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MICROWAVE ASSISTED EXTRACTION AND ANALYSIS OF COTTON SEED OILFROM Gossypium herbaceum L.

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Abstract
The present study reports the extraction of oil from cotton seeds using Raga,s scientific microwave oven. Powered seed were extracted with n-hexane as a solvent. The chemical properties of the oil determined include the saponification value, free fatty acid, iodine value, peroxide value and acid value. The physical properties of the oil determined are viscosity, Density, refractive index, Surface tension, color, and pH. The values obtained are Saponification value (210mgKOH/g), free fatty acid value (4.899mgKOH/g), iodine value (92.52gI/100g), peroxide value (7.862mEq/kg) and acid value (9.798mgKOH/g). The oil yield was 38%.From the results obtained it can be seen that oil with low free acid value usually have high saponification value signifying that it is utilised for edible purposes and for manufacturing soaps also.

Keywords: microwave-assisted, Cotton seed oil, physico-chemical

1. INTRODUCTION

Cotton is one of the most important fibre crops and is grown in tropical and subtropical regions. India is the largest natural source of fibre, In which cotton is the most important commercial crop. Thus, cotton production plays a vital role in Indian economy, providing employment for more than one million farmers [1-3]. The often-ignored fact is that the cotton plant produces more food for us and feed for animals than fibre. Cottonseed contains hull & kernel. The hull produces fibre and linters. The kernel contains oil, Proteins, carbohydrates and other constituents such as Vitamins, minerals etc. [4]. Cottonseed oil is extracted from cottonseed kernel. It is also termed as 'Heart oil'. It is cholesterol free and additional benefit from cottonseed is its high level of antioxidants-tocopherols [5-6].

The most common method which is used in laboratories for extraction of oil from solid samples are soxhlet, goldfisch, and folch methods. All these method required 8 to 24 hrs. Nowadays, microwave assisted extraction are successfully applied for the seed oil extraction and known as proficient extraction technique that significantly decrease extraction time, increasing yield and enhancing the quality of the extract [7-8] and more environmental friendly.

The aim of present investigation was to extract cotton seed oil by using microwave technique. Also to study its physico-chemical parameters to prove its utility for good health.

2. MATERIALS AND METHODS

Cotton seed *Gossypium herbaceum L.* were collected and then dried for sometime before usedamaged seed were discended and a healthy and clean seeds were selected and cracked and then ground in a pestleand morter food grinder to reduce the particle size, (sealed in a plastic container and stored in refrigerator until extraction).All the chemicals and reagents used were of analytical grade and were purchased from Qualigen. Distilled water was used in the preparation of solution and dilution.

SEQUENTIAL MICROWAVE ASSISTED EXTRACTION

A RAGA's microwave oven with power settings range from 100-750W was used for oil extraction. 5 g of powder of seeds was taken in a 30 ml vial containing 12 ml hexane and subjected to full power of microwave irradiation. After 20 sec microwave heating the vial was taken out and shaken vigorously to cool. The vial was again placed into the oven for further 20 sec. The same practice was repeated after each 20 sec so that to obtain the 2 minutes of microwave oven exposure. After extraction, the miscella was collected and replaced with fresh solvent. The process was repeated four more times to attain a 10 min of microwave exposure. After oil extraction, the solvent was recovered by simple distillation using a rotary evaporator and the residual oil was oven-dried at 75°C for one hour. The oil was then transferred to a desiccator and allowed to cool before being weighed. Following were the chemical properties determined by the standard procedure.

CHEMICAL PROPERTIES OF COTTON SEED OILS

ACID VALUE

Acid value was determined using the formula

$$\text{Acid Value} = \frac{56.1 \times M \times V}{W}$$

Where, M = Concentration of KOH
V = Titre value
56.1 = Molecular weight
W = Weight of oil sample

Saponification value

The saponification value was determined by the standard method. This saponification value (SV) is given by:

$$S.V = \frac{(S - B) \times M \times 56.1}{\text{sample weight(g)}}$$

Where, S =sample titre value
B = blank titre value
M = molarity of the HCL
56.1 = molecular weight of KOH

IODINE VALUE

The iodine value was determined by the standard method. This value is calculated by the expression:

$$I.V. = \frac{12.96C(V1 - V2)}{w}$$

Where, C – concentration of sodium thiosulphate us
V_1 – volume of sodium thiosulphate used for the blank,
V_2– volume of sodium thiosoulphate used for determination,
W– weight of the sample.

PEROXIDE VALUE

The peroxide value was determined as follows:

$$P.V. = \frac{(S-B)\times M\times 1000}{W}$$

Where, Peroxide value= Meq Peroxide per 100g of sample
S = volume of titrant(cm^3) for sample
B = volume of titrant(cm^3)for blank
M= Molarity of sodium thiosulphate($Na_2S_2O_3$ in mEq/cm3)
1000=conversion of units (g/kg).
W = weight of oil sample (g).

FREE FATTY ACID VALUE

Free fatty acid value was determined by using the formula,

$$\% \text{ FFA} = \frac{V_0 \times 2.82 \times 100}{W_0 \text{ (g)}}$$

where , 100 ml of 0.1 M NaOH = 2.83 g of Oleic acid,
W_0 = sample weight;

PHYSICAL PROPERTIES OF COTTON SEED OILS: PERCENTAGE YIELD

The oil which was recovered by complete distilling of the solvent on a heating mantle was then transferred into a measuring cylinder. The measuring cylinder is then placed over water bath for complete evaporation of solvent for about 2-3 hour in accordance with the method reported and volume of the oil was recorded and expressed as oil content (%) as follows.

$$\text{oil content (\%)} = \frac{\text{volume of the oil}}{\text{weight of sample}} \times 100\%$$

SURFACE TENSION

Surface tension of the water was determined by using stalagnometer as

$$\Upsilon_l = \frac{\eta_w d_l}{\eta_l d_w}\Upsilon_w$$

COEFFICIENT OF VISCOSITY

Coefficient of viscosity of the water was determined by using Ostwald's viscometer using water as reference

$$\eta_l = \frac{t_l d_l}{t_w d_w}\eta_w$$

REFRACTIVE INDEX

R. I. was determined by using Abbe's refractometer.

pH MEASURMENT:. It was determined by Equip-ronics pH meter.

RESULT

Physical properties of the extracted oil were summarised in Table 1.

IR SPECTRA OF COTTON SEED OILS

From the Fig.1, the spectrum was characterized with asymmetric and symmetric strong stretching vibrations of carboxyl group at 2852.92 cm^{-1} and aldehyde, ketones (C=O) group along with carboxyl group at 1744.94 cm^{-1}. C-O group combined with carboxylic group at 1162.75 cm^{-1}. Alkane groups strongly stretched at 2921.69, 2852.92 and 1460.29 cm^{-1}.

CHEMICAL PROPERTIES OF COTTON SEED OILS

Chemical characteristics including acid value, free fatty acid, peroxide value, iodine number and saponification value of cotton seed kernel oil were summarised in Table 2.

DISCUSSION

Table-1& 2 shows the physico-chemical properties of the extracted cottonseed oil. It is reported that oils with low free fatty acid usually have high saponification value (210mgKOH/g). This indicates that the oil could be used in soap making. The Acid value was obtained by multiplying the free fatty acid value by 2, giving a value of 9.798mgKOH/g[9]. Generally, the peroxide value should be less than 10meq/kg. The high values of PV are indicative of high levels of oxidative rancidity of the oils and also suggest absence or low levels of antioxidant [10].

CONCLUSION

The oil can be classified as non-drying based on the value obtained for Iodine value.

chemical analysis presented saponification value, peroxide value, acid value that fell within the range of those acceptable as having good storability and also suitability for soap production.

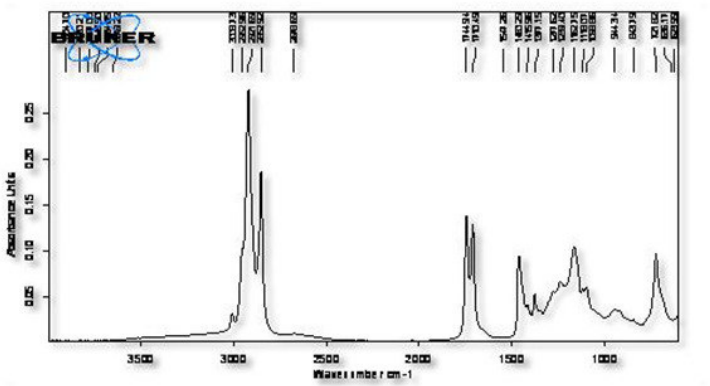
Table 1

S.N.	Parameters	Result
1	Colour of oil	Yellowish brown
2	Odour	pungent
3	Oil yield	38%
4	Refractive index	1.47
5	pH	5
6	Viscosity	492.155×10^{-3} Nsm^{-2}
7	Surface tension	34.664 dyne/cm
8	Density	0.9812 gm/ml

Table 2

S. N.	**Parameters**	**Result**
1	Acid value	9.798mgKOH/g
2	Saponification value	210mgKOH/g
3	Iodine value	92.52gI/100g
4	Peroxide value	7.862mEq/kg
5	Free fatty acid value	4.899mgKOH/g

Fig.1- IR spectra of cotton seed oil



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