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EXTRACTION AND CHARACTERIZATION OF OIL FROM DATE PALM SEED (PHOENIX DACTYLEPHERA) USING N-HEXANE

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ABSTRACT

This research aimed to extract, characterize and identify oil components in date-palm seed The date-palm were collected after eating several date-palm (seed). The extraction was undertaken with the aid of a soxhlet apparatus and a solvent hexane was selected based on the fact that it has a very low value of toxicity and A huge retraction rate. The particles gotten from were separate units from numbers i.e. 710um, 1mm and 2mm mesh size mesh size, which 40g each were measured and subjected to the extraction steps and the following values of oil were obtained: respectively: 363, 3.49 and 3.25 with the smallest particle size producing the highest yield. , While the result obtained from FTIR analysis showed the following functional group results CH_2, C=O, C=C, C-C, C-O. In the Oil Extract the physicochemical indicates acid value: 2.55mg/g, peroxide value: 1.40mg/g, Saponification value: 80.50mg/g, iodine value: 83.31mg/g, free fatty acid value: 6.71mg/g. However, from this analysis date palm seed oil has high oil value compared to other edible vegetable oil.

Keywords: Date palm seed oil, soxhlet apparatus Oil Extract, Oil Extract, Saponification,. , iodine value, free fatty acid value, peroxide value

INTRODUCTION

In desert regions of North Africa and the Middle East, dates, the fruits of the date palm tree (Phoenix dactylifera L.), are a significant staple food. The farming of date crop is also vital to the economy and social wellbeing of these areas. (Janick *et al*., 2008; Glasner, *et al*., 2002; El-Deek *et al*.,2010 The world's date varieties above 3000. Majorly diversify germplasm are uncovered in Iran, Iraq, Morocco, and Tunisia. (Zaid *et al*., 2002; Abdelmajid, 2005).

The date palm is an evergreen palm tree that grows to a height of 15 to 40 meters. Its fasciculate root system can extend six meters deep (Zaid *et al*., 2002). The cylindrical, straight, and up to 1-1.1 meter-diameter stem is called the stipe. The date palm has 100–120 enormous, 4–7-meter-long fronds. Phoenix dactylifera has male and female plants, making it a dioecious species. About 12 inflorescences are produced annually by female trees. With a central rachis and 50–100 spikelets, these spike-like clusters of up to 10,000 blooms resemble spikes. (Zaid *et al*., 2002; Ecocrop, 2011).

1.15 million ha of date palm trees were planted, with an average output of roughly 6.52 t/ha (FAO, 2011). Egypt, Iran, Saudi Arabia, the United Arab Emirates, Pakistan, Algeria, Iraq, Sudan, and Oman were the top producers (FAO, 2011). 70% of the date palms in the world are found in Arab nations (El- Juhany, 2010). Only 10% of the crop was exported in 2007; the majority is consumed domestically. Since Ancient Egypt's cultivation of the date palm about 4000 BC, it has been one of the earliest and most significant domesticated fruit crops (Ramawat, 2010). The best latitude for date palm trees is between 24 and 34°N in the Old World and between 33 and 35°N on the West Coast of the USA. Date palm trees are extensively distributed in dry and semi-arid locations between 10° and 39° in the Northern Hemisphere. (Zaid *et al*, 2002). Other nations like Pakistan, Australia, Mexico, South America, and South Africa have also adopted it (Janick *et al.*, 2008; Chao *et al.*, 2007). By using the Soxhlet extraction method, date seed can be converted into date seed oil. Oleic acid (Cl8:1), which makes up more than 50% of the fatty acid composition in date seed oil and is the primary fatty acid in the oil, is followed by palmitic acid (C16:0), lauric acid (C12:0), and 19% linoleic acid (C18:2) (Nehdi *et al*, 2010). Oleic, linoleic, lauric, and palmitic acids were present in Deglet Nour seed oil in amounts of 41%, 12%, 18%, and 11%, respectively, while they were present in Allig seed oil in amounts of 48%, 21%, 6%, and 15%, respectively (Besbes *et al*, 2004). According to Al-Shahib and Marshall's 2003a research, 24 cultivars of date seed oil have oleic acid contents that range from 41 to 59%.

MATERIAL AND METHODS

The materials and reagents used include n-Hexane, Date palm seed, Water, Ethanol,

Apparatus

The apparatus used includes a Soxhlet extractor, Round bottom flask, thimble holder, Rotatory evaporator,, date palm seed, sieve shaker model 160, mechanical grinder model (RRH-AS500), Weighing balance, beaker, when exposed to heat or flame

Sampling method

The method used for the extraction is the soxhlet extraction technique

Procedure for Extraction of Oil from Date Seed using N-Hexane as Solvent

Utilizing n-Hexane as the solvent, the date seed oil was extracted following the method described by (BS EN ISO, 2009). The date seed sample was collected from Kogi State University Anyingba market.

The seeds were separated manually and then washed in another to remove the peels and dried under the sun

The cleaned and washed seed was grinded using a mechanical grinder model (RRH- AS 500)

The grounded date palm seed was separated by a sieve shaker model 160

80 g of the grounded seed were weighed and transferred to a 30 mm x 200 mm cellulose thimble
It is then placed on a 500 ml distillation flask containing 300 ml of (n-Hexane)
The Date seed oil was then extracted under reflux with n-Hexane for 1,2,3 and 6 hrs (10-12 cycle/hour) n-Hexane was then removed by using a heated rotatory evaporator under vacuum condition.
All extracting processes were carried out in a triplicate, and the mean value was reported.
The yield of oil extract was expressed as a percentage of the weight of extract obtained from extraction relative to the weight of extract obtained from extraction relative to the weight of Date seed used for extraction.

$$Yield\ of\ oil\ extraction = \frac{(weight\ of\ oil\ extracted)\times 100}{(weight\ of\ date\ seed\ used)} \quad (1)$$

Procedure for Physiochemical Characterization of Date palm seed Oil Acid value of Date palm seed Oil.
lg of the grounded date palm seed oil sample was weighed and 75ml of hot neutral alcohol was added with a few drops of phenolphthalein. The mixture was shaken vigorously and titrated against 0.1M NaOH solution with constant shaking until the pink coloration remained permanent, acid value was calculated using the formular.

$$Acid\ value = \frac{V\times 5.6}{weight\ of\ sample} \quad (2)$$

were V = Titration end- point

Peroxide value
2 g of grounded date palm seed oil was weighed into a test tube and 1 g powderedpotassium iodide with 20 ml of solvent mixture (glacial acetic and Chlorofonn). was added, this was then placed in boiling water for 30s. The content was poured into a flask containing 200 ml of distilled water and titrated with 0.002N sodium thiosulphate solution using starch as an indicator. A blank was prepared alongside the oil sample.
The Peroxide value was calculated using the formula

$$Peroxide\ value = \frac{2(V1-V2)mg/kg}{weight\ of\ sample} \quad (3)$$

were V2 = Blank titre value
VI = Sample titre value

Saponification Value
2 g of oil sample was weighed into a conical flask and 250 ml of alcoholic potassium hydroxide was added, solution was heated in boiling water for 1 hour, l ml of 1% of phenolphthalein was added and titrated with 0.5M Of HCL. A blank was prepared alongside the oil sample. The value was calculated by the formular:

$$Saponification\ Value = \frac{56.1\ N(A-B)}{W} \quad (4)$$

Where
N = Normality of acid used
A = Volume of HCl for Sample
56.1= Equivalent weight of potassium hydroxide
W = Weight of oil used

Iodine Value
2g of oil sample was weighted into a dry glass stopper bottle of 250 ml capacity and 10ml of carbon tetrachloride was added to the oil. About 20ml of Wij's solution was added and allowed to stand in the dark for 30 mins. 15 ml of (10%) potassium iodide and 100ml water were added and then titrated with 0.1M sodium thiosulphate solution using starch as an indicator just before the end point. A blank was also prepared alongside the oil sample.
The Iodine value is calculated using the formula

$$Iodine\ value\ (Wij's) = \frac{(V2-V1)\times 1.269}{Weight\ of\ sample(g)} \quad (5)$$

Where
V2 = Titre value for blank
VI = Titre value for sample

Specific Gravity
The specific gravity bottle was oven-dried to remove existing after which its mass (empty) was measured and recorded, it was then filled with 25 ml of water and its mass was measured and recorded. The specific gravity bottle was then filled individually with an equal volume of oil extract while its mass was measured and recorded, the specific gravity of the oil extract was calculated using the formula below.

$$Specific\ gravity = \frac{W1-W2}{W3-W2} \quad (6)$$

Were W1 = Mass of specific gravity bottle + Oil extract
W2 = mass of empty specific gravity bottle
W3 = Mass of specific gravity bottle + water

Free fatty acid
The Free fatty acid is the acid value expressed in percentage. 5 g of the oil was weighed into a flask of hot neutralized ethanol and 2 cm3 phenolphthalein indicator was added and titrated with 0.1M sodium hydroxide.

$$\%Free\ fatty\ acid = \frac{[Titre\ value\times 2.82]}{Weight\ of\ oil} \quad (7)$$

RESULTS AND DISCUSSION

Results

Table 1: Percentage yield of Extraction

S/N	Weight of sample(g)	Volume of solvent (ml)	Extract + solvent (ml)	Reflux (times)	Weight of extract only	Yield of oil (ml)	Percentage yield (%)
1	80	300	245	9	8.82	42.0	11.03
2	80	300	244	9	8.81	41.0	11.03

Table 2: Saponification titer Value

Final	Titer Value (ml)	Initial Titer Value (ml)	Volume used (ml)
Blank	4.20	0.00	4.20
Sample	17.50	10.20	7.30

Saponification Value = 80.50 mg/kg

Table 3: Iodine Titer Value

Final	Titer Value (ml)	Initial Titer Value (ml)	Volume used (ml)
Blank	15.50	0.00	15.50
Sample	42.50	22.20	20.30

Iodine value = 83.31 mg/kg

Acid Value

Table 4: Acid Titer Value

Final Titer Value (ml)	Initial Titer Value (ml)	Volume used (ml)
34.90	0.10	34.80

Acid Value = 2.55 mg/kg

Peroxide Value

Table 5: Peroxide Titer Value

Final	Titer Value (ml)	Initial Titer Value (ml)	Volume used (ml)
Blank	15.70	1.00	14.70
Sample	16.20	0.80	15.40

Peroxide value = 1.40 mg/kg

Table 6: Free Fatty Acid Titer Value

Final	Titer Value (ml)	Initial Titer Value (ml)	Volume used (ml)
Sample	14.20	2.30	11.90

% Free Fatty Acid Value = 6.71

Table 7: Table for FTIR result on date palm seed oil

Group	Band Freq.(cm^{-1})
CH_2 (stretch)	2854.74
CH_3 stretch	2824.18
C=0 stretch	1743.71
C=C stretch	1651.12
CH_2 Bending	1458.23
CH_3 Bending	1381.08
=C - H Stretch	1535.23
C — O (Vibrations)	1095.80 – 1085.80 – 1033.39
C = N	2360.95

Discussion

The Current study shows that the present technique (FTIR) is powerful in discriminating among edible oils by comparing spectra data of the oils usually in the range of (4000 - 400).

The Result of the FTIR analysis on data palm oil shows several absorption bands, notably at 2854.74, 1743 and 1033.39, etc. due to the presence of several groups like CH_2, C=0, C=C, C-0 etc. in the oil extract.

The band at 2854.7 and 28.24.18cm^{-1} is due to the stretching vibration of the group CH_2 and CH_3 presence in the oil extracts.

The weak band at 1743.71 is due to the presence of the aldehyde carbonyl functions in the extracts.

The weak nature of the band may be due to the presence of impurities in the oil extracts.

However based on the fatty acid composition 95% of the date seed oil, it suggests the use of the oil for nutritional purpose, as an edible cooking oil and also for the production of margarine due to the high stability and resistance of date seed oil to thermal treatment which indicates the good shelf life and storability of the oil even for a long period.

Moreover different degree of unsaturation of date seed oil compared to other vegetable oil makes it a potential oil that can be developed for different uses than the already existing commercial vegetable oils.

CONCLUSION

Compared to other commercial vegetable oil, grape seed oil is the most similar oil to date seed oil in terms of tocopherolcontent (Adhikari *et al*., 2008).The review had shown that the total tocopherolcontent was found by (Nedhil *et al*, 2010). is greater than that of olive oil. As there is scarce information on date seed oil, perhaps more research should be conducted not only to identify the characteristic and it differences that will occur either inter or intra species, but also for the development of various edible and non-edible products.

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