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Physico-Chemical Properties of Oil from Water Melon *Citrullus Lanatus (Thunb)* Seeds

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Abstract

Oil from the peeled and unpeeled seeds of watermelon was extracted using petroleum ether (Boiling point 40 – 60^{O}C). The result revealed that the oil from peeled 63% and from unpeeled 58% seed was high indicating that the seed can serve as good sources of raw materials for oil production on a large quantity for commercial purposes. The oil extracted was tested for chemical and physical properties. The result of the chemical properties test indicates the presence of the following parameters: iodine value 9.61mg/g, saponification value 123.2mg/g, peroxide value 3.00 milliequivalent O_2/Kg, acid value 5.63 % and free fatty acid 2.83% for oil from peeled seed, while the oil of the unpeeled seed gave the following parameters: iodine value13.87mg/g, saponification value 61 6mg/g, peroxide value 4.00 milliequivalent O_2/Kg,, acid value 4.54% and free fatty acid 2.28% for. The presence of these chemical properties make the oil from watermelon a good raw material to be used in industries for the production of cosmetics, adhesives, candle and soap. The result of the physical properties test showed the specific gravity (0.90g/cm3), refractive index 1.49019 and color (light yellow) of the oil from peeled seed and specific gravity 0.84 g/cm3, refractive index 1.49006 and color (light yellow) of unpeeled seed. Based on these findings, oil from watermelon seed can also be used as an alternative source of vegetable oil.

Keywords: Chemical Properties, Physical Properties, Peeled Seed, Unpeeled Seed and Vegetable Oil.

Introduction

Fats and oil are lipids material derived from plants. Physically, oils are liquid at room temperature and fats are solid. Chemically, both fats and oil are composed of triglycerides. Although many plants parts may yield oil, in commercial practice oil, oil is extracted primarily from seeds (Beare-roger, 1983).

Fats and oils are substance of vegetable or animal origin. They are insoluble in water and greasy to touch. The most important characteristic is that they have caloric content more than twice as high as the other food stuff (Kalanithi and Badri, 1993). Also they act as lubricants during mixing of ingredient and as media for heat transfer carrier for fat soluble vitamins. Also, they are a source of external fatty acid (Charley, 1982). The plants and animals that produce oils and fats in plentiful quantity and insufficiently available form for it to be an article of commerce are comparatively few. The large sources of oils that are present are the seeds of annual plant (Donald *et al.*, 2005).

The saturated acid tends to be solids, while the unsaturated are usually liquid. This circumstance also extends to fats and oils. Fats are made up of fatty acid that is mostly saturated, while oils are primarily composed of fatty acid portions that have greater numbers of double bonds. In other words, unsaturation lower melting point (Eckey and Meller, 1954; Kim *et al.*, 2012).

There are various types of fats and oil these includes; saturated fats on the other hand, which are preferentially incorporated into adipose tissue because the absence of double bonds allows a high energy yield per carbon than is obtained from oxidation of unsaturated fatty acids (Harper, 1999). These fats are derived from animal products such as meats, diary and eggs. They can also found in some based sources such as coconut, palm and palm kernel oils. These fats are solid at room temperature. Saturated fats directly raise cholesterol levels.

The natural source of fats and oil are normally found from plants or its seed, nuts, animal or marine organisms and can also be found by industrial and laboratory extraction. Seeds have nutritive and calorific value, which makes it necessary in diets. They are also good source edible oil and fats (Odoemelam, 2005).

Apart from the domestic use of oils and fats as cooking oils, they also find wide applications as source of oleo chemicals (Morrison *et al.,* 1995; Augustin *et al.,* 2015). Oleo chemicals are completely biodegradable and so could replace a number of petrochemicals. Many vegetable oils are used in making soaps, lubricant, candles, perfumes, cosmetic products and are also used in making paints and other wood treatment product.

Vegetable oils are chiefly present in seeds and nuts of plants. They are stored in seeds to serve as nourishment for the germination of embryo. There are quite a few seeds and nuts which are rich in fat contents. Thus soya beans, groundnut, palm kernel and mustered sesame seed are all important source of edible oil (Linder, 2000).

Watermelon belongs to the family of Cucurbitaceae, scientifically classified as *Citrullus lanatus* (Donald, 2003). It is cultivated extensively for its pleasant-tasting fruit. Watermelon is of the twelve species of the family of Cucurbitaceae cultivated by man. It is the major vegetable crop in the United States and other parts of the world and account for 6.8% of the world area devoted to vegetable crop production (FAO, 2002).

The vine, an annual plant is coarse and hairy and bears divided, oval leaves on short stalks and round, light yellow with individual flowers. The rounded, oblong, berrylike fruit grows to a very large size. The thick rinds are green and the watery parts are usually red in colour and contain many dark flat seeds (Prashant *et al.,* 2011).

Watermelon rinds usually light green or white colour are also edible and contain many hidden nutrients, but most people avoid taken them due to their unappealing flavor, sometimes used as vegetable. Watermelon joice can be made into wine (Charles, 2005). They are used as animal feeds (Nadkarni, 1954).

Watermelon seeds are used as masticatory article and the residue is used as a source of heat energy for cooking (Nadkarni, 1954). Watermelon seed contains oil which is rich in linoleic acid, and used for frying and cooking in some African and Middle Eastern America countries owing to its unique flavor (Akoh and Nwosu, 1992). Watermelon seed oil is light, penetrating and rich in essential fatty acid (Mahendra, 2006; Oyving and Kenneth, 2006; Kathirvel and Sujatha, 2012) In Nigeria, the major source of edible oil are peanut (*Arachishy pogoea)* and oil palm (*Eloesis guineensis*). These oils are used mainly as cooking oils, for the production of soap, margarine and cosmetics (Ong *et al.,* 1995). With increasing demand which has led to importation of cooking oils, there is need to source for local oil-bearing seeds which can be used in production of oils, both for consumption and industrial applications. Again there is an increasing trend toward production of alkyl ester as basic oleo chemicals. This alkyl ester can be obtained from palm oils (Choo and Goh, 1987; Choo *et al.,* 1986; Ouilly *et al*., 2017). The production of palm oil is labour and capital intensive (Ong *et al.,* 1995), hence, the need to source for other oil - bearing local raw materials (such water melon seed) that will not require large amount of labour and capital. The purpose of this study is to extract and analyze oil from watermelon seed.

Materials and Method

Collection and identification of sample

The watermelon seed used for this study was obtain from a local market in Mubi, Adamawa State Nigeria and was identified as *Citrullus lanatus thumb* by the department of biological science, Faculty of science Adamawa state University Mubi.

Sample preparation

The peeled and unpeeled seed of water melon were mechanical cleaned and were kept in moderate temperature to dry in the laboratory. The sample was grounded using motor and pestle. The fine powered sample was stored in clean and dry sample container for the analysis.

Extraction of oil

100ml extraction flask was weighed empty and 40g of the grounded water melon seed was folded in a thick filtered paper and inserted into an extraction thimble. It was place in the Soxhlet extractor, the flask was connected to petroleum spirit (40 – 60^0C) filled with extractor and the solvent siphoned over and over until it was colorless then the solvent was gently boiled under reflux. At the end the solvent was evaporated by direct heating on water bath (69^0C). Then the flask containing the oil was oven dried 30 – 40^0C for at least 30 minutes. It was allowed to cool and weighed to find its mass. The result was carried out in three replicates (Jensen, 2007).

Chemical analysis of watermelon seed oil

Saponification

0.5g of the oil was weighed into 250ml conical flask fitted with an air condenser. It was dissolved in 10ml alcohol and 10ml of 2.5KOH solution. The sample flask and the blank was kept on the water bath to boil gently and steadily until it saponified and an appearance of clear solution about an hour later. It was cooled and two drops phenolphthalein was added and was titrated with standard 1M oxalic acid until the pink color disappear (AOAC, 1990).

Iodine

1g of the oil and 25ml of chloroform was weighed into 500ml conical flask. 30ml of wij's solution was also added. The flask was shaken and was allowed in the dark for 30 minutes. 30ml 15% KI and 10ml of water was added. The liberated iodine was titrated with standard 0.1M sodium thiosulphate solution using starch (AOAC, 2000).

Acid value and fatty acid

2g of water melon seed oil was weighed into 250ml conical flask, 25ml 96% alcohol was added and 1ml phenolphthalein was added as indicator and was shaken. The solution was titrated with 0.1M NaOH, with constant shaking until pink color was obtained, but the pink color disappears after a while (AOAC, 2000).

Peroxide value

1g of watermelon seed oil was weighed in to 250ml conical flask, 25ml of a solvent (n – hexane), 15ml KI solution was added and was allowed in the dark for 5 minutes. 35ml of distilled water and 3ml of starch oil was added. The solution was titrated with 0.1M sodium thiosulphate. The same procedure was taken for the blank using distilled water (AOAC, 2000).

Physical characterization of water melon seed oil

Specific gravity

A clean dry density bottle was weighed with the stopper, it was then filled with distilled water while the excess was wiped by a cotton wool and weighed. The bottle was emptied, dried, refilled with oil and weighed again (AOAC, 2000).

Refractive index

Abbe's refractor meter was the instrument used for the determination. The instrument was first standardized by taking the refractive index of distilled water. After cleaning and adjustment, the refractive index of water melon seed oil was taken. The oil sample was dropped on transparent glass which was reflected and viewed. The reading was taken in accordance with AOAC (2000)

Color of the oil extract

The color of the peeled and unpeeled seed oil of water melon was determined visually.

Results and Discussion

Table 1 shows the result of the chemical properties of oil from peeled and unpeeled seed of water melon. While Table 2 shows the physical properties of oil from peeled and unpeeled seed of water melon. Codex standard for chemical and physical characteristic of crude vegetable oil are presented in Table 3.

Table 1: Chemical properties of oil from peeled and unpeeled seed of water melon

Parameter	peeled seed value	unpeeled seed value
Oil content (%)	63.00	58.00
Iodine value (mg/g)	9.61	13.87
Saponification value (mg/g)	123.2	61.6
Perioxide value (meqquiv O_2 Kg)	3.00	4.00
Acid value (%)	5.63	4.54
Free fatty acid (%)	2.83	2.28

Table 2: Physical properties of oil from peeled and unpeeled seed of water melon

Parameter	Peeled seed	unpeeled seed
Specific gravity (g/cm^3)	0.90	0.84
Refractive index	1.49019	1.49006
color	light yellow	light yellow

Table 3: Codex standard for chemical and physical characteristics of crude vegetable oils

Parameter	Cassia seed oil	Arachis Oil	Babussu oil	Coco-nut Oil	Cotton Seed oil	Sesame Seed oil	Soya Bean oil	Mustard seed oil	Palm oil	Sunflo-wer Seed oil
Relative Density	-	0.912-0.920	0.914-0.917	0.908-0.921	0.918-0.926	0.915-0.924	0.919-0.925	0.910-0.921	0.891-0.899	0.918-0.923
Refractive index	1.456	1.460-1.465	1.448-1.451	1.448-1.450	1.458-1.466	1.465-1.469	1.466-1.470	1.461-1.469	1.454-1.456	1.461-1.468
Iodine Value	95.02	86-107	10-18	6.3-10.6	100-123	104-120	124-139	92-125	50.0-55.0	118-141
Saponi-fication Value	183	187-196	245-265	248-265	189-198	186-195	189-195	168-184	190-209	188-194
FFA (as percentage oleic acid) fats and oil						0-5%				
Peroxide value										
Other fats and oil						Up to 10milliequavalents active oxygen/kg oil				
Virgin oil and cold pressed fats and oil						Up to 10milliequavalents active oxygen/kg oil				

FAO/WHO. 2011.

Discussion

The chemical properties of oil from peeled and unpeeled seed of water melon were shown in Table 1. The % of oil extracted from peeled seed of watermelon was 63.00% while that of the unpeeled seed was 58.00%. This shows that water melon peeled and unpeeled seed can serve as a good raw material that will produce oil of commercial quantity. The % of the oil extracted is in comparison to ground nut oil (60%) which is in line with the report of AOAC (1990).

Iodine value of the peeled seed oil was 9.61mg/g while the unpeeled seed oil was 13.87mg/g. This shows that the oil is non – drying oil because the iodine value of non – drying oil ranges from 9.00 – 65.00mg/g, semi – drying oil ranges from 85- 130 mg/g and drying oil range from 150 – 200mg/g. Oil within this range is very good for the manufacture of cosmetic and as adhesives (Americana Encyclopedia, 2000).

The saponification value of peeled seed oil was 123.2 mg/g while that of unpeeled oil was 61.6mg/g. This shows that the oil cannot be easily saponified as compared to that of codex standard oil (168 – 265 mg/g) in Table 3. Saponification value indicates the average molecular weight of oil (Booth and Wickens, 19880). Low saponification value indicates larger molecular weight than the common oil. Oils with low saponification values can be used for candle and soap production and as chemical feed stocks for lubricant (Samy and Ignacimuthu, 2000).

The peroxide value of peeled seed oils was found to be 3.00 meqquive O_2/Kg while that of unpeeled oil was found to be 4.00 meqquive O_2/Kg. The peroxide value is the measure of oxidative rancidity of oil (Ekpa and Ekpa, 1996). Fresh seed oils exhibit peroxide value less than 10 meqquive O_2/Kg oil while 20 – 40 meqquive O_2/Kg oil results in rancid (Akubuwo and Ugbogu, 2007). Oxidative rancidity is the addition of oxygen across the double bonds in unsaturated fatty acid in the presence of enzymes of certain chemical compounds. The odor and flavor associated with rancidity are due to liberation of short chain of carboxylic acids. High peroxide values are associated with higher rate of rancidity. Variation of peroxide value could be due to the number of unsaturated fatty acid content, since rate of autoxidation of fats and oil increase with increasing level of unsaturation. The low peroxide value of the oils indicates that they are less liable to oxidative rancidity at room temperature (Bazil, 1985).

The acid value of peeled seed oil was observed to be 5.63 % while the unpeeled seed oil was found to be 4.54%. Acid value of oil measures the extent to which they glycerides had been decomposed by lipase action. The decomposition is actually accelerated by heat and light. Deterioration of grains and milled products had been reported to be implicated by increasing acidity. The acids that are usually formed include free fatty acid, acid phosphates and amino acid. Free fatty acids are formed at faster rate than the other type of fatty acid (Baumer, 1996). The low acid values also indicate that the oil could be stored for a long time without deterioration. Acid value is used as an indicator for edibility of oil and suitability use in paint industry (Eckey, 1954).

The free fatty acid value of the peeled seed oil was 2.83% while that of the unpeeled seed oil was 2.28%. The values obtained were below the 5.00% FFA content recommended as the maximum for non – rancid oil (Samy and Ignacimuthu, 2000) and codex standard. This implies that the oils are not rancid.

Table 2 shows the physical properties of peeled and unpeeled seed oil of water melon which gives a light yellow color. The specific gravity (at 25^{O}C) of the peeled seed oil was 0.90 g/cm^3 while the unpeeled seed oil was 0.84 g/cm^3. The present value was almost comparable with coco nut oil and palm oil of the codex standard (Table 3). According Minzangi *et al.*, (2011) seed oil containing specific gravity within the range of 0.880 – 0.9400 g/cm^3 are more suitable for edible purposes whereas those with values 0.8114 – 1.0714 g/cm^3 have more potential for biofuel.

The values of refractive index for oil from water melon seed were found to be within the range of some common vegetable oils (Table 3). The refractive index of the peeled seed oil was 1.49019 while that of unpeeled seed was 1.49006. The refractive index and specific gravity are two physical parameters which provide useful information about the purity of vegetable oil. As such vegetable oils have certain range for this parameters and deviation of the data from set specification may indicate adulteration of oil. Both of these parameters are supportive in the assessment of relative purity an identity of oils and fats.

Conclusion

The result of the study revealed that the peeled and unpeeled seed of water melon found in this area contains high % of the oil which indicate that the seed can serve as a good sources of raw material for oil on a large quantity for commercial purposes. The analysis also showed that the oil from peeled and unpeeled seed were nondrying oil which suggest that they can be used in industries for the manufacture of cosmetics and adhesive. The oils are hardly saponified, meaning that the oil can be used for candle and soap production and as chemical feed stock for lubricant. It can be kept for a long time without becoming rancid. Also the oil is edible with low acid values and unique odor. Therefore, the oil from water melon seed (peeled and unpeeled) found in this area are of high quality for domestic use as well as industrial applications**.**

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