

PHYSICAL AND CHEMICAL PROPERTIES OF THE SOAPS PRODUCED FROM JATROPHA AND SOME DISCARDED FRIED OILS

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ABSTRACT: *The jatropha seeds are good source of oil, representing from 34.88 to 57.7% in seed kernel, but it is unsuitable for human consumption. Therefore, this oil and its blends with olive and commercial coconut oils (90%JO: 10% OO or CO)., were intended to produce soaps.*

- *Results showed that the properties of soap samples made from Jatropha oil and its blends were compared to those of toilet-soap according to the Egyptian standard description No. 2391/2005. Total fatty acids ranged from 76.34% to 86.76%, free alkali was less than 0.1%, moisture content ranged from 12.53 to 14.50%, free acidity was almost 0.01%, salt alkali and the water insoluble materials were less than 1.0% and those insoluble in alch.. were about 1.0%.*
- *On the other hand, the properties of soap samples obtained by using the fried discarded sunflower oil and palm olein and their blends with olive and coconut oils were similar to those of toilet-soap according to the same description except for the free acidity and the water and alcohol insoluble materials in which a lower increase was recorded compared to the previously mentioned standard.*

Keywords: *jatropha oil, using discarded fried oil, soap, free acid content (free caustic content) , moisture content, total fatty acid, free alkali, alch. and water insoluble materials and salt alkali (total alkali).*

INTRODUCTION

Jatropha curcas grows almost anywhere even on gravelly, sandy and saline soils. It can thrive on the poorest stony soil. It can grow even in the crevices of rocks. *Jatropha curcas* is usually found in the tropics and subtropics and likes heat, although it does well even in lower temperatures and can withstand slight frost. Its water requirements is extremely low and can stand long periods of drought by shedding most of its leaves to reduce transpiration loss. (Reyadh, 2000).

The seeds of *J. curcas* are a good source of oil although the seed is toxic to rats, (Makkar and Becker 1997). Also species of the Genus *Jatropha* are known to be very toxic, (Schmook *et al.*, 1997 and Makkar *et al.*, 2002)

Crude fat content of *Jatropha curcas* L. seed cultivated in Egypt was 38% (Reyadh 2000), and was 29.93% in the second harvest of *jatropha* season 2005 on dry matter (Atta 2006).

The most interesting and economically viable use of the jatropha oil is in soap production. Jatropha oil gives a very good foaming, white soap with positive effects on the skin partially due to the glycerine content of the soap. (Reinhard, 2000).

The seed of jatropha contains (50% by weight) viscous oil, which can be used for the manufacture of candles, soap, and in the cosmetics industry, as well as for cooking and lighting by itself or as adiesed / paraffim in substitute or etender (RFS/IR/DC, 1998).

Traditionally, the rural women used Jatropha curcas for medicine as well as for soap production. The traditional soap-making process is very labor-intensive, producing small amount of relatively poor-quality soap. When Jatropha oil is used, either alone or in combination with other local plant oils such as shea butter, larger amounts of more refined soaps are produced (ReiMhard, 1998).

Soap making is a well – established technology that has progressed tremendously through the years with the production of high quality soap (Ainie and Hamirin 1998).

Physical and chemical properties of toilet- soap according to the description of Egyptian standards(2005), were fatty acid matter (FAM), more than 74% moisture content less than 15%, free acid content (free caustic content) less than 2%, alcohol insoluble material. less than 2% and in water less than 1% and free alkliat material less than 0.1%.

Soaps prepared from the raw oil and from a mixture of processed jatropha curcas and coconut oils were assessed for lathering property and in skin-irritation tests. A soap prepared from a 75 : 15 : 10 mixture of hydrogenated J. curcas oil, refined and bleached J. curcas oil and coconut oil had a lathering value of 200-220 ml. compared to that of the regular line production of toilet soap (Holla *et al.*, 1993).

Palm oil that was discarded as waste from chip factors after frying of potatoes was used for the production of toilet soap (Girgis, 2004).

Ahmed (1984) reviewed the economics of using palm oil and palm stearin as raw materials for soap making.

Total fatty matters ranged from 76 to 85%, free caustic content was 0.1%, sodium chloride content was 0.3-0.4% and moisture content was 8 -14% of soap made from blends of distilled palm oil and palm kernel oil (Ainie *et al.*, 1996).

The properties of soap made from distilled palm stearin and palm kernel fatty acid and its blends were, total fatty matter ranging from 79-84%, free caustic content (free acidity) 0.1% and moisture content 10-18% (Ainie and Hamirin 1998).

The object of this study discusses the quality and characteristics of soap produced from jatropha, fried oils and their blends with olive and commercial coconut oils. The aim was also extended to make use the large amounts of oils discarded after using in fried products.

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MATERIALS AND METHODS

Materials:

- 1- **Jatropha seeds** : *Jatropha curcas* L. seeds were obtained from Inshas experimental station, water management and irrigation system, National Research Institute, Water Research center, Ministry of water Resources and Irrigation. Skarkiya Governorate, Egypt.
- 2- Discarded fried oils (sunflower, and palm olein oils) were obtained after frying potato chips at 180° C for 16 hours in the laboratory.

Methods :

1- Extraction of oil from Jatropha seeds:

Jatropha seeds were crushed twice using a grinder model (MF10 Micro fine grinder drive). The crushed sample was pressed with laboratory type of carver hydraulic press under 10.000 ib/in (pic) pressure for 1h. at room temperature according to the method of Ustan *et al.*, (1990). The produced oil was filtered and kept in dark bottles in the refrigerator until analysis.

Total oil content: Total oil content was determined according to the method described in the A.O.A.C. (2000).

2- Preparation of discarded fried oils:

Sunflower and palm olein oils were used as wastes after frying potato chips at 180°C for 16 hrs. in the lab.. These oils were filtered with filter paper then bleached with activated bleaching earth according to the method of the Vasconcellos and Berry (1982).

3- Blending the samples:

- **Jatropha oil (Jo)** was blended with olive oil (OO) by a ratio 90% Jo : 10% OO [blend (1)] also it was blended with commercial coconut oil at the ratio 90% JO: 10% CCO [blend (2)].
- Discarded fried palm olein (UFPO) was blended with olive oil at the ratio 80% DFPO: 20% OO [blend (3)] and also it was blended with CCO at the ratio 80% DFPO : 20 % CCO [blend (4)]

4- The component of soap making.

Oil, water and caustic soda.

5- Water: Oil ratio in the soap made from Jo.

- A- 1 liter water + 1 Liter oil + 150 gm caustic sod (1:1).
- B- 0.75 liter water + 1 liter oil + 150 gm caustic soda (0.75 : 1)
- C- 0.5 liter water + 1 liter oil + 150 gm caustic soda (0.5: 1)

6- Preparation of soap pieces:

- Preparation of the solution of caustic soda : to prepare the solution of caustic soda, calculate the amount of caustic to be mixed with the water.
- Stir the solution until the caustic soda is dissolved.
- Pour the caustic soda solution slowly into the oil by stirring until the mixture looks like crema.
- The mixture must be put into plastic container (soap), then air dried at room temperature, until it becomes hard to be suitable for cutting into pieces.

7- Parameters of oil samples:

- Fatty acid composition : The fatty acid methyl esters were identified by GC-capillary column according to the method of 100 C (2001).
- Acid, iodine and saponification values were determined according to the method of A.O.A.C. (2000).

8- Determinations of properties of soap pieces:

Moisture content, total fatty acid or total fatty matter (TFM), free alkali, free acid content (free caustic content), water and alcohol insoluble materials and total alkali soluble in water (salt alkali) were determined according to the description of the Egyptian standard method of inspection and experiment of the soap. No. 1140 (2001).

RESULTS AND DISCUSSION

The oil content in seeds and seed kernel of *Jatropha curcas* L.

Table (1) indicates that the oil content in the seed was 34.84%, but it was 57.7% in seed kernel of *Jatropha*. These results are in agreement with Reyadh (2000) and Holla *et al.*, (1993).

Table (1): Oil content in seed and seed kernels of *Jatropha curcas* L.

Jatropha	Oil content %
Seed	34.84
Kernels	57.7

Table (2) shows the quality of oil materials, acid value, iodine and saponification values for *Jatropha* oil, and the discarded fried palm olein and its blends with olive and commercial coconut oils and discarded fried sunflower oil. Acid value ranged from 2.13 to 3.05, and the range of iodine value was 26.89 – 94.09; the iodine value increased by increasing the amount of C_{18:1} and C_{18:2} and decreased with increasing the amount of C₁₂, C₁₄ and C₁₆ in this oils under study. On the contrary, saponification value decreased by increasing the amount of C_{18:1} and C_{18:2} and vice versa.

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Table (2) Chemical properties of oil materials:

Chemical properties	Oil materials						
	Jo	Blend (1)	Blend (2)	DFSO	DFPO	Blend (3)	Blend (4)
Acid value	3.05	2.67	2.79	2.13	2.84	2.28	2.22
Iodine value	94.09	82.85	53.31	59.68	31.73	35.65	26.89
Saponification value	193.68	194.25	200.40	191.23	195.82	198.84	220.14

Bland1 = 90% Jatropha oil + 10% Olive Oil

Bland2 = 90% Jatropha oil + 10% Commercial Coconut Oil

Bland3 = 80% Discarded Fried palm Olein + 20% Olive Oil

Bland4 = 80% Discarded Fried palm Olein + 20% Commercial Coconut Oil

Fatty acid composition of samples:

Table (3) shows the fatty acid content of samples, JO, blend (1), blend (2), UFSO, UFPO, blend (3) and blend (4). From the data in this table all the previous samples contained, 0.70, 0.22, 1.86, 1.02, 0.23, 0.76 and 5.52 % myristic acid (C14:0), 13-45, 13.75, 12.65, 10.46, 24.87 , 22.85 and 21.90% palmitic acid (C 16:0), 7.29, 7.02, 6.55, 3.45, 4.47 , 3.72 and 3.65% stearic acid (C18:0), 47.29, 51.43, 44.74, 44.46, 38.63, 46.83 and 30.85 % oleic acid (C18:1) , 30.68, 27.50, 27.95, 40.15, 31.51, 25.60 and 24.81%.

Linoleic acid (C18:2), 0.23, 0.03, 0.21, 0.46, 0.200, 0.19 and 0.07% linolenic acid (C18:3) and 0.28, 0.02, 0.25 , 0.0, 0.090, 0.05 and 0.087% decanoic acid (C20) respectively, but the samples of the blends (2) and (4) contained 4.76 and 9.52% lauric acid (C₁₂), 0.57 and 2.04% caproic acid (C₁₀), 0.41 and 1.56% caprylic acid (C₈), respectively .

Table (3): Fatty acid composition of oil materials :

Fatty acid composition	Jo	Blend (1)	Blend (2)	DFSO	DFPO	Blend (3)	Blend (4)
C8:0	-	-	0.41	-	-	-	1.56
C10: 0	-	-	0.57	-	-	-	2.04
C12:0	-	-	4.76	-	-	-	9.52
C14:0	0.70	0.22	1.86	1.02	0.23	0.76	5.52
C16:0	13.45	13.75	12.65	10.46	24.87	22.85	21.90
C16:1	0.08	0.03	0.05	-	-	-	-
C18:0	7.29	7.02	6.55	3.45	4.47	3.72	3.65
C18:1	47.29	51.43	44.74	44.46	38.63	46.83	30.85
C18:2	30.68	27.50	27.95	40.15	31.51	25.60	24.81
C18:3	0.23	0.03	0.21	0.46	0.200	0.19	0.07
C20:0	0.28	0.02	0.25	-	0.090	0.05	0.087
Total st.	21.72	21.01	27.05	14.93	29.66	27.38	44.27
Total uns.	78.28	78.99	72.99	85.07	70.34	72.62	55.73

Water content in soap produced from Jatropha oil :

Data in table (4) indicate the effect of water content in the soap during soap making on the yield.

From the data in table (3) it could be noticed that, in case of the quantity of water being equal to that of oil (1 liter water: 1 liter oil) that gave a higher amount of soap 1600 gm followed by when the quantity of water being half and quarter of the quantity of oil (0.75 liter water : 1 liter oil) which gave 1450 gm soap, and when the quantity of water to oil was (0.5 liter water: 1 liter oil) the soap quantity was 1300 gm.

Table (4): Effect of water content of soap made from Jatropha oil on the yield:

Water content in soap (water content : Jatropha oil	Yield of soap (gm)
Ratio (1:1)	1600
Ratio (0.75 : 1)	1450
Ratio (0.5 : 1)	1350

Effect of water content on the properties of the soap samples:

Table (5) shows the changes in the properties of the soap samples produced from jatropha oil as a result of water content in the soap during soap making – when the ratios of the water content: Jatropha oil (v/v) were, (1:1) (0.75:1) and (0.5:1). From the data in table (5), moisture content increased by increasing the water content in soap. On the contrary, total fatty matter increased by decreasing the water content in soap. Total fatty matter of soap made from (0.5: 1) was 79.72% followed by (0.75: 1) being (78.08%) but (1:1) gave (76.72% and also the free alkliial, total alkliial soluble in water and the alcohol insoluble material increased by decreasing the water content in the soap. Generally free acid content (free caustic content) was less than 0.1 % and ranged from 0.012 to 0.014 %. Also free alkliial was less than 0.1% and ranged from 0.007 to 0.05 and total alkliial soluble in water (salt alkliial) ranged from 0.32 to 0.55%. On the other hand the alcohol insoluble materials. were more than 1% and ranged from (1.14) to (1.32)%, but those non-soluble in water ranged from 0.17 to 0.33%. These results were compared with the description of the Egyptian standard properties of toilet-soap No. 2391 (2005). Finally the quality of soap produced from the ratio (0.5: 1 v/v) water : Jatropha oil were the best sample.

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Table (5): Changes in the properties of soap made from jatropha oil as a result of water content in soap.

Properties of soap (%)	Water content in soap		
	Water : oil 1 : 1	Water : oil 0.75 : 1	Water : oil 0.5 : 1
Moisture content	14.34	14.06	12.53
Total fatty matter (TFM)	76.72	78.08	79.72
Free acid content (free caustic content)	0.012	0.012	0.014
Alcohol insoluble materials.	1.14	1.23	1.32
Water insoluble materials.	0.33	0.21	0.17
Free alkial (total alkial)	0.007	0.01	0.05
Total alkial soluble in water (salt alkial)	0.32	0.35	0.55

Physical and chemical properties of soap made from Jatropha oil and its blends with olive and commercial coconut oils:

Table (6) shows the properties of these samples. Moisture content ranged from 12.53 to 14.50% total fatty matter (TFM) of soap made from Jatropha oil was 79.72% but it increased to 81.81 and 86.76% as a result of addition of 10% olive oil or coconut oil respectively.

And also the free acid content (free caustic content) recorded as a light increase from 0.014% in Jatropha oil to 0.016 and 0.017 % in blends of Jatropha oil with olive or coconut oils respectively. On the contrary, the alcohol and the water insoluble materials. and in water, free alkial and total alkial soluble in water decreased in soap made from 90% jatropha oil + 10% olive oil Blend (1) and 90% Jatropha oil +10% coconut oil Blend (2) compared to the soap made from Jatropha oil. The properties of soap made from Jatropha oil and from its blends with olive or coconut oils were similar to those of toilet-soap according to the description of the Egyptian standard No. 2391 (2005). Similar data are reported by (Ainie *et al.*, 1996 and Ainie and Hamirim 1998).

Table (6): Physical and chemical properties of soap made from jatropha oil and its blend with olive and coconut oils

Physical and chemical properties of soap (%)	Jatropha oils	Blend (1)	Blend (2)
Moisture content	12.53	14.07	14.50
Total fatty matter (TFM)	79.72	81.18	86.76
Free acid content (free caustic content)	0.014	0.016	0.017
Alcohol insoluble materials.	1.32	0.94	1.26
Water insoluble materials.	0.17	0.14	0.15
Free alkali (total alkali)	0.05	0.011	0.03
Total alkali soluble in water (salt alkali)	0.55	0.29	0.48

Physical and chemical properties of soap produced from discarded fried oils:

Table (7) shows the properties of soap made from the used fried oils, sunflower oil, palm olein and blends of palm olein (80%) with olive or coconut oils (20%). The moisture content of soap made from discarded fried palm olein and its blends with olive and coconut oils were 13.58, 14.13 and 14.99% but the content in soap produced from used fried sunflower oil was (16.14%). Total fatty matter (TFM) of soap of all samples was greater than 74% while the free acid content of all samples was less than 1%.

No change in materials non soluble in alcohol of the soap occurred as a result of addition of olive or coconut oils to the used fried oil during making of soap. But the addition of olive or coconut oils to the discarded fried palm olein caused a decrease in the materials non soluble in water from 3.58% to 1.69 and 2.63 respectively.

On the other hand, free alkali and total alkali soluble in water (salt alkali) of soap produced from the used fried palm olein with olive or coconut oils increased to (0.01 and 0.03%) and 0.02 and 0.01%) respectively, compared with that produced from used fried palmolein (0.001 and 0.008%). In conclusion soap samples made from the discarded fried palm olein and its blend with olive or coconut oils were similar to the Egyptian standard description No. 1391 (2005) to toilet –soap. Quality of soaps produced from Jatropha oil and its blend with olive or coconut oils were the best samples.

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Table (7): Physico-chemical properties of soap produced from discarded fried oils and its blend.

Physical and Chemical properties (%)	Discarded fried oils			
	DFSO	DFPO	Blend (3)	Blend (4)
Moisture content	14.14	13.58	14.13	14.99
Total fatty matter (TFM)	74.09	74.18	79.40	81.81
Free acid content (free caustic content)	0.77	0.85	0.34	0.13
Alcohol insoluble materials.	3.18	3.7	2.44	3.69
Water insoluble materials.	7.86	3.58	1.69	2.63
Free alkial (total alkial)	0.005	0.001	0.01	0.03
Total alkial soluble in (salt alkial)	0.037	0.008	0.028	0.01

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الخواص الطبيعية والكيميائية للصابون المنتج من زيت بذور الجاتروفا وبعض زيوت التحمير السابق استخدامها

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الملخص العربي

تعتبر بذور الجاتروفا مصدر جيد للزيت حيث تصل النسبة المئوية للزيت في البذور إلى ٣٤.٨٤% وإلى ٥٧.٧% في لب البذرة وحيث أن هذا الزيت يعتبر غير صالح للاستخدام الآدمي لهذا فقد تم استخدام زيت الجاتروفا ومخاليطه مع زيوت الزيتون أو جوز الهند التجاري (٩٠: ١٠ على التوالي) في إنتاج الصابون. وقد تبين من النتائج الآتي:

- أن خواص الصابون المصنع من زيت بذور الجاتروفا ومخاليطه مع زيوت الزيتون وجوز الهند تضاهي بدرجة كبيرة تلك الخواص لصابون التواليت طبقاً للمواصفات القياسية المصرية رقم ٢٣٩١/٢٠٠٥. حيث وجد أن الأحماض الدهنية الكلية تتراوح ما بين ٧٦.٣٤% إلى ٨٦.٧٦% والقلوية الطليقة (الحرّة) لكل العينات كانت أقل من ٠.١% ومكونات الرطوبة تتراوح ما بين ١٢.٥٣ إلى ١٤.٥% والحموضة الحرّة كانت تقريباً لكل العينات أقل من ٠.١% وأملاح القلويات القلوية الكلية الذائبة في الماء) والمواد الغير قابلة للذوبان في الماء كانت تقريباً ١% والمواد الغير قابلة للذوبان في الكحول كانت أقل من ١%.

- وعلى الجانب الآخر وجد أن خواص الصابون المتحصل عليه من زيوت التحمير السابق استخدامها لزيوت عباد الشمس ونخيل الأولين ومخاليط الأولين مع زيوت الزيتون وجوز الهند كانت تماثل تقريباً تلك الخواص لصابون التواليت لنفس المواصفات السابقة فيما عدا الحموضة الحرّة والمواد الغير قابلة للذوبان في الماء والكحول فقد سجلت كليهما زيادة بسيطة مقارنة بمثيلتها في المواصفة.