Extractaion, Characterization and Physiochemical Properties of Melon Seed Oil

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ABSTRACT

In this research, Melon seeds oil was extracted using n-Hexane as an extracting solvent by soxhlet extraction method. The physiochemical properties was conducted to determine some necessary parameters of the extracted oil(Acid value, Saponification value, Iodine value and Peroxide value) and FT-IR analysis was employed to identify the functional group of the extracted oil. The results revealed that the oil was golden yellow colour, oil content was found to be 35%, acid value 7.07mg/g, saponification value158.82mg/g, iodine value 113.31g/100g, and peroxide value 5.07meq/kg. The results indicated that the oil are semi drying oil which are suitable for industrial application such as soap, cosmetics, paints and medicine due to the high iodine and saponification value. The low acid and peroxide value suggest that the oil are suitable against oxidation and rancidity. The FTIR spectra show that the oil contain some high degree of unsaturated fatty triglycerides which suggests that the oil has not been activated or used for any reaction and it suitable for epoxidation and others group present are in agreed with results of some reviewed literatures.

Keywords: Melon seed oil, characterization, physiochemical properties, and extraction.

INTRODUCTION

The escalating global population has intensified food demands, placing substantial pressure on available land resources. Recognized by various stakeholders, including national governments and international agencies such as the Food and Agricultural Organization (FAO), vegetable crops are acknowledged as economical sources of energy [1, 2]. Rich in phytochemicals and vital nutrients such as carbohydrates, carotene, protein, vitamins, ascorbic acid, tannins, and essential trace minerals [3, 4], these crops play a crucial role in meeting dietary needs. The burgeoning interest in essential oils, characterized by their volatile and aromatic compounds derived from plant sources, has propelled them into the spotlight as versatile components with multifaceted applications across diverse industries. These industries encompass a wide spectrum, ranging from cosmetics and pharmaceuticals to the therapeutic realms of aromatherapy [5, 6]. Essential oils, often extracted through methods such as steam distillation, have emerged as pivotal contributors to the formulation of various products and therapies, owing to their distinct and potent chemical compositions. Within the expansive array of plant species yielding essential oils, the egusi melon [7] stands out prominently due to its unique and noteworthy properties.

The Citrullus lanatus is the important melon species in Africa [7]. The egusi plant is a genus of a desert vine, having its stem climbing up its trail. Members bear small sepals, solitary staminate flowers, and a corolla that is 5-parted to the base. The leaves are not or rarely divided beyond the middle, the fruits are smooth, or at most green-lined or hairy and a ground trailer [8]. The leaves are soft to touch, with a broad sinus and distant lobes at the base. Egusi melon comprises of a fleshy mesocarp which occurs during the third week of cultivation.

Egusi seed is enclosed in the mesocarp and must be scooped out, dried and dehulled before utilisation [9]. The good seeded melon (Citrullus lanatus) which is small flat and oval has a soft golden brown seed coat, which must be dehulled before the tinny white seed is obtained. The dehulling can be manually done by hand twisting its flexible shell, or mechanically using a dehulling machine [9].

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The egusi plant can withstand pests and diseases because it covers the ground as it grows and can help reduce the growth of unwanted plants [7]. This attribute of egusi makes it the number one choice for farmers when it comes to intercropping with sorghum, cassava, coffee, cotton, maize or bananas. Egusi seed must be dehulled to obtain the inner white seed is obtained. Studies by researchers indicate that egusi melon pods have an almost spheroidal external shape and an ellipsoidal seed cavity. Mature egusi melons can also remain in the field for a long time without rotting, so crop loss and loss of plant nutrient due to leaching of soil and erosion is minimised while the waste of plant during harvest is rare. Once the seeds are harvested, rot and spoilage are rare [10]. The applications of the oil extracted from egusi melon (Citrullus lanatus) seeds are both broad-ranging and historically rooted in diverse domains. A historical thread weaves through its utilization in traditional medicine, where melon seed oil has been recognized for its purported anti-inflammatory and antioxidant properties, as detailed [11]. This historical significance underscores a rich legacy of the melon seed oil's therapeutic potential, prompting a deeper exploration into its traditional medicinal roles. In culinary field, the multifaceted utility of egusi melon seed oil takes center stage. Beyond serving as a cooking medium, the oil imparts a distinctive and nuanced flavor profile to a myriad of dishes. Its incorporation into culinary practices not only adds a sensory dimension but also highlights its cultural and gastronomic importance, enriching the culinary landscape with the essence of the egusi melon. Moreover, contemporary research endeavors are actively expanding the horizons of melon seed oil applications. Ongoing studies, exemplified [12], delve into the unique fatty acid composition of the oil. This distinctive composition, marked by specific fatty acid profiles, has positioned melon seed oil as a subject of keen interest in cosmetic formulations and industrial processes. The exploration of its potential in these realms reflects a forward-looking dimension, offering promising avenues for innovation and practical application in diverse industrial sectors. The study aim to extract the Melon seed oil, characterize and investigate the physiochemical properties of the oil.

MATERIAL AND METHODS

Material

The chemical reagents used are n-Hexane (AR, Kermel, > 99%), Glacial acetic acid (36%, Loba Chemie), Hydrogen peroxide (AR, JHD, 99%), Wij's & Iodine solution (sigma Andrich, > 98%), other's chemicals used were analytical grade, and distilled water.

Collection Of Plant Material

Melon seeds were obtained from Oja Oba local market in Ado-EKITI, Ekiti State, Nigeria.

Methods

Seeds Preparation

The seeds were sundried for easy dehulling, after which it was dehulled manually.

Pulverisation Of The Seeds

The dried melon seeds was grinded into a fine power.

Extraction Of Oil

The dried melon seed powdered was soxhlet extracted using n-Haxane solvent at about 60°C on a heating mantle, the extraction with n-Haxane solvent is stopped when the extractant becomes colourless in the stem of the soxhlet extractor, after which the solvent was separated from the melon seed oil by distillation. The oil obtained was weighed and the percentage oil yield was calculated using the expression below:

$$\% \text{ Yield} = \frac{Extracted\ Oil\ weight}{Melon\ seed\ powder\ weight} \times 100\%$$

The oil was thereafter stored in an airtight container (glass) under cool condition before use.

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Determination Of Physiochemical Properties of Melon Seeds Oil

The standard procedures to determine Physiochemical properties of Oil were described and strictly followed according to Association of official Analytical chemists [13].

The Association of Official Analytical Chemists [13], described standard procedures to characterize the oil's physicochemical properties.

Determination Of Acid Value

In 250ml beaker, 25ml of diethyl ether and 25ml of ethanol were combined. The resulting mixture was added to 10g of oil in 250ml conical flask, along with few drops of phenolphthalein indicator. With constant shaking, the mixture was titrated with 0.1M NaOH until a dark pink color was detected and the volume TV was recorded. The acid value (AV) was calculated using the expression

$$\mathrm{AV} = \frac{TV \times N \times M}{W} \quad (eqn: 1)$$

TV is the titre value, N is the normality of NaOH (0.1 M), and M is the molar mass of NaOH (40.0), and W is the Weight of the oil sample. The acid level evaluates the extent of oxidation in the oil.

Determination Of Saponification Value

A Flask was filled with 2g of Oil. The mixture was then gently boiled for 1 hour under a reflux condenser with 25ml of the alcoholic potassium hydroxide solution added. At regular intervals, the flask contents were swirled. Then 1ml of phenolphthalein indicator was added and titrated to permanent pink color using conventional 0.5M HCl. Titrations were performed while the solution was still hot. Under the same conditions, the blank was also identified. The saponification value (SV) was calculated using the expression:

$$\mathrm{SV} = \frac{(B-S) \times N \times M}{W} \quad (eqn: 2)$$

B = blank titre value, S = sample titre value, N = normality of KOH (0.5 M), M =molar mass of KOH (56.1), and W =Weight of oil sample. It is used in evaluate adulteration in oil and its potential in soap making.

Determination Of Iodine Value

Wijs method was applied to calculate the iodine value, in which 0.2g of oil was weighed and placed in 250ml conical flask. 10ml of carbon tetrachloride was poured into it, as well as a blask 250ml conical flask. Each flask was filled with 25ml of Wijs reagent. The mixture was thoroughly mixed and left in the dark for one hour. After adding15ml of 10% potassium iodide solution and 100ml of distilled water, the contents both flasks were titrated with standard 0.1M sodium thiosulphate solution. To ensure that the iodine in the carbon tetrachloride layer was transpoted to the aqueous layer, a starch indicator was utilized near the endpoint with continuous shaking during the titration. The existing unsaturated bonds absorb iodine to saturate the double bonds, and any residual iodine is subsequently titrated with sodium thiosulphate. The iodine value (IV) was calculated from the equation 3**.**

$$\mathrm{IV} = \frac{(B-S) \times M \times 12.69}{W} \quad (eqn: 3)$$

Where: IV =Iodine value of samples, S =Volume of $Na_2S_2O_3$ used for sample (ml), B =Volume of $Na_2S_2O_3$ used for blank (ml), W =Weight of sample used (g), M = Molarity of the $Na_2S_2O_3$ used.

Determination Of Peroxide Value

5g of oil was placed in 30ml glacial acetic acid/ chlorofoam (3:2 v/v) and a saturated solution of potassium iodide (0.5ml) was added to liberate iodine by reacting with peroxide. The resultant solution was titrated against a solution of sodium thiosulphate (0.01M) using a starch indicator until the yellow color vanished. The peroxide value PV was calculated from equation 4.

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$$PV = \frac{(S-B) \times M \times 1000}{W} \quad (\text{eqn: 4})$$

Where: PV =Peroxide value of samples, S = Titre volume used for sample (ml), B = Titre volume used for blank (ml), W =Weight of sample used (g), M = Molarity of the $Na_2S_2O_3$ (0.01M) used.

Table 1: physiochemical properties of Melon seeds Oil extract.

Property	Value
% Oil content	35
specific gravity (30^{o}C)	0.89
Colour	Golden yellow
Acid value(mg /g)	7.07
Saponification value (mg/g)	158.82
Iodine value (gi_2/100g)	113.31
Peroxide value (meq/kg)	5.07

Fourier Transform Infrared (Ftir) Spectroscopy Analysis

Fourier transform infrared spectroscopy spectrum of C. citratus extract (oil) was obtained using FTIR spectrophotometer (Agilent Technologies). FTIR used for chemical identification as each molecule and chemical structure creates a unique spectra. The IR spectra were accounted in % transmittance. The wave number region for analysis was 4000-650 cm^{-1} (mid-infrared range.) with resolution of 0.15 cm^{-1}.

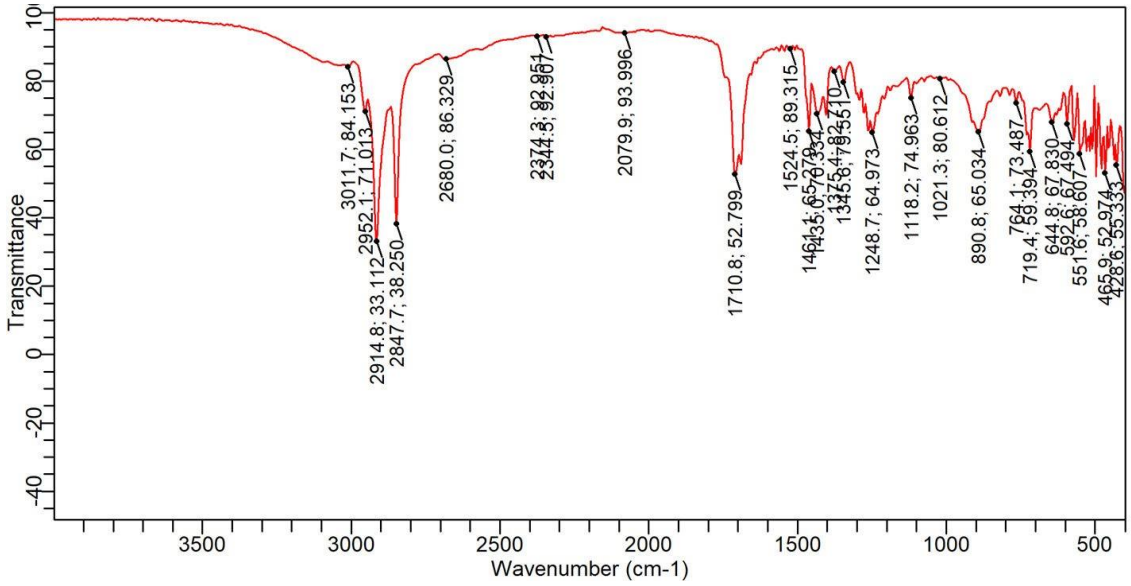

Fig.1: FTIR Spectra of Melon seed Oil.

RESULTS AND DISCUSSION

The pre-treatment/preparation of the Melon seeds was to removes dirty and other impurities by dehulling manually.[14]. The pulverization of dried melon seeds was to increases the surface area and to allow easy access of the solvent during extraction. The addition of n-hexane using soxhlet apparatus is to separate the oil content and oil colour been golden yellow, which is characteristic of edible oil.

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The physiochemical characteristic of melon seeds oil extract were shown in Table 1. Specific gravity was 0.89 which is in good range of most edible seeds oil (0.85-0.93) which shows that it's less density to water, and low viscosity according to [15]. Acid value is an essential measure for the degree of reactivity and degradation representing free fatty acid content and determined by mass of base material needed to neutralize the acid. The acid value 7.07 mg KOH/g as seen in table 1 which is range of the standard recommended value (less than 10) for edible oil and acceptability for industrial application. The acid value of 7.07 mg KOH/g is lower when compared with 9.05mg KOH/g of that Melon oil reported by Obieogu et al., 2024. This is however higher than the Melon oil (9.05mg KOH/g) that reported in [17]. However, acid values of oil can be influenced by the nature of oil, method of extraction, maturity of seeds, storage time and storage conditions as well as moisture and high temperature which can increase the acid value due to hydrolysis of glycerides into free fatty acids [18]. The saponification value of melon seed oil was found as 158.82mgKOH/g as expressed in Table 1. Saponification value indicates the typical molecular weight of the oil and also the oil molecular weight, a gage to its saturated level. As a result, a high saponification value implies that the oil has a more significant concentration of low molecular weight fatty acids. An iodine value of 113.31g/100 g of fat confirms that the oil with a greater iodine value results in more reactive and less stable fatty acids. The iodine value shows the presence of unsaturated fatty acid triglycerides in the oil. A higher iodine value implies there is a greater possibility that the iodide ions will connect to the unsaturated carbon chains [16]. Peroxide value of oils measures the oxidation and rancidity limits. The low peroxide value of 5.07meg/kg and as seen in Table 1, indicates freshness, stability against oxidation and rancidity [15].

Ftir Result

FT-IR analysis was employed to identify surface functional groups on extracted Melon seeds oil. Results are shown in figure 1. An absorption band between 1021.4 and 1118.3 cm^{-1} represents carbon-carbon double bond (c=c) which indicates that the oil contains unsaturated fatty triglycerides that can be suitably epoxidized [19]. The absorption band between 2847.8 and 2952.2 cm^{-1} validates the presence of carbon-hydrogen (C-H) stretching in methyl and methylene group respectively, which confirm the alkyl group in the oil. While 1461.1 and 1524 cm^{-1}.6 is the bending vibration of methyl and methylene group and also absorption band of 1710.8 cm^{-1} for ester group, which correspond to the functional group of egusi melon seeds oil.

CONCLUSION

Melon seed oil extracted, the physiochemical parameters indicate that the oil are semi drying oil, suitable against oxidation and rancidity and which are suitable for industrial purpose such as paints, soap, cosmetics, and medicine. The characterization of the oil revealed that some band intensities of some functional groups highly correlated with some important properties of melon seed oil and suggested the oil has not been activated.

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