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SOXHLET EXTRACTION AND CHARACTERIZATION OF OIL FROM CANARIUM SCHWEINFURTHII (BLACK DATE) FRUITS FOR DOMESTIC PURPOSE

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ABSTRACT

The fruits of canarium schweinfurthii are good source of oil, which can be extracted for various purposes. Extraction and characterization of oil from canarium schweinfurthii (Black date) fruits was achieved using solvent extraction method. The use of soxhlet extraction (Solvent extraction) gave a reasonable percentage of oil (51.2%) by weight in grams. Black date fruits contain high quality of oil. It contains fatty acid composed of oleic acid, linoleic acid, palmitic acid, stearic acid and others. The extracted and characterized oil has: density of 0.87g/cm3, specific gravity of 0.87g/cm3, flash point of 111^0C , viscosity of 36cp at 29^0C, saponification value of 125.4 mg/KOH/gram of oil, iodine value of 88.I2/100g of oil, peroxide value of 0.72ml/g of oil and free fatty acid content of 1.26%. These values are very close to those of the recommended codex standard for vegetable oil. Furthermore, the studied characteristics of the oil extracted shows that it may be used for many domestic and industrial purposes.

1. INTRODUCTION

In the last few decades, there have been growing concerns over vegetable oils as source of material in preference to petroleum or mineral oil. The main factor for this concern is due to environmental issues that regard mineral oil as major contributor of volatile organic compounds (VOCs) which themselves are responsible for most of our present recalcitrant pollution problems threatening the ecology. Oil processing expands the use of crops and also brings value to waste products [1].

Vegetable oils derived from plant seeds have been playing vital roles to provide comfort in human lives in various aspects. Plant seeds have been used since antiquity as sources of vegetable oil. Examples of some plant seeds which have been conventionally exploited commercially for this purpose includes soya beans, cotton seed, groundnut, corn, palm seeds and sunflower [2].

Fruits and Seeds of plants are a good source of food for humans, including animals, because they contain nutrients necessary for plant's initial growth, including many healthy fats, such as omega fats. In fact, the majority of foods consumed by human beings are seed-based foods. Edible seeds include cereals, Legumes and nuts. Oilseeds are often pressed to produce rich oils – sunflower, flaxseed, rapeseed, sesame. Seeds are typically high in unsaturated fats and, in moderation, are considered a healthy food, although not all seeds are edible [3].

Fats and oil are found widely distributed in nature, in both the plant and animal kingdoms and since ancient times human beings have known how to remove oil and fat from their natural sources and make them

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fit for their own uses [4]. Fats and oil are generally grouped as edible and inedible. They usually consist of mixtures of the glycosides' of various fatty acids [5].

Black date "Atili" also known as "Canarium schweinfurthii bursaraceae" is found in the kingdom plantae, because it is made up of multicellular and non-motile organism and its leaves also contain chlorophyll. It possesses vascular bundles placing it in the sub-kingdom tracheophyta. It falls under the super division spermatophyte seed plants because it is a higher gymnosperm. The embryo bears two cotyledons which places it in the class magnoliopsiodae dicotyledons. It also belongs to the sub-class rosidae because of its polypetalous corolla [6].

In Nigeria, the fruit of the perennial tree plant is called "ube okpoko" in Igbo and "Atili" in Hausa. The fruit is commonly found in large quantities in Pankshin area, Plateau state of Nigeria and is also produced in similar quantities in other state of northern and south-eastern Nigeria, The fruit yields fats and oil [7].

The plant produces its fruits in the rainy season, usually between the months of April and September. The flowers grow in clusters at the end of the twigs and are small and dark green in color, the fruit which are of two varieties – long spirals and short round in shape develop from the flowers [8].

The general methods employed in obtaining fats and oil from oil bearing fruits is pressing, solvent extraction and rendering. Obtaining crude oil and fats involve primarily physical changes or unit operations but chemical changes conversions are concerned in the refining and further processing of such oils [9].

2. MATERIALS AND METHODS

2.1. Sample Collection and Preparation

Fresh and well ripe fruits of the black date (Atili) tree were purchased from local market at Jos, Plateau state North-Central Nigeria. The fruits were sorted out to remove any dirt or foreign material present in them. They were then washed in cold water to remove any dirt adhering to the surface of the fruits.

The separation of the pulp with the seed was done manually. After the separation, the pulp is pounded into smaller particles and then dried.

2.2. Extraction of the Black date (*Atili*) oil

The grounded pulp was packed into the extraction chamber of the sox let extractor; while a solvent (N-Hexane) was poured into the round bottom flask of the extractor. The whole set-up was mounted on a heating mantle at 65^{O}C and allowed to reflux for about 8 hours.

The extract was filtered (to remove impurities) and evaporated using a rotary evaporator to isolate the free flow lipid from the solvent. The extracted oil was further evaporated in an oven at 150°C to eliminate any moisture and residue solvent that may be present. The weight of the oil produced and the residue were measured to ascertain the percentage of the oil content.

2.3. Characterization of the Extracted Oil

In evaluating the physical and chemical characteristics of the extracted oil, the following parameters: flash point, density, viscosity, specific gravity, saponification value, peroxide value, free fatty acid, acid value and iodine value were determined by using standard methods.

2.4. Fatty Acid Composition

The fatty acid composition of the oil sample was analyzed using a Gas Chromatography (GC) of model GC-2014, Shimadzu, Japan.

It is equipped with flame ionization detector (FID) and capillary column. The analysis of the sample was carried out by injecting 1 µl of the extracted oil into the GC. The identification of the fatty acid was achieved by retention times.

3. RESULTS AND DISCUSSION

1.3. Results

The results obtained from the experimental work of this project are presented in the Tables 1, 2, 3, and 4. The Tables include results of the oil yield of the extraction process, composition of the free fatty acid, as well as the physical and chemical characteristics of the extracted oil.

Table 1 Percentage Yield of the Black Date oil extracted

Time (hr)	1	2	3	4	5	6	7	8	9	10
Sieve Size (mm)	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18
Volume of Solvent (ml)	200	200	200	200	200	200	200	200	200	200
Temperature (°C)	65	65	65	65	65	65	65	65	65	65
Mass of sample	18.36	18.36	18.36	18.36	18.36	18.36	18.36	18.36	18.36	18.36
Mass of Obtained Oil	4.16	6.25	7.8	8.28	8.65	8.84	9.14	9.40	9.40	9.40
% Oil Yield	22.65	34.04	42.80	45.10	47.11	48.12	49.80	51.20	51.20	51.20

Table 2 Fatty acid composition of the oil extracted.

Fatty Acid	Percentage Composition (%)
Oleic Acid	36
Linoleic Acid	28
Palmitic Acid	26
Stearic Acid	7
Others	3

Table 3 physical Characteristics of the Oil

Parameters	Analyzed
Color	Dark Green
Odour	Agreeable
State @ room tempreture	liquid
Specific Gravity	0.87
Density(g/cm³)	0.87
Flash point(°C)	111
Viscosity at 29°C (cp)	36

Table 4 Chemical Characteristics of the Oil

Parameters	Analysed
Saponification Value (Mg Kohg-¹ Of Oil)	125.4
Iodine Value (1_2 g 100 g-¹ of Oil)	88.32
Peroxide Value (Ml g-¹ of Oil)	0.72
Free Fatty Acid (%)	1.26

3.2. Discussion

The oil yield of the black date after eight hours of extraction time was found to be 51.2% as presented in Table 1. From the results, it is clear that the percentage of oil yield increased from 22.26% to 49.80% as the time of extraction increased from 1hr to 7hrs, but eight hours after it became constant. The oil yield which is about 51.2% is high compared to the value reported in seeds of African star apple 12% [1] neem seeds 46%, cotton seeds 24% and groundnut 46% [10]. It is also higher than the Balanite Aegyptica seeds 34.52% as presented by [11]. This indicates that the black date may be good source of abundant oil for both domestic and industrial purposes.

Table 2 shows the presence of four major fatty acids in the extracted oil. The main unsaturated fatty acids are oleic acid (C18:1) and linoleic acid (C18:2), while the saturated fatty acids are palmitic (C16:0) and stearic acid (C18:0). The percentages of the acids present in the oil is 36%, 28%, 26% and 7% respectively as presented in Table 2. It is extremely important to realize that vegetable oils are mixtures of triglycerides from various fatty acids. Fatty acid compositions are used to describe the specific nature of fatty acids occurring in fats and oils [12]

Some selected physical characteristics of the oil extracted were presented in Table 3. The oil is a liquid at room temperature, dark green in color, the odour is agreeable and not offensive, and it has a specific gravity of 0.87 which shows that it's less dense than water. This value is close to those obtained by [13] and that of jatropa curcas oil as obtained by [14], which is similar to that of [15]. The oil has a viscosity of 36cp

at 29^{o}C, while the flash point of the oil was found to be 111^{o}C. This shows that it can be used for both domestic and industrial purposes.

The chemical characteristics of the extracted oil were presented in Table 4. The saponification value obtained was 125.4 mg/KOH/g of oil. This is lower than sesame seeds (189 - 190mg/KOH/g) as reported by [16]. However, according to [17] this saponification value is within the range of edible oils. The iodine value 88.32mg/100g is in close agreement with that obtained by [18]. Peroxide value is an index of rancidity, thus the low peroxide value of the oil indicates a resistance of the oil to peroxidation during storage and the low acid value is a reflection of the freshness and edibility. According to [19] the low acid and peroxide values are indicators of the ability of the oil to resist hypolitic hydrolysis and oxidation deterioration.

4. CONCLUSION

The results of the oil yield and other physio-chemical analysis of the black date (Atili) oil compared favourably with those of other conventional seed oils such as: groundnut, sesame, cotton, African star apple and others. The oil yield 61.2% is high compared to some oil seeds. It has a viscosity of 36cp at 29^{o}C, while the flash point of the oil was found to be 111^{o}C. This shows that it can be used for both domestic and industrial purposes. The oil is composed of saturated and unsaturated fatty acids, the main unsaturated fatty acids are oleic acid (C18:1) and linoleic acid (C18:2), while the saturated fatty acids are palmitic (C16:0) and stearic acid (C18:0). The percentages of the acids present in the oil is 36%, 28%, 26% and 7% respectively The low peroxide value of the oil indicates a resistance of the oil to peroxidation during storage and the low acid value is a reflection of the freshness and edibility. Conclusively, the *Atili* oils have potential for use as domestic and industrial oil.

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