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Physiochemical Parameters of Extracted Castor Oil in Saudi Arabia

Sarra Talab*

Department of Chemistry, College of Sciences, Al Imam Mohammad Ibn Saud Islamic University (IMSIU), P.O. Box 5701, Riyadh 11432, Kingdom of Saudi Arabia. Department of Chemistry, College of Applied and Industrial Sciences, University of Bahri, P.O. Box 11111, Khartoum 1660, Sudan.

***Corresponding author:** Sarra Talab, Department of Chemistry, College of Sciences, Al Imam Mohammad Ibn Saud Islamic University (IMSIU), P.O. Box 5701, Riyadh 11432, Kingdom of Saudi Arabia. Tel.: +966502658004
E-mail address: SATalab@imamu.edu.sa*

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ABSTRACT

Objectives: This study aimed at the extraction and characterization of castor seed oil purchased from local market in Riyadh, Saudi Arabia. **Methods:** Castor oil was extracted from beans via extraction with n-hexane by using Soxhlet apparatus. The oil was subjected to different test for characterizations. **Results:** A positive test with the disappearance of the purple color of $KMnO_4$ indicated the presence of double bond. Also the reaction of the oil with concentrated H_2SO_4 giving reddish brown color, has confirmed the presence of double bond. The physiochemical parameters were carried out by simple reaction and the result has showed that the color of the oil is pale yellow color, the density is 1.01 g/mL, peroxide value is 12.8 Meq/K, acid number is 0.6288 mg KOH/g and saponification value is 171.105 mg/g. **Conclusion:** The studied castor seeds contain a high percentage of oil, which is rich in unsaturated oil.

Keywords: *Castor beans; Castor oil; Physiochemical parameters; Ricinus communis*

INTRODUCTION

Castor oil is one of the few naturally occurring triglycerides that approach being a pure compound, since the fatty acid portion is nearly nine-tenths ricinoleic[1]. Its crude form is a pale straw colour that turns colorless or slightly yellowish after refining and bleaching. Castor oil pale amber viscous liquid derived from the seeds of the plant *Ricinus communis* is sometimes known as ricinus oil[2]. Castor plant, *Ricinus communis* L. is a species of flowering plant in the Spurge family (Euphorbiaceae), which contains a vast number of plants mostly native to the tropics[2]. *Ricinus communis* L belongs to a monotypic genus *Ricinus*, which is a latin word named for tick[2]. The crude oil has a distinct odor, however, it can easily be deodorized in the refining process like any other vegetable oils. It contains triglycerides, which chemically is a glycerol molecule with each of the three hydroxyl groups esterified with long chain fatty acids. Their major fatty acids are of the unsaturated fatty acids, hydroxylated 12-hydroxy, 9-octadecenic acid, known familiarly as the ricinoleic acid[3], containing between 87-90% ricinoleic acid[5,6]. The presence of a hydroxyl group at C12 of the recinoleic acid, the ester linkages, double bonds and hydroxyl groups provide reaction sites that makes it usually polar, which provide sites for the production of a wide range of natural and synthetic resins, waxes, polymers and elastomers. It also has excellent emollient and lubricating properties, a marked ability to wet and disperse dyes, pigments and fillers[7] as well as several medicinal values [8]. Castor oil has excellent solubility in methanol and hence theoretically an ideal oil for trans-esterification to biodiesel, requiring a minimum amount of catalyst and

heating which can reduce cost for production[9]. Thus it was encouraging to study the characterization of the extracted castor seed oil purchased from local market in Riyadh, Saudi Arabia.

MATERIALS AND METHODS

Caster seeds were purchased from local herbs market (Whatcom Seed Company®) (seedrack.com) in Riyadh. The seeds were collected and the damaged seeds were discarded. The seeds were cleaned, de-shelled and dried at room temperature for 48 hours. All chemicals used in the study were analytical grade and used without further purification.

Extraction of oil

To 300 ml of n-hexane (in round bottom flask), 100 g of caster seeds were placed in the thimble and was inserted in the center of the extractor. The Soxhlet set up was heated at 60 ºC and allowed to continue for 6 hours. Then removed cooled to room temperate and dried under vacuum the extracted oil was collected as pale yellow oil[3] (20 g, 20%).

Acid value

Ten g of castor oil was weighted by using digital balance in a clean conical flack, then 25 ml of diethyl ether and 25 ml of ethanol were mixed in a 250 ml beaker then added to conical flack contents then few drops of phenolphthalein were added to the mixture. The mixture was titrated against 0.1 M NaOH to the end point. The experiment was repeated three times[10].

$$\text{Free Fatty Acid (FFA)} = V/W * 2.82 * 100$$

$$\text{Acid value} = FFA * 2$$

Where, V: volume of sodium hydroxide used; W: weight of oil.

Peroxide value

Five g of castor oil was weighed in a clean conical flack, 12 ml of chloroform was added and shacked well, then 18 ml of acetic acid (CH_3COOH) was added, followed by 0.5 mL of potassium iodide (Kl) the flack content was shaked well and then titrated against/ sodium thiosulfate ($Na_2S_2O_3$) until the end point. The experiment repeated three times[10].

$$\text{Number of peroxide} = V*M \text{ of Sodium thiosulfate } (Na_2S_2O_3)/W$$

Where, V: volume of Sodium thiosulfate ($Na_2S_2O_3$) used; M: molarity of Sodium thiosulfate ($Na_2S_2O_3$); W: weight of oil.

Saponification value

Two g of castor oil was weighted by using digital balance in conical flack, 25 ml of 0.5 N alcoholic potassium hydroxide (KOH) was added to conical flack. The mixture was refluxed on water bath for 30 min. Then titrated with 0.5 M Hydrochloric acid (HCl) and using phenolphthalein as an indicator, until the end point. The blank test conducted by repeated the same experiment without the addition of the oil [10].

$$\text{Saponification value} = M * (V1 - V2) * 56.1 / W$$

Where, M: concentration of alcoholic potassium hydroxide (KOH); V1: volume of blank used; V2: volume of alcoholic potassium hydroxide (KOH) used; W: weight of oil.

Moisture and volatilities

Five g of seeds was weighted in porcelain crucibles and kept in hot air oven at 110 ºC for 4 h. The weight was taken after cooling to room temperature[11].

$$\text{Moisture} = W1/W2 * 100$$

Where, W1: weight of sample before heating; W2: weight of sample after heating.

Density of oil

One ml of oil was measured by measurement cylinder and the weight of this amount was taken[12].

$$D = M/V$$

Where, M: weight of sample in gram; V: volume of sample in ml.

Characterization of the double bond

Reaction with potassium permanganate

Few drops of potassium permanganate ($KMnO_4$) were added to 1 ml of oil and were shaked well. The potassium permanganate color disappeared[13].

Reaction with sulfuric acid

Few drops of sulfuric acid (H_2SO_4) were added to 1ml of oil, the solution became dark[13].

RESULTS AND DISCUSSION

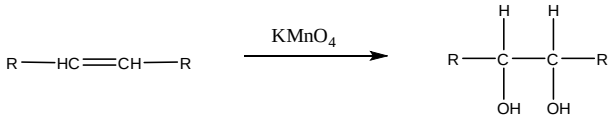
Castor oil was evaluated for physical and chemical properties as shown in **Table 1**, the density 1.01 g/ml and the moisture and volatilities 5%. The saponification value of castor seeds oil was found to be 171.105% mg/g, the peroxide value 12.8 Meq/kg and the acid value is 0.6288 mg NaOH/g.

A potassium permanganate ($KMnO_4$) Solution can oxidize a double bond at room temperature to form a 1,2-diol with the simultaneous reduction of Mn^{+7} in $KMnO_4$) to Mn^{+4} in manganese oxide (MnO_2).

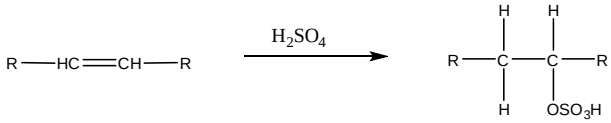
A positive test is the disappearance of the purple $KMnO_4$ and the appearance of MnO_2 as brown precipitate.

Table 1. Physiochemical parameters of castor oil

	Analytical parameter	Values	Publish Data
1	Color	Pale yellow	Pale yellow
2	Odor	Disagreeable	Disagreeable
3	Oil percent (%v/w)	20%	30 – 55 % [2]
4	Acid value (mg NaOH/ g of oil)	0.6288	0.4 – 4.0 [9]
5	Peroxide value	12.8	10.79 – 13.73 [9]
6	Saponification value (mg/g)	171.105	175 – 187 [9]
7	Moisture (%w/w)	5.0	5 – 7 [10]
8	Density of oil (g/ml)	1.01	0.959 [11]



Reaction of castor oil with concentrated (H_2SO_4) gives brown color which confirmed the presence of double bond.



A potassium permanganate ($KMnO_4$) Solution can oxidize a double bond at room temperature to form a 1,2-diol with the simultaneous reduction of Mn^{+7} in ($KMnO_4$) to Mn^{+4} in manganese oxide (MnO_2).

CONCLUSION

In conclusion, based on the above data, castor seeds contain a high percentage of oil showing their composition is rich in unsaturated oil.

Conflict of Interest

The author declares no conflict of interest.

Acknowledgment

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