

Gallali, Y. M., Abujnah, Y. S., and Bannani, F. K. 2010. Preservation of fruits and vegetables using solar drier: A comparative study of natural and solar drying. III. Chemical analysis and sensory evaluation data of the dried samples (grapes, figs, tomatoes and onions). *Renewable Energy*. 19(1/2), 203–212. https://doi.org/10.1016/S0960-1481(99)00032-4

Hart, A.D., Adeniji, T.A., Sanni, L.O. and Barimalaa, I.S., 2016. Anti-nutrients and heavy metals in some new plantain and banana cultivars. *Nig. Fd. J*. 25, 171-177.

Hassan, L.G. and Umar, K. J., 2014. Proximate and mineral composition of seeds and pulp of African locust bean (*Parkia biglobosa* L.). *Nigerian Journal of Basic and Applied Sciences*, 13: 15-27.

Iwe, M. O., 2014. Science and Technology of food, Chemisry, Nutrition, processing and Utilization. Rojoint communication Services, Enugu, Nigeria. Pp 56-71.

Jecinta, N. A., Terrumun, A. T. and John, O., 2015. Studies on African pear *(Dacroydes edulis)*: Phytochemical and medicinal principles of raw seeds. *J. Natural Products Plant Res*. 5 (2), 13-19.

Jenkins, D. J. A., Wolever, T. M. S., Leeds, A. R., Gassull, M. A., Haisman, P., Dilawari, J., Goff, D. V., Meta, G. L., Albert, K. G. M. M., 2000. Dietary fibres, fibre analogues and glucose tolerance: importance of viscosity. *British Med. J*. 1:1392–1394

Kengue. J., 2011. A Guide on the cultural characteristics of African pear *(Dacroydes edulis)*. Editions CLE, Yaounde. Pp 23-57.

Khush, H. J., Mark, A.I. and George, K.M. 1998. Comprehensive Food Science and Nutrition. Revised edition Grace foundation pub. India. Pp 334-359.

Lilja, K. and Lingert, H., 2011. Effect of processing methods on nutrient retention and contribution of cassava (*Manihot spp.)* to nutrient intake. *African J. Fd. Agrc. Dev*. 10, 2099-2111.

Malomo, F. D., Adebowale, Y. A., Adeyemi, I. A. and Oshodi, A. A., 2012. Functional and physicochemical properties of flour of six *Mucuna sp*. *Afr. J. Biotech*. 4(12), 1461-1468

Maziya -Dixon, B., Adebowale, A.A., Onabanjo, O.O. and Dixon, A.G.O., 2015. Effect of variety and drying methods on physico-chemical properties of high quality cassava flour from yellow cassava roots. African Crop Science Conference Proceeding. 7, 635-641.

National Academy of Sciences, 2014. Dietary Reference Intakes (DRIs): Recommended Intakes for Individuals, Elements. Food and Nutrition Board, Institute of Medicine, National Academies. Available online at: http://www.nap.edu.

Ndindeng, S.A, Ambang, Z., Woin, N., Ajebesone, N. F., Atanga, N. S., Mapie, M. D., Nkeabe, L. W., Mireille, J. A., Geraldine, L. and Mbah, T. V., 2012. Valorization of African pear *(Dacroydes edulis)* fruit (safou) through Improved Drying Procedures, Packaging, and Processing. *Frontiers in Sci*. 2(6), 250-255

Ojo, A., Abiodun, O.A., Odedeji, J.O. and Akintoyese, O.A., 2014. Effects of Drying Methods on

Proximate and Physico-chemical Properties of Fufu Flour Fortified with Soybean. *British J. Applied Sci. Techn.* 4(14), 2079-2089

Omole, J. A., 2017. Cassava in the nutrition of layer, In: Cassava as Animal Feed. Nestel B, Grahams M (Eds). Process Workshop (IITA), Ibadan: Nigeria. Pp 83-91.

Omogbai, B.A. and Ojeaburu. S. (2010). Nutritional Composition and Microbial Spoilage of African pear *(Dacroydes edulis)* fruits vended in Southern Nigeria. *Sci. World J.* 5, 5-10.

Omoti O. A., 2017. Characteristics and composition of the pulp oil and cake of the African pear (African pear *(Dacroydes edulis)*). *J. Fd. Agric*. 38(l), 67-72.

Ondo-Azi, A., Ella, M. M., Silou, T. and Chalchat, J., 2013. Variation in physicochemical characteristics of safou African pear *(Dacroydes edulis)* (G. Don) H.J. Lam) fruits. International conference, nutrition and food production in the Congo basin. Brussels, Belgium. 30 September – 1 October.

Oppong, D., Arthur, E., Kwadwo, S.O., Badu, E. and Sakyi, P. (2015). Proximate composition and some functional properties of soft wheat flour. *Int. J. Innovative Res. Sci. Eng. Techn*. 4(2), 753-758.

Onwuka, G. I., 2018. Food analysis and instrumentation theory and practices Naptali prints. Lagos, Nigeria. Pp 38-45.

Onimawo, T. And Egbekun, L., 2018. Nutraceutical potential and sensory acceptability of Composite Flour Blends. *Food Science and Quality Management*, 39:84-97

Pamela, K. Muzanila, Y.C. and Mwakiposa, V., 2012. Assessment of nutritional status of traditionally prepared banana flour "Khenyangwa". African Crop Science Proceedings 6, 564-567.

Parr, R.M., Crawley, H., Abdulla, M., Iyengar, G.V. and Kumpulainan, J., 2012. Human dietary intakes of trace elements. A global literature survey mainly for the period 1970-1991. Report NAHRES. Vienna. International Atomic Energy Agency.

Potter, N. N., 2016. Food science, AVI publishing company, Connecticut. Pp 231-239.

Ratti, C. (2011). Hot air and freeze-drying of high value foods: a review. *J. Fd. Engineering*. 49 (4)? 311–319

Rwubatse, H., Marriot, J. and Lancaster, P.A., 2014). African pear *(Dacroydes edulis)*. Chan, H.T. (ed). Handbook of tropical foods, Marcel Dekker, New York, 85-143.

Savage, G.P., Dutta, P.C. and Rodriguez-Estrada, M.T., 2012. Cholesterol oxides: Their occurrence and methods to prevent their generation in foods. *Asian Practical J. Clin. Nutri.* 11:72-78

Seena, S. and Sridhar, K.R., 2015. Physicochemical, functional and cooking properties of under explored legumes, Canavalia of the southwest coast of India. *Fd. Res. Int*. 38, 803-814.

Sefa-Dede, D. and Agyr-Sackey, T., 2014. Effects of heat and tretracycline treatments on the food quality and acridity factors in cocoyam *Xanthosoma sagittifolium* (L) Schott. *Pakistan J. Nutri.* 3, 240-243

Sengev, I. A., Akpapunam, M.A. and Ingbian, E.K. (2012). Physicochemical and Sensory Properties of Instant Kunun-Zaki Flour Blends from Sorghum and Mango Mesocarp Flours. *Nig. Fd. J.* 30 (2), 8-16.

Shaista, Q., Muhammad, A., Fahrulzaman, H. and Muhammad A. J., 2017. Comparative Study for the Determination of Nutritional Composition in Commercial and Noncommercial Maize Flours, *Pakistan J. Botany*. 49(2), 519-523.

Siddiq, M., Ravi, R., Harte, J. B. and Dolan, K. D., 2010. Physical and functional characteristics of selected dry bean (*Phaseolus vulgaricus* (L.) flours. *LWT-J Fd. Sci. Tech*. 43, 232-237.

Soetan, K.O., Olaiya, C.O. and Oyewole, O.E., 2010. The Importance of mineral elements for humans, domestic animals and plants: A review, *Afri. J. Fd. Sci*. 4(5), 200-222.

Suresh, C. and Samsher, P., 2013. Assessment of functional properties of different flours. *African J. Agric. Res.* 8(38), 4849-4852.

Taiwo, A. A., Agbotoba, M. O., Oyedepo, A., Shobo, O. A, Oluwadare, O.M.O., 2018. Effects of drying methods on properties of water melon (*Citrullus lanatus*) seed oil, *AJFAND*, 8(4), 492-501.

Tagodoe, A. and Nip, W. K., 2014. Functional properties of raw and precooked taro Colocasia esculenta flour. *Int. J. Fd. Sci. Techn*. 29, 457–482

Thed, M. and Philips, W. (2015). Studies on the nutrient composition, antioxidant activities, functional properties of flours. *Asian J. Clin. Nutr*. (3): 33-39.

Timothy, G.E. and Bassey, E. E., 2019. Preliminary study on the effects of tuber sett weight derived from regions of seed yam on growth and yield of yam in South Eastern Nigeria. *Nig. J. Agric. Techn*. 2:32-40.

Varo, P., Veijalainen, K., Koivistoinen, P., 2007. Effect of Heat Treatment on the Dietary Fibre Content of Potato and Tomato. *Int. J. Fd. Sci. Techn*. 19, 485 – 492.

WHO, 2018. The Changes in quality characteristics of food during microwave drying. *Drying Technology*. 27(7), 857–862.

Wikipedia, 2020. African pear *(Dacroydes edulis)*. https://en.m.wikipedia.org/dacyodes_edulis. Retrieved 2nd march, 2020.

Yang, Y., Song, X., Sui, X., Qi, B., Wang, Z., Li, Y., and Jiang, L. (2016). Rosemary extract can be used as a synthetic antioxidant to improve vegetable oil oxidative stability. *Industrial Crop and Products*. 80, 141-147.

Table 1: Functional properties of African pear *(Dacroydes edulis)* mesocarp flour samples

Samples	BD (g/mL)	WAC (mL/g)	OAC (mL/g)	FC (mL/g)	WT (mL/g)	SI (mL/g)	GT (^{O}C)
OD	$0.71^{b} \pm 0.14$	$4.16^{b} \pm 0.01$	$26.11^{a} \pm 0.01$	$6.16^{a} \pm 0.01$	$122.50^{a} \pm 0.71$	$1.05^{c} \pm 0.01$	$69.60^{c} \pm 0.14$
SD	$0.71^{b} \pm 0.01$	$3.31^{d} \pm 0.01$	$22.26^{d} \pm 0.01$	$5.03^{c} \pm 0.01$	$124.50^{a} \pm 0.71$	$1.18^{a} \pm 0.01$	$62.35^{d} \pm 0.07$
TD	$0.75^{a} \pm 0.01$	$5.08^{a} \pm 0.01$	$28.12^{a} \pm 0.01$	$6.19^{a} \pm 0.01$	$117.50^{b} \pm 0.71$	$1.01^{d} \pm 0.01$	$73.45^{a} \pm 0.07$
MWD	$0.71^{b} \pm 0.01$	$4.08^{c} \pm 0.01$	$25.10^{c} \pm 0.14$	$6.09^{b} \pm 0.01$	$122.50^{a} \pm 2.12$	$1.08^{b} \pm 0.01$	$70.85^{b} \pm 0.35$

a-d: Values are means ± s.d of duplicate determination. Mean value in the same column but with different superscript are significantly different (P<0.05). OD (Oven dried samples), SD (Sun dried samples), TD (Toast Dried) and MWD (Microwave dried). BD (bulk density) WAC (water abs orption capacity) OAC (oil absorption capacity) FC (foaming capacity) WT (wettability) SI (solubility index) GT (gelation temperature)

Table 2: Proximate composition of African pear *(Dacroydes edulis)* mesocarp flour samples

Samples	Moisture content (%)	Fat content (%)	Ash content (%)	Fibre content (%)	Protein content (%)	Carbohydrate content (%)
OD	$9.07^{b} \pm 0.99$	$30.23^{c} \pm 0.02$	$2.52^{a} \pm 0.73$	$1.02^{d} \pm 0.01$	$11.56^{c} \pm 0.02$	$45.60^{b} \pm 0.06$
SD	$10.03^{a} \pm 0.04$	$32.44^{a} \pm 0.02$	$2.44^{a} \pm 0.01$	$1.14^{b} \pm 0.02$	$13.25^{a} \pm 0.02$	$40.70^{d} \pm 0.31$
TD	$8.36^{c} \pm 0.51$	$29.84^{d} \pm 0.01$	$1.90^{a} \pm 0.01$	$1.26^{a} \pm 0.01$	$10.36^{d} \pm 0.01$	$48.28^{a} \pm 0.01$
MWD	$9.29^{b} \pm 0.01$	$30.51^{b} \pm 0.01$	$2.16^{a} \pm 0.01$	$1.07^{c} \pm 0.01$	$11.71^{b} \pm 0.01$	$45.26^{c} \pm 0.01$

a-d: Values are means ± s.d of duplicate determination. Mean value in the same column but with different superscript are significantly different (P<0.05) OD (Oven dried samples), SD (Sun dried samples), TD (Toast Dried) and MWD (Microwave dried)

Table 3: Mineral composition of African pear *(Dacroydes edulis)* flour samples

Samples	Calcium content (mg/100g)	Magnesium content (mg/100g)	Iron content (mg/g))	Sodium content (mg/100g)	Potassium content (mg/100g)
OD	$0.05^{a} \pm 0.00$	$0.03^{b} \pm 0.00$	$0.01^{b} \pm 0.00$	$0.00^{a} \pm 0.00$	$0.07^{b} \pm 0.00$
SD	$0.05^{a} \pm 0.00$	$0.03^{a} \pm 0.00$	$0.01^{a} \pm 0.00$	$0.00^{a} \pm 0.00$	$0.08^{a} \pm 0.00$
TD	$0.03^{b} \pm 0.00$	$0.02^{c} \pm 0.00$	$0.00^{c} \pm 0.00$	$0.00^{a} \pm 0.00$	$0.06^{b} \pm 0.00$
MWD	$0.05^{a} \pm 0.00$	$0.03^{a} \pm 0.00$	$0.01^{b} \pm 0.00$	$0.01^{a} \pm 0.00$	$0.09^{a} \pm 0.01$

a-d: Values are means ± s.d of duplicate determination. Mean value in the same column but with different superscript are significantly different (P<0.05) OD (Oven dried samples), SD (Sun dried samples), TD (Toast Dried) and MWD (Microwave dried)

Table 4: Dietary fibre composition of African pear *(Dacroydes edulis)* mesocarp flour samples

Samples	Total dietary fibre (%)	Soluble dietary fibre (%)	Insoluble dietary fibre (%)
OD	$2.66^{a} \pm 0.01$	$0.87^{b} \pm 0.01$	$1.79^{a} \pm 0.02$
SD	$2.33^{c} \pm 0.01$	$0.93^{a} \pm 0.01$	$1.41^{c} \pm 0.02$
TD	$2.65^{a} \pm 0.01$	$0.87^{b} \pm 0.02$	$1.78^{a} \pm 0.01$
MWD	$2.58^{b} \pm 0.01$	$0.88^{b} \pm 0.01$	$1.70^{b} \pm 0.01$

a-d: Values are means ± s.d of duplicate determination. Mean value in the same column but with different superscript are significantly different (P<0.05) OD (Oven dried samples), SD (Sun dried samples), TD (Toast Dried) and MD (Microwave dried)

Table 5: Vitamin composition of African pear *(Dacroydes edulis)* mesocarp flour samples (mg/100g).

Samples	Pro-Vitamin A	Vitamin C	Vitamin E
OD	$0.93^{c} \pm 0.01$	$4.30^{b} \pm 0.01$	$97.15^{b} \pm 0.21$
SD	$1.06^{a} \pm 0.01$	$8.86^{a} \pm 0.01$	$197.00^{a} \pm 1.41$
TD	$0.00^{d} \pm 0.00$	$2.05^{c} \pm 0.01$	$73.10^{c} \pm 0.14$
MWD	$0.98^{b} \pm 0.01$	$4.34^{b} \pm 0.02$	$97.45^{b} \pm 1.06$

a-d: Values are means ± s.d of duplicate determination. Mean value in the same column but with different superscript are significantly different (P<0.05) OD (Oven dried samples), SD (Sun dried samples), TD (Toast Dried) and MD (Microwave dried)

Table 6: Peroxide value of African pear *(Dacroydes edulis)* mesocarp flour samples

Samples	Peroxide value (meq O_2/kg)
OD	$4.74^{b} \pm 0.03$
SD	$2.99^{d} \pm 0.03$
TD	$4.84^{a} \pm 0.01$
MWD	$4.60^{c} \pm 0.03$

a-d: Values are means ± s.d of duplicate determination. Mean value in the same column but with different superscript are significantly different (P<0.05). OD (Oven dried samples), SD (Sun dried samples), TD (Toast Dried) and MWD (Microwave dried)