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Extraction of Luffa eylindrica seeds and characteristics of the seed oil*

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ABSTRACT

The oil of the seeds of vegatable sponge (Luffa cylindrica)-from Southern Turkey-extracted by n-hexane. The refining methods of the crude oil was investigated.

The quality of the oil was determined according to the Turkish Standard Methods of T.S.E. which are prepared by recommendation of ISO***. The oil content of the seeds was found 23–26 % – even 32 % in good ecological conditions.

The oil-cake was found as a valuable by-product having 18–19 % of protein content.

Luffa eylindrica (vegatable sponge) is a member of the cucurbitaceae family of the Dicotyle donea class. It is cultivated in warm climates such as South America. Africa and Turkey.

Luffa eylindrica is an annual plant. It is sawn in the middle of February, the product is harvested in August, September and October. Flowering period continues to the second half of September. Fruits obtanied from the same plant are nearly the same size. It is cultivated in Turkey to use its spongy tissne as vegatable sponge. There are some investigations however on its value as food. (1,2) It looks that up to the moment the seede of Luffa eylindrica have not been yet considered as a source of oil in Turkey. It vould be interesting to investigate the seed-oil of Luffa eylindrica cultivated in in this connection.

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*** T.S.E. = Institute of Turkish Standarts.
ISO/R 660 (1968), ISO/R 661 (1968) ISO/R 662 (1968).

In this work orushed seeds of Luffa eylindrica has been extrated by n-hexane, refining of the crude oil has been achieved by various methods. The oil content of the seeds according to the ecological conditions also has been investigated.

EXPERIMENTAL

Material:

Luffa cylindrica was cultivated in Antakya-İskenderun region (Southern Turkey) in summer seasons of 1974–1975.

Chemicals were obtained from Fluka.

a) Fruit

The fresh fruits having 35–40 cm length and 12–15 cm diamater and weighing 600–700 g have been dried in air. Weight of the dried fruits are 88–96 g.

One of the air dried fruit weighing 91.4 g gave:

42.3 g seed ..... 46.3 % of total weight

21.2 g spongy tissue ..... 23.2 %

27.9 g peel, stalk etc .... 30.3 %

b) Seed

The seeds may be in different colours from white to black. They are dark grey mostly if the fruit is well ripen. Hull of the seed is very hard.

Size of the seeds : Length : 10–15 mm
Width : 5–7 mm
Tickness : 1.5–2 mm

Weight of 100 seeds : 14.53 g

54–59 % of the seed was found as kernel and 41–46 % as hull.

c) Extraction agent

Diethylether, *n*-hexane and carbon disulfide were tried for the extraction of the oil from the seeds. *n*-Hexane was found most suitable solvent for extraction and purification of the oil beeause the other solvents extracted non-lipid species more than *n*-hexane.

d) Extraction

The crushed seeds were dried at 105 °C for 30–35 minutes and kept in a desiccator. 100.00 g of the dried sample were used for each extraction and extracted by 600–650 ml of *n*-hexane in a Soxhlet apparatus for 6 hours. The extract was transferred to a pre-weighed flask. Hexane vas removed in a rotary evaporator and the weight of the crude oil was determined by the difference of the weights.

e) Crude oil

The crude oil was a dark greenish-red liquid. It has rather heavy odor. This crude product was observed containing considerable amount of non-lipid material such as free fatty acids, gums, resines etc.

f) Characteristics of the crude oil

Refractive index was determined by a thermostated ($\pm$ 0.1 °C) Abbe Refractometer and found as $n_D^{20} = 1.4722$

Viscosity at 25 °C was found as 10.3° Engler

Density was found as $D_{20}^{20} = 0.928$

Ash was found 0.072 % according to the Turkish Method of Stardards. (No. T.S. 894)

Free fatty acids-determination was carried out according to the Turkish Methods of Standards (No. T.S. 894)

Acidity number	: 9.32
Acid percentage (as oleic acid)	: 4.75
Saponification equivalent	: 180.0
Unsaponified part	: 1.45 %
Ester number	: 175.30
Glycerol	: 9.58 %
Iodine number	: 119.08 by Vijs method

Rodan number of the crude oil was determined according to the H.P. Kaufmann method and found as 66.30

Dien number was determined by addition of melein anhidride and found as 3.36

g) Refining:

Refining of the seed-oil of Luffa cylindrica was first achieved applying different methods. The oil was containing large amount of nonlipid impurities because it was not pressed oil.

To separate the refining agents from the oil after refining process which form emulsion and suspension has not been possible in laboratory scale for lack of a powerful industrial separator. The refining of the crude oil without using a powerfull separator has been possible by adding the refining agents to the solution of crude oil in *n*-hexane and removing the solvent when the frefining process was completed. Emulsion formation was highly diminished by this method.

I. Decolorizing

1.1–2 % silicagel was added to the hexane solution and mixture was kept in a water bath (45 °C) for 40 minutes, decolorizing was not satisfactory.

2.1–2 % activated carbon was added to to the hexane solution and mixture was kept in a water bath (45 °C) for 40 minutes. This process gave better result than silicagel, upper part of the mixture was pale in colour.

3. A mixture of activated carbon and silicagel (1:1) was added to the hexane solution and kept at 40 °C for 40 minutes. This process gave the best result in decolorizing The solution became almost colourless and decolorizing agents were removed by filtration under diminished pressure.

II. Degumming:

1– The warm water (65–70 °C) was added to the preheated miscella (65–70 °C) 7–8 % by volume. The mixture left for coagulation. After 60 minutes very few cougalation was observed. This was not satisfaetory.

2– Phosphoric acid (1 % by volume) was added to the preheated (30 °C) miscella and stirred vigorously for 30 second and

left for sedimentation of impurities. The result is much beter than the above process but was not satisfactory enough.

3– Miscella was first treated with 20 Bé sodium hydroxide solution as a reverse process of industrial procedure then washed with warm water (60 °C). and then phosphoric acid (1 % by by volume) was added to a nearly clear solution and a very rapid coagulation and sedimentation observed. The clear limpid solution separated and washed 4 times with distilled water and dried over anhydrous soduim sulphate.

After removing of hexane the refined oil was used for determinations of characteristics.

h) Characteristics of the refined oil:

Refractive indees n_D^{20} 1.4672

Density: D_{20}^{20} 0.921

Ash: 0.021 %

Free fatty acids: 0.17 % as oleic acid

Saponification number	:	191.54
Unsaponified part	:	0.033 %
Ester number	:	191.37
Glycerol	:	10.46 %
Iodine number	:	119.08
Dien number	:	3.43

ı) Oil-cake

Because all lipids and hexane soluble non-lipid metarial has been extracted by hexane the oil-cake was not investigated deeply. To estimate its value as animal food only ash and protein content was determined via nitrogen percentage.

Ash in the oil-cake was found 2.23 %.

Nitrogen was determined in oil-cake by Dumas and Kjeldahl methods. It was found 2.96 % by Dumas method and 2.92 % by Kjeldahl method. Avarage protein content of the oil-cake 2.94x6.25 = 18.37

RESULTS AND DİSCUSSİON

Effect of the season on oil content

The oil content of the seeds highly depends on the temperature of the season. Keeping all the other factors the same the oil contents were found 26.09 in the product harvested in September, 23.50 % in the product harvested in October.

Effect of the watering on oil content

Three group of plants were chosen to investigate the effect of watering. Water was given ones a week to the first group, twice a week to the second and three times a week to the third. The fruits harvested from each group of plants 28 days later after flowering, dried and oil contents of the seeds were determined.

The oil contents were found 23.7 %, 25.2 % and 32.2 % respectively.

Oil loss in storage

The oil content of the same sample (product of September 1974) was determined both in November 1974 and in November 1975. It was found as 24.1 % in 1974 whereas it was 21.8 – one year later. Appearently oil content of the seeds decrease in storage by physiological activity of embrio.

Ouality of the oil:

Having rather high iodine number (over 109) and rodan number (over 60) the oil was found as a drying oil. The abundance of unsaponified species is reasonable for the oil under investigation was an extraction oil. The refined oil was found as edible oil according to the ISO/R Standarts.

Oil-cake:

The oil-cake was found having 2.23 % ash and 18,37 % protein. It may be a valuable by-product as animal food.

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ÖZET

Bu çalışmada Antakya-İskendurun bölgesinde, yetiştirilen lif kabağı (Lufta cylindrica) bitkisinin çekirdek yağı ekstraksiyon yöntemile alınarak yağ yüzdeleri saptanmış, ekolojik koşulların yağ miktarına etkisi incelenmiştir.

İncelenen yağ ektraksiyon yağı olduğu için sabunlaşmıyan madde miktarının yüksek çıkması da doğal görülmektedir.

Lif kabağı çekirdek yağı fabrika koşullarında kolay arıtılabilecek yarı kuruyan bir bitkisel yağdır (İyod indisi > 109, Rodan indisi > 60'dır).

Arıtılmış yağın Türk Standartlarına göre yenilebilir nitelikte olduğu küsbenin % 18–19 protein içerdiği ve iyi bir hayvan yemi olabileceği görülmüştür.

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