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Effect of Processing Temperature on the Yield of Oil from African Pear Seed

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ABSTRACT

Oils were extracted from the seeds of African pear (*Dacryodes edulis*) and their physicochemical properties was studies. The seed ofAfrican pear, dehulled from the mesocarp, cut into small pieces and sundried for 48hours was used for this study. The oil was extracted by soxhlet extraction using n-hexane. The oil extracts was analyzed for its physicochemical properties such asAcid value (16.27mg KOH); Saponification value (96.66mgKOH); Iodine value (2.72mg/g); Peroxide value (2.20mg/kg); Specific gravity (0.0029g/cm³) and PH value (3.34). The effect of processing temperature on the yield of oil from African pear seed was also studied. Results revealed that higher oil yield (37%) was obtained at a processing temperature of 100°C and 30% oil yield was obtained at room temperature respectively. The physiochemical characteristics of African peer seed oil shows that the oils have great potentials as fuel and can be obtained at high yield when the processing temperature is higher..

BACKGROUND OF THE STUDY

The African pear (*Dacryodes edulis*) are tropical forest trees which belong to the family of Bursericea. They are widespread and are found in the forest and sometimes planted. (Nwanekezi and Onyeagba 2017a, Burfill,2015).African pear is known in Nigeria by several tribal names such as Eben (Efik and Ibibio), Ube (Igbo) and Elemi (Yoruba). (Emebiri and Nwafor, 2016, Burkhill, 2015). The fruits of African pear are purplish – blue or purplish – black in colour. The fruits are characterized by central core surrounded by edible freshly layers. The seeds of African pear fruits are covered by leathering material.

African pear (Dacryodes edulis) is consumed traditionally in Nigeria raw, roasted or boiled in hot water and is eaten alone or used in garnishing fresh maize. It is widely found in many sub-Saharan countries including Nigeria, Liberia and Cameroons. (Boungou*et al.*, 2019).It may be available for up to 6 months of the year according to Eka (2013), Omoyi and Okiy (2014). African pear can be a source of vegetable oil and the seeds of the fruits contains up to 18-70% oil. (Gunstone and Norris, 2017). African pear fruits like most fruits is highly perishable. Despite of its low moisture content of 9-11%, it has a short shelf life of 3-5days. (Nwanekezie and Onyeagba, 2017a).

Large quantities of African pear fruits are harvested between July and September, the fruits pulps are consumed but their seed are thrown away and wasted, as they are more or less considered to have no recognized food and economic values. However, African pear seeds have been found to contain oil and protein and can be used as livestock feed in some places. (Omoti and Okiy, 2014).African pear fruits having large percentage of oil could be used as sources of future industrial and edible oils. Most studies on the oils of African pear seed were focused on their physioco-chemical properties.

Seed oils are vegetable oils obtained from the seed (endosperm) of some plants, rather than the fruit (pericarp). Most vegetable oils are seed oils, examples are groundnut seed oil, mango seed oil, corn seed oil, palm kernel seed oil, etc.

Seed oils are importance sources of nutritional oils and industrial raw materials. The characterization of oils from different sources depend mainly on their compositions; no oil from a single source can be suitable for all purposes thus the study of their constituents is important. There are numerous seed oils derived from various sources. These include soybeans, cotton seed, mango seed oil, etc.

Most agricultural products such as these oils extracted from local seeds, and nut, if properly monitored and harvested, it can be very useful for us in Nigeria and even exported for foreign exchange, hence the need of this project which deals on the extraction and physioco-chemical properties of African pear seed oil. Oils from vegetable and fruits seed are rich in amino acids, triglycerides and can augment common household oils.

African pear seed oil rated a great potential in agricultural and power sectors. They are some relevantproblems discovered during the course of this study. The fruits of the African pear are fragile and about half of the harvested fruits are lost due to softening and spoiling.Despite of its low moisture content of about 9-11%, it has a short shelf life of 3-5 days.The seeds are usually discarded after consumption and this can cause land pollution to the environment.The seeds of the African pear are underutilized in Nigeria despite its great potential in agricultural and power sector.Therefore, this study is done to assess the possibility of extracting oil from the seed of African pear as well as determining its physicochemical properties.

MATERIALS AND METHOD

The fruits of African pear (Dacryodes edulis) was purchased from Beach market, commonly known as EsukNsidung, Calabar South, Cross River State, Nigeria. The fruits were fully ripened, fresh and wholesome and were of different shapes and sizes. The seeds were cut into small pieces and sun-driedfor 48 hours to remove moisture.The seeds were pound with mortar and pestle.After pounding, the powder was packed in sample bottle and labelled. Care was taken not to grind the seed to a very tiny particles as this will prevent free flow of solvent during extraction which could lead to reduction in the yield of the oil.For temperature studies, african pear seed was boiled in water to 100ºC. All experiments carried out with the unboiledafrican pear seed (UAPS) was repeated with the boiled seed labelled (BAPS = boiled african pear seed).

The soxhlet extraction method described by Musa *et al*(2015) was used in the extraction of African pear seed (*Dacryodes edulis*) two hundred and fifty millimeters (250ml) of n – hexane was poured into a round bottom flask. Ten grams (10g) of UAPS AND BAPS was introduced into a separate thimble and were placed at the centre of the soxhlet extractor. The extractor was then heated to 79ºC (This temperature was chosen because n – hexane has an optimum boiling point of 78ºC) and was held at that temperature throughout the duration of the reflux process (5 hours). The African pear seed oil (UAPS AND BAPS) was recovered and heated in an oven at 80^0C for 10 minutes to allow any residual n – hexane in the mixture to evaporate. The oil samples obtained were Labelled and package in an air – tight container and stored in a refrigerator for analysis of acid value, Saponification value, iodine value, peroxide value, specific gravity and pH, etc.

RESULTS AND DISCUSSION

The percentage oil yield of un-boiled african pear seed (UAPS) and boiled african pear seeds(BAPS) is presented in Table l. Percentage yield is the percentage ratio of actual yield to the theoretical yield. The percentage yield of oil extracted from both samples (UAPS and BAPS) obtained in this study is 30% (UAPS) and 37% (BAPS).It is observed that, the boiled African pear seed has higher percentage yield than the un-boiled African pear seed, this is due to change in temperature during sample pre- treatment and during extraction which increased the surface area of solvent penetration to bring out the oil by leaching.

Results showing the physico-chemical properties of oils is presented in Table 2. The oils extracted were liquid at room temperature, this means that they could be classified as oil and not fat (Figure 1).

Table 1: Percentage oil yield for UAPS and BAPS

Parameter	UAPS	BAPS
Weight of the African pear	28.5g	38.5g
Weight of the oil extracted	95.5g	105g
Percentage yield of the oil	30%	37%

Acid value is an important index of physiochemical properties of oil which is used to indicate the quality, age, edibility and suitability of oil for use in industries such as paint industry (Akubugwo*et al*, 2018). Due to prolong storage of the sample before the extraction, the acid value of African pear seed oil was observed to be 27.69mg/KOH UAPS and 16.29mg/KOH for BAPS respectively.The higher the acid value and free fatty acid content, the lower the quality of the oil. The acid value additionally increases with the age of an oil as triglycerides and glycerol have an effect of time.According to world health organization the standard edible value of acid value ranges from 0.1 to 0.6 mgKOH.Generally, an acid value greater the none (>1) is considered to be high. It is observed that the acid value obtained from this research is high due to deterioration of the oil and prolong storage of the sample before extraction.The acid vales presented in this work from both samples are higher than 9.60mgkOH in african pear oil reported by Ikhunoria and Maliki (2015).Therefore, it is not good for human consumption.

Table 2: physico-chemical properties of oils from unboiled and boiled african pear seeds

	Acid value (mg/KOH)	Saponification value (mg/KOH)	Iodine value (mg/g)	Peroxide value (mg/kg)	Specific gravity (g/cm^3)	PH value
UAPS	16.27	96.66	2.72	2.20	0.0029	3.34
BAPS	27.69	88.68	2.16	1.00	0.0036	3.09

Saponification value is used in checking the alteration of the oil (Akubugwo*et al*., 2018). The saponification value was observed to be 96.66mg/KOH for UAPS and 88.64mg/KOH for BAPS respectively.The larger the saponification value, the better the soap making ability of the oil. The high saponification value in the oil sample suggest that they are normal triglyceride whereas low saponification value indicate that the oil sample has a longer fatty acid chain and higher molecular weight.The saponification value obtained from this research is lower that the saponification value of African pear seed (172.80mgkOH) reported by (Utomi and Okyi, 2017)

Figure 1: Oils obtained from UAPS (processing Temperature 30ºC) and BAPS respectively (processing temperature (100ºC)

Iodine value is a measure of the degree of unsaturation of fatty acid in an oil and could be used to quantify the amount of double bonds present in the oil which reflect the susceptibility of oil to oxidation. Oils are classified into three categories depending on their iodine values namely; drying oil, semi-drying oil and non-drying oil. The iodine value of a drying oil is higher than 130; for semi-drying oil, the value ranges from 90-130 and if the value is smaller than 90, the oil is said to be non-drying oil.The iodine value obtained in the study was 2.16mg/g for UAPS and 2.72mg/g for BAPS respectively. Result shows that the oils have low degree of unsaturation compared to the value of iodine in african pear seed (32.40mg/g) reported in the literature by Utomi and Okyi (2017). Oils from African pear can be used as plasticizer and lubricants.

Peroxide value is used as a measure of the extent to which rancidity reactions have occurred during storage. The peroxide value obtained in this study was 2.20mg/kg for UAPS and 1.00mg/kg for BAPS respectively. This shows that, the oils have a low degree of rancidity. High peroxide value indicate that the oil has been damaged by free radicals and ketones.Oils withperoxidevaluerangingfrom1-3mg/kg are considered fresh and of good quality. The peroxide value obtained in this study was lower than the peroxide value of african pear seed oil (6.02mg/kg) reported in the literature by Ikhuoria and Maliki (2015).

Specific gravity is an index used to measure the density of a liquid. It is calculated as a ratio of the density of a liquid to the density of water. Solid and liquid are measured against water, so if the specific gravity is less than one it will float but if it is higher than one it will sink. The specific gravity is also useful in assessing the purity of the oil. The specific gravity obtained in this study was 0.0029g/cm³ for UAPS and 0.0036g/cm³ for BAPS and are regarded as pure oil.

P^H value obtained in this study was 3.34 for UAPS and 3.09 for BAPS. In the case of fresh oil, the P^H value of 10.0 and P^H value 9.0 to 11.0 is appropriate. When it falls below P^H 9.0, deterioration starts. The lower the P^H value is, the more the degradation progresses. The p^H value of cooking quality vegetable oil is generally kept neutral and usually ranges from 6.9 to 6.7. As the temperature rises, p^H value of the oil decreases.Comparing the P^H value of UAPS(3.34) and BAPS (3.09), it is observed that, the temperature used in preparing the seed was different. UAPS was washed with normal room temperature water at 30ºC while BAPS was washed with hot water at 100ºC. This shows that, as the temperature increases, the p^H value ofoils decreases.

The oil extracted from the unboiled African pear seed (UAPS) was light yellow in color while the oil extracted from the boiled African pear seed was light brown in color.It is observed that, increase in temperature also affects the colour of the oil obtained from the boiled african pear seed (BAPS).

EFFECT OF TEMPERATURE ON THE PRODUCTION OF AFRICAN PEAR SEED (UAPS AND BAPS).

During sample pre-treatment, the unboiled African pear seed (UAPS) was washed with a room temperature (30ºC) water before the extraction process while the boiled African pear seed (BAPS) was boiled in hot water (100ºC) before the extraction.At the process of extraction, it was found that, increase in temperature also increased the percentage yield of the oil and a decrease in temperature, decreased the percentage yield of the oil respectively.The percentage yield of oil from unboiled African pear seed (UAPS) obtained in the study was 30% while for the boiled African pear seed (BAPS) was 37%.The 30% and 37% yield of UAPS and BAPS is higher than the percentage yield of mango seed oil (12.15%) reported by Khalique (2019). This is due to the effect of temperature during the production of oil.

CONCLUSION

Most seed oil such as oil extracted from African pear seeds, if properly monitored and utilized, it can be useful for us in Nigeria, and even exported for foreign exchange. They yield different composition and by extraction their physicochemical properties determine their usefulness in various application aside from edible uses. The studies shows that the seed have found to contain a reasonable amount of oil. Solvent extraction was used in extracting oil from African pear seed. Studies on industrial production is recommended for future purpose instead of abandoning the seed which may leads to environmental hazard.

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