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Effect of Two Processing Methods on Fatty Acid Profile of Three Varieties of African Pear (*Dacryodes edulis*)

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Abstract

The pericarp of African pear (*Dacryodes edulis*) is butyraceous. This study evaluated the fatty acid contents of three varieties of African pear (*Akpabuyo* pear, *Ikom* butter pear and *Ikom* pear).Ripe fruits of the three varieties of pear were purchased from Marian markets Calabar Cross River State, Nigeria. Each sample was divided into three batches. The first batch was left raw, the second was pan roasted till the pulp became soft, and the third batch was immersed into boiled water for 3 minutes. Each batch was prepared by deseeding the soft pulp. They were separately homogenized and stored in an airtight container and refrigerated for fatty acid (FA) analysis. The fatty acid contents of the samples were determined by Gas chromatography-mass spectrometry (GC-MS) methods. Data obtained were analyzed using the mean and standard deviation. Arachidonic acid in raw *Akpabuyo* pear was the predominant (1.55 g/100g) UFA.Saturated Fatty Acids (SFA) were found to be present in a higher percentage compared to the unsaturated fatty acids (UFA) in all the samples. Roasted *Akpabuyo* pear had the highest concentration of SFA (Lauric 28.45 g/100g),Blanched pear samples had lower FA. The consumption of raw and blanched *Akpabuyo* pear was recommended because of the type and concentration of the FA.

Keywords: Fatty, Acid, African, Pears, Profile, Processing, Saturated, Unsaturated, Monoun

Introduction

The World Health Organization has persistently emphasized the importance of fruits, among other foods as life-enhancing medicine with because they are rich in vitamins, minerals, and many phytonutrients {(Word Health Organization (WHO, 2015)}. African pear (*Dacryodes edulis*) is a fruit, and it is also known as African pear, African bush pear or plum or butter fruit. In Nigeria, it is called "*Ube*" in Igbo language, *Atili* in Hausa language, *Elemi* in Yoruba, and *Eben* among the Efiok/ Ibibio (Orwa *et al.,* 2009; Ene-Obong *et al.,* 2019). The major fruiting season is between May and October although fruitingstarts 5-6 years after planting Orwa *et al.,* 2009; Food and Agricuture Organization (FAO), 2014). Pears being a buttery fruit is very important partly because of the public health benefits accrued to fruits and vegetables for their role in chronic disease prevention and mortality reduction WHO 2015; Smith *et al.,* 2022). These health benefits might be attributed to the nutrient and

phytochemical contents (Aguilera *et al.*, 2016). In Africa, Nigeria is not listed among countries that rely on either production or imports of pear, its consumption rate is also negligible. In Africa generally, market reports showed a steady decline in both production and consumption of African pear from 2014 to 2021 (Index Box Market Intelligence Platform, 2023).

African Pear can be consumed in its raw fresh form by leaving it in the mouth to soften. It can be roasted or blanched. It can serve as an accompaniment to fresh and roasted corn during the months of April to November, its butyraceous nature makes it a good spread on bread, yam, and even rice, among others.It is however, most often consumed after cooking by either roasting or blanching in boiled water. With advancements in recent cuisine, it could be sautéed, simmered alongside soups, or even baked. Owing to the report on high bacteria load on uncooked pear, it is imperative that any of the cooking methods should be used to make it more palatable by improving the flavour and safety by reducing the micro-organism load. The absorption of the nutrients in pear might be high as studies have cited very low antinutrients in the pulp (Ibanga and Ekpa, 2009).

Fat contents of African pear is high and ranges from 18 to 36 percent across different varieties, however its proximate composition reveals that moisture is most abundant (36.5% to 53.82%) followed by fat and others (Onuegbu and Ihediohanma, 2008). The importance of fat in this fruit makes it valuable to determine the fatty acid composition because specific fatty acid is unique in its function (Uhunmwangho and Omoregie, 2022; Ene-Obong *et al*. 2019; Ihediohanma and Onuegbu, 2010), for example different types of saturated fatty acids (SFA) uniquely have different effects on the plasma lipoprotein cholesterol fractions concentration. Saturated fatty acids like lauric, myristic and palmitic acids increase low density lipo-protein (LDL) cholesterol whereas stearic acid has no effect (FAO,2010) . It was recommended during the FAO, consultation meeting on Fat and fatty acid in human nutrition held in Geneva in the year 2008 that when saturated fatty acid (SFA) is replaced with polyunsaturated fatty acids (PUFA) LDL cholesterol concentration will be decreased and the total/ high density lipo-protein (HDL) cholesterol ratio will also be decreased. The same is achievable when SFA is replaced with monounsaturated fatty acids (MUFA), although the effectiveness is not as much as that of PUFA. It is important to note that when dietary sources of SFA is replaced with carbohydrates, LDL and HDL cholesterol concentration are decreased but the total/HDL cholesterol ratio is not changed. On the other hand, when SFA is replaced with trans-fatty acids (TFA), HDL cholesterol decreases (Liska *et al.*, 2016; Dhaka, *et* al., 2011; FAO 2010).

Food processing can be broadly defined as the treatments given to agricultural food products after harvest till they are ready for consumption. African pear does not require rigorous processing prior to consumption. The unit preparation and processing of these fruits includes sorting, washing,

blanching and roasting. Blanching and roasting are important household food processing methods. Blanching is a cooking process in which fruits or vegetables are immersed in boiled water and allowed to remain in for a short period of time before the water is discarded and the food quickly cooled (Sunmonu *et al.,* 2021: Fellows, 2017), On the other hand, roasting is achieved in an uncovered pan without water to produce a well-browned exterior and a moist cooked interior (Hotz and Gibson, 2007; Nzewi and Egbuonu, 2011). Nutritional changes during processing are an important consideration when assessing nutrient intake. The effect of processing on the fatty acid composition of *Dacryodes edulis* is an important data that might enhance its use because it faces the danger of extinction if not properly utilized. It is on this background that this study was carried out in order to evaluate the fatty acid content of processed African pear.

Objectives of the Study

The general objective of this study was to assess effects of processing methods on fatty acid content of three varieties African pear.

Specifically, the study determined fatty content of:

1. raw African pear varieties (*Akpabuyo, Ikom* butter and *Ikom* pear)
2. roasted and blanched*Akpabuyo* pear,
3. roasted and blanched *Ikom*butter pear,
4. roasted and blanched *Ikom* pear.

Material and Methods

***Procurement/Preparation of Sample*:**

Mature and ripe pulp of African pear were purchased from Watt market in Calabar Cross River State, Nigeria. They were identified by the locals and market women as popularly known as *Ikom* butter pear, *Akpabuyo* pear and *Ikom* pear. The fruits were washed with tap water and each was divided into three batches of equal weight (1kg). The first batch was left raw for control. The second batch was roasted in a hot pan and a wooden spatula was used to toss the fruits for 3 minutes until they became soft. The last batch was then immersed in boiled water at a temperature of 100°C for 3 minutes. After processing, each batch was separately de-seeded and homogenized using mortar and pestle. Each sample was put in an airtight container and labeled accordingly. They were stored in a refrigerator for fatty acid analysis.

***Analysis of Fatty Acids*:** Oil from 200 g of each sample was extracted with petroleum ether at 60°C for 3 hours using a Soxhlet apparatus on an electro thermal mantle. The extract was concentrated using a rotary evaporator to remove all alcohol. Fatty acids methyl esters (FAMEs) derivatization of the oil sample was carried out. The oil sample was weighed into a 10 mL micro-reaction vessel and 2 mL BCl3-MeOH 12 percent w/w was added. This was followed by the addition of 1 mL 2, 2-dimethoxyproprane. The mixture was mixed thoroughly and then heated for 5 minutes at 60°C. It was then cooled to below 30°C and 1 mL distilled water and 1 mL n-hexane were added and allowed to stand. The GC-MS Analysis of FAMEs described in the work by Igile *et al*., 2018 was used with a slight modification was used to complete the analysis.

***Statistical Analysis*:** Data obtained were expressed as the mean ± standard deviation. The data were analyzed using SPSS version 20. One-way analysis of variance (ANOVA) was used to categorize the means. Significant differences were considered at $p < 0.05$.

Results

Table 1: Fatty acid Compositions of Raw *Ikom*, *Ikom* Butter and *Akpabuyo* Pears (g/100g Wet Weight Basis).

Fatty acids	*Akpabuyo*	*Ikom* butter pear	*Ikom* butter
Capric	0.65±0.00^{b}	0.83 ±0.00^{a}	0.66±0.00^{b}
Caprylic	5.98 ±0.00^{c}	8.44 ±0.00^{a}	6.33 ±0.00^{b}
Caproic	4.34±0.00^{a}	3.78 ±0.00^{b}	3.88 ±0.00^{b}
Lauric	27.05±0.00^{b}	28.05 ±0.00^{a}	26.23 ±0.00^{b}
Myristic	16.87±0.00^{c}	18.55 ±0.00^{a}	17.66 ±0.00^{b}
Palmitic	6.05±0.00^{b}	7.66 ±0.00^{a}	6.25 ±0.00^{b}
Stearic	1.66±0.00^{c}	2.87 ±0.00^{a}	1.88 ±0.00^{b}
Palmitoleic	0.03±0.00^{c}	0.07±0.00^{a}	0.04 ±0.00^{b}
Arachidonic acid	1.55±0.00^{a}	0.07 ±0.00^{b}	0.05 ±0.00^{b}

Data are presented as mean ± SEM. Superscript letter (a-c) means within each row with different superscripts are significantly ($p<.05$) different

Table 1 presents the fatty acid compositions of raw *Ikom* pear, *Ikom* butter pear and *Akpabuyo* pear. Raw *Akpabuyo* pear had significantly ($P<0.05$) higher Caproic (4.34±0.00 g/100g) and *Arachidonic* acid (1.55 ±0.00 g/100g) than other pears, Raw *Ikom* butter pear however, had significantly ($P<0.05$) higher Capric: 0.83±0.00 g/100g, Caprylic: 8.44±0.00 g/100g, Lauric (28.05±0.00 g/100g), Myristic (18.55 ±0.00 g/100g),Palmitic (7.66 ±0.00 g/100g), stearic (2.87 ±0.00 g/100g) and palmitoleic (0.07±0.00 g/100g) than all other studied pear varieties.

Table 2: Effect of Roasting and Blanching on the Fatty Acid Composition of *Akpabuyo* Pear (g/100g) as Consumed.

Fatty acids	Raw	Roasted	Blanched
Capric	0.65±0.00^{b}	0.87±0.00^{a}	0.66 ±0.00^{b}
Caprylic	5.98 ±0.00^{c}	8.87±0.00^{a}	6.33±0.00^{b}
Caproic	4.34±0.00^{b}	4.66±0.00^{a}	3.88±0.00^{c}
Lauric	27.05±0.00^{b}	28.45±0.00^{a}	26.23±0.00^{c}
Myristic	16.87±0.00^{b}	18.88 ±0.00^{a}	16.66 ±0.00^{b}
Palmitic	6.05±0.00^{b}	7.75±0.00^{a}	6.35 ±0.00^{b}
Strearic	1.66±0.00^{b}	2.67 ±0.00^{a}	1.88 ±0.00^{b}
Palmitoleic	0.03±0.00^{c}	0.06±0.00^{a}	0.04 ±0.00^{b}
Arachidonic acid	1.55±0.00^{a}	0.05±0.00^{c}	0.07 ±0.00^{b}

Data are presented as mean ± SEM. Means within each row with different superscripts are significantly ($p<.05$) different

Table 2 presents the effects of roasting and blanching on the Fatty acid compositions of *Akpabuyo* pear (g/100g) as consumed. Roasting significantly (P<0.05) increased the Capric (0.87 ±0.00 g/100g), Caproic (4.66 ±0.00 g/100g), Lauric (28.45 ±0.00 g/100g), Myristic (18.88 ±0.00 g/100g),Palmitic (7.75 ±0.00 g/100g) and stearic (2.67 ±0.00 g/100g) fatty acids contents of *Akpabuyo* pear from the levels in the raw samples. On the other hand, significant decrease was observed in the Arachidonic fatty acid contents of both the roasted (0.05±0.00g/100g) and blanched (0.07 ±0.00g/100g)when compared with the raw sample (1.55g/100g). There was also significant (P<0.05) decrease in the Lauric (26.23 g/100g) and caproic (3.88 g/100g) acid contents of blanched Akpabuyo pear when compared with the raw sample the raw (27.05 g/100g and 4.34 g/100g respectively).

Table 3: Effects of Roasting and Blanching of Fatty Acid Contents of *Ikom* Butter Pear (g/100g) as Consumed

Fatty acids	Raw	Roasted	Blanched
Capric	0.83 ±0.00^{a}	0.54 ±0.00^{c}	0.78 ±0.00^{b}
Caprylic	8.44 ±0.00^{a}	5.98 ±0.00^{c}	7.45 ±0.00^{b}
Caproic	3.78 ±0.00^{b}	4.56 ±0.00^{b}	5.25 ±0.00^{a}
Lauric	28.05 ±0.00^{a}	24.55 ±0.00^{c}	27.67 ±0.00^{b}
Myristic	18.55 ±0.00^{a}	16. 80±0.00^{c}	18.23 ±0.00^{b}
Palmitic	7.66 ±0.00^{a}	5.88±0.00^{c}	7.23 ±0.00^{b}
Stearic	2.87 ±0.00^{a}	1.78±0.00^{c}	2.67 ±0.00^{b}
Palmitoleic	0.07±0.00^{a}	0.02 ±0.00^{b}	0.04 ±0.00^{b}
Arachidonic	0.07 ±0.00^{a}	0.02 ±0.00^{c}	0.06 ±0.00^{b}

Data are presented as mean ± SEM. Means within each row with different superscripts are significantly (p<.05) different

Table 3 presents the effect of roasting and blanching on the fatty acid composition of *Ikom* butter pear. There was significant (P<0.05) decrease in the fatty acid compositions of almost all the roasted and blanched pears when compared with the raw pear. In contrast to this observation, only Caproic acid (3.78 ±0.00 g/100g) contents of the roasted and the blanched samples did not decrease when compared to their raw counterpart, rather, there was a significant increase of the Caproic acid contents of both the roasted and blanched *Ikom* butter pear. The increase was significant (P<0.05). It ranged from 3.78 ±0.00 g/100g in the raw pear to 4.56 ±0.00g/100g in the roasted sample and highest in the blanched pear (5.25 ±0.00 g/100g).

Table 4: Effect of Roasting and Blanching on Fatty Acid Content of *Ikom* Pear (g/100g)

Fatty acids	Raw	Roasted	Blanched *Ikom* Butter
Capric	0.66±0.00^{a}	0.47 ±0.00^{c}	0.72 ±0.00^{a}
Caprylic	6.33 ±0.00^{b}	4.44 ±0.00^{c}	8.24±0.00^{b}
Caproic	3.88 ±0.00^{c}	4.38 ±0.00^{b}	5.12 ±0.00^{a}
Lauric	26.23 ±0.00^{b}	23.35 ±0.00^{bc}	27.45 ±0.00^{a}
Myristic	17.66 ±0.00^{b}	16.66 ±0.00^{c}	18.15±0.00^{a}
Palmitic	6.25 ±0.00^{b}	5.46 ±0.00^{c}	7.34±0.00^{a}
Stearic	1.88 ±0.00^{b}	1.55 ±0.00^{c}	2.47±0.00^{a}
Palmitoleic	0.04 ±0.00^{b}	0.02 ±0.00^{b}	0.08±0.00^{a}
Arachidonic (g/100g)	0.05 ±0.00^{a}	0.02 ±0.00^{b}	0.06 ±0.00^{a}

Data are presented as mean ± SEM. Means within each row with different superscripts are significantly (p<.05) different

Table 4 presents effects of roasting and blanching on the fatty acid composition of *Ikom* pear. The result on the effect of roasting and blanching on the fatty acid contents of *Ikom* pear followed a peculiar trend. Cooking significantly (P<0.05)increased the fatty acid contents of the raw sample from Capric: 0.66 ±0.00 g/100g, Caprylic: 6.33±0.00 g/100g, Lauric (3.88 ±0.00 g/100g), Myristic (17.66 ±0.00 g/100g),Palmitic (6.25±0.00 g/100g), stearic (1.88 ±0.00 g/100g) and palmitoleic (0.04 ±0.00 g/100g) to (Capric: 0.72 ±0.00 g/100g, Caprylic: 8.24±0.00 g/100g, Lauric (27.45 ±0.00 g/100g), Myristic (18.15±0.00 g/100g),Palmitic (7.34±0.00 g/100g), stearic (2.47 ±0.00 g/100g, palmitoleic (0.08 ±0.00 g/100g) in the roasted sample. But blanching caused some significant reduction (P<0.05) in the samples as follows: (Capric: 0.47 ±0.00 g/100g, Caprylic: 4.44±0.00 g/100g, Lauric (23.35 ±0.00 g/100g), Myristic (16.66 ±0.00 g/100g), Palmitic (5.46±0.00 g/100g), stearic (1.55 ±0.00 g/100g), and Arachidonic (0.02 ±0.00 g/100g).

Discussion

The fatty acid profile of raw, roasted, and blanched *Akpabuyo, Ikom* butter pear and *Ikom* pear pulp shows that both saturated and unsaturated fatty acids were present in all the samples, though in varied amounts.The higher concentration of Arachidonic and palmitoleic fatty acids in the raw *Akpabuyo* pear could be advantageous in deciding the best way to process food. These fatty acids may improve heart health (El-Fakharany *et al.,* 2018). There are several reports, suggesting that polyunsaturated fatty acids, enhanced bone formation (Dansgaard *et al.,* 2012). Polyunsaturated fatty acids are also known to possess body weight management properties, including reducing body fat and increasing lean muscle mass. These are some potential benefits that African pears may confer on populations consuming the fruit.

However, saturated fatty acids which do not contain any double bond in their structure are considered to be unhealthy sources of edible oils. These include palm oil (palmitic acid) and refined palm kernel oil (lauric acid) as

well as stearic acid (Carta *et al.,* 2017). A saturated fatty acid structure is fully hydrogenated as in palmitic, lauric, and stearic fatty acids. The molecule issaid to be very stable (usually solid at room temperature) and hard to break up or disintegrate. This allows it to store and provide more energy than carbohydrates and makes it more likely to stick to the body as cholesterol resulting in high arterial and plasma cholesterol, also known as hypercholesterolemia (Carta *et al.,* 2017). High arterial and plasma cholesterol predispose to hypertension. Also, the high content of polyunsaturated fatty acid in African pear pulp oil and its arachidonic acid and palmitoleic contents make it a rich source of essential fatty acids, with great potential to enhance the nutritional value of its food products. African pear pulp oil for margarine and bakery shortening production, and other food product formulations is greatly enhanced by the low free fatty acids value. This discovery is consistent with the values of fatty acids previously found in different oil seeds including, sunflower, soybean, peanut, and olive oil.

The lower contents of these FAs in the blanched *Akpabuyo* pear and *Ikom* butter pear is not surprising because leaching of nutrients is occasioned by blanching (Sunmonu *et al*., 2021; Severini *et al.,* 2016). Contrarily to expectation, the FAs contents of *Ikom* pear were increased, this could be as a result of varietal difference.

The reason for the high fatty acids content in the roasted *Akpabuyo* pearcould be attributed to the heating process, which led to the increase in temperature and release of more fats and also evaporation of moisture, hence concentration of fat. It is however surprising to see a contrasting result in the *Ikom* pear and *Ikom* butter pear, roasting significantly reduced the fatty acid contents of almost all the fatty acids identified except caproic acid. This could be attributed to variety and concentrationof fatty acid. The greater buttery nature of *Ikom* butter this pear must have enabled the result, other reasons for the difference in the contents of these fatty acids may be to climatic variables, soil type, and processing methods. In addition, the results of the present study support the earlier study of Ene-Obong *et al.* (2019), who reported variation in the nutrients and bioactive compounds of different accessions of the West African pear.

Conclusion

This study has revealed and provided information on the fatty acid composition of raw, roasted and blanched African pear fruits. Arachidonic and palmitoleic acids were the only unsaturated fatty acids found among the studied pears. They were more abundant in raw *Akpabuyo* pear. Blanching reduced the FA contents of *Akpabuyo* pears and increased those of *Ikom* and *Ikom* butter pears. Roasting significantly reduced their concentration in *Ikom* pear and *Ikom* butter pears and caused increases in the FA compositions of *Akpabuyo* pears. Saturated fatty acid (capric, caprylic, lauric, palmitic, stearic acids) was highest in roasted *Akpabuyo*pear while stearic acid was more in raw *Ikom* butter pear. These reports therefore imply that roasted *Akpabuyo* pear, which recorded high percentages of saturated fatty acids

should be consumed with care considering the nutritional status of the individual. The study also revealed that variety is a strong determinant of the outcome of FAs compositions of roasted and blanched studied pears.

Recommendations

Based on the findings, it is recommended that:

1. consumers should leverage on the types and distributions of fatty acids present in these pears in making their food choices.
2. consumption of raw and blanched African pears, which had a low percentage of saturated fatty acids with a high percentage of unsaturated fatty acids should be encouraged.
3. presence of caproic acid in *Ikom* butter pear might be considered as a good food additive (flavouring agent)

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