

## UTILIZATION OF CHICKEN FAT IN THE TOILET SOAP PRODUCTION

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### ABSTRACT

This work aimed to utilize the chicken abdominal and skin fats in toilet soap manufacturing. The fat was extracted by dry and wet rendering from abdominal and skin raw fat of chickens. The fat content was 35.2% and 40.1% in the abdominal and skin, respectively. Eight samples of toilet soap were manufactured from palm oil, palm kernel oil and chicken fat (mixture of abdominal and skin fats 1:1, w/w) at different ratios. The results showed that the consistency of produced soap from blends No. 1,2 and 8 were semi-hard with bad quality properties, while the physical properties of produced soap from blends No 3 , 4 , 5 , 6 , and 7 were good quality either from hard structure or from rich hand lather. The results also showed that the extracted chicken abdominal and skin fats can be used up to 40% of the total fatty blends in the toilet soap manufacture.

**Keywords:** Chicken fat, palm kernel oil, wet and dry rendering, toilet soap, palm oil.

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## INTRODUCTION

Soap is one of the earliest manufactured chemical substances, dating back before written Literature (Swern, 1979 and Hui, 1996). Tallow, palm kernel and coconut oils are used in toilet soap manufacture (Ahmed, 1984).

Soap manufacture especially the result of interaction between caustic alkali and neutral fixed oils (Kuntorn and Kifli, 1994). Choose of fatty materials used for soap-making in the earliest days would have been limited to neutral animal fats [suet or tallow], vegetable oils [olive or canola oils] and possibly fish oil (Willcox, 1993). In recent years, palm kernel oil becomes popular replacement for coconut oil (Hui, 1996). In Egypt, recently, the price of palm oil has sharply risen and the production cost of toilet soap is high. The present production volume of chicken fats in Egypt still quit low compared with palm oil, unless the price of chicken fats is very low compared with price of palm oil.

The aim of this study is to use chicken fats (which is very cheaper than palm oil) as alternative to palm oil up to 40% in production of toilet soap by reducing the used content of palm oil in this manufacturing process.

## MATERIALS AND METHODS

### Materials

Chicken abdominal and skin fats were obtained from El-Sharkia Poultry Co., Billbis, El-Sharkia Governorate, Egypt. Palm and palm kernel oils were supplied from Cairo Oils and Soap Company, Cairo, Egypt, All chemical materials were purchased from EL-Gomhoria Company for Pharmaceutical, Cairo, Egypt.

### Fat Samples

The chicken abdominal and skin fats were extracted according to the Hui (1996) technique for wet rendering as follows:-

Either chicken abdominal or skin fats were separately boiled in tap water (1:1 w/w) in open vessel for 6 hours under the atmospheric pressure after addition of 1.5% Na Cl powder. The extracted fats were separated from water at 50°C using a separating funnel, dried by anhydrous sodium sulphate, then filtrated and kept in dark bottles at -20°C till analysis.

Chicken abdominal and skin fats were separated by dry rendering according to the method described by Hui (1996) as follows:

Chicken abdominal and skin fats were individually put in open vessel which was directly put on hot plate for 6 hours under the atmospheric pressure. The extracted fats were separated at 50°C using a separating funnel, dried by anhydrous sodium sulphate, then filtrated and kept in dark bottles at -20°C till analysis.

### **Analytical Methods**

#### **Determination of some physical and chemical properties of fatty materials used in this study**

Acidity (as oleic acid %), peroxide number (meq O<sub>2</sub>/one kg oil), saponification value (mgKOH saponify/g oil) and melting point (°C) were determined according to AOCS methods (2005) and (E.O.S.Q.C., 2005).

The color of fatty materials were measured by Lovibond Tintometer, Model E, using 5.25 inch cell according to the method described in the AOCS (2000).

#### **Methylation of fatty materials**

Fatty materials in this study were separately methylated (using benzene : methanol : concentrated sulfuric acid ( 10 : 84 : 4) at 90 ±

2°C for an hour according to the method described by (Ludy *et al.*,1968).

#### **Fractionation and determination of the fatty acid methyl esters**

Gas-Liquid chromatography (Pye – Unicam PRO – Gc) was used for fractionation and determination of fatty acid methyl esters of fatty materials according to the method reported by Zygadlo *et al.* (1994).

#### **Making of the Soap Samples**

Eight samples of toilet soap were manufactured from palm oil, palm kernel oil and chicken fat (mixture of abdominal and skin fats 1:1, w/w), at different ratios as follows: 0: 0: 100 (blend No. 1), 0:15: 85 (blend No. 2), 85:15:0 (blend No. 3), 75:15:10 (blend No. 4), 65:15:20 (blend No. 5), 55:15:30 (blend No. 6), 45:15:40 (blend No. 7), and 35:15:50 (blend No. 8), respectively.

One hundred grams of each fatty blend (from No. 1 to No. 8) were separately heated on hot plate (90 ± 2°C), sodium hydroxide solution (35 Baume) was used to saponify the fatty blends. The content of soda used for full

saponification ranged from 13.2 to 13.5% of the fatty blend weight. The hot soda ( $90 \pm 2^\circ\text{C}$ ) used to saponify the fatty blends was individually added slowly until complete saponification has taken place, following 5-10% hot water ( $90 \pm 2^\circ\text{C}$ ) was added to remove the excess of soda from the soap paste. Thereon, 10% hot brine (6% NaCl, w/v%) solution ( $90 \pm 2^\circ\text{C}$ ) was gradually added over the surface of soap paste during its boiling to separated the glycerol water in the bottom, while the saponified mass was floated on the surface. The glycerol water was removed by siphoning. The soap paste was washed again with 5-10% hot water ( $90 \pm 2^\circ\text{C}$ ) to reduce the excess of soda and salt with any impurities found in the soap paste. The homogeneity after the complete saponification process was measured using the finger method, knife test and the total electrolyte (Martin, 1951). After that, the soap paste was poured in wooden frame and left at room temperature for hardening. The block of soap was cut into two soap bars each of (75g). Soap sample No. 3 was the control soap. The obtained soap samples were analyzed for their chemical and physical properties.

#### **Determination of some chemical properties of the resultant soap samples**

Percentages of moisture content, total fatty acids content, free alkali as (NaOH) salt as (NaCl), total electrolyte and free oil, in the produced soap samples were determined according to the methods reported by the Egyptian Organization for Standardization Methods, Standard Specifications (E.O.S.Q.C., 2007) and the AOCS (2000).

#### **Determination of some physical properties of the obtained soap samples**

The odor and color of the dried soap samples were evaluated according to the methods outlined by Ahmed (1984) and Kiritsakis (1991), while the appearance and consistency of the soap samples were evaluated according to the methods described by Martin (1951). The lather and erosion from hand washing of the soap samples were measured according to the methods reported by Ginn *et al.* (1968) and Gupta (1991).

## RESULTS AND DISCUSSION

### Some Chemical and Physical Properties of the Fatty Materials

Results in Table 1 show some of the chemical and physical properties of abdominal and skin fats used in toilet soap. The obtained data revealed that the values of acidity, peroxide number and saponification value of wet and dry rendering of abdominal and skin fats were inside the range reported by E.O.S.Q.C. (2005), which limited that the levels of acidity, peroxide number and saponification value must not exceed 0.3% as oleic acid, 10 meq. O<sub>2</sub>/ kg oil and 185-195 mg KOH/g oil, respectively. While, the values of melting point (°C) in above fats under investigation were ranged between 36.2°C and 37.0°C. On the other hand, chicken abdominal and skin fats [wet and dry rendered] recorded nearly the same value in color Lovibond units. The above data are in conformance with E.O.S.Q.C., 2005.

Identification of chicken abdominal and skin fats, using Gas – liquid Chromatography apparatus, is given in Table 2. From the obtained results, it could be

noticed that the major unsaturated fatty acid in both fats was oleic acid which ranged from 42.4 to 43.97%. On the other hand, the main saturated fatty acid for chicken abdominal and skin fats was palmitic acid which ranged from 23.31 to 25.51%. These data could be showed that the fatty acid composition of chicken abdominal and skin fats are almost the same in content. These results are almost similar to that found by Yossef (2002).

Chemical properties of the resultant soap samples are shown in Table 3. Data indicated that the moisture contents of samples No. 1 and 2 were 35.8 and 31.0%, respectively. These values were higher than that (30.0%) obtained by Martin (1951). Moreover, total fatty acids of the same samples were 55.6 and 58.0%, respectively, which were lower than the range (61.5 – 64.1%) obtained by Martin (1951). Free alkali and free oil in the same samples were high (0.56 and 0.50%) and (0.45 and 0.51%), respectively, which may be attributed to high percentage of chicken fat (100.0 and 85.0%). These values were not in accordance with those indicated by E.O.S.Q.C. (2005), who reported that free alkali should be less than

0.33% (NaOH) and less than 0.5% for free oil in the soap.

From results in Table 3, it can be noticed that moisture contents in the other six samples (No. 3-8) were: 17.3, 19.2, 20.0, 20.6, 21.1 and 23.0%, respectively, while their total fatty acids were 72.9, 71.3, 70.9, 69.7, 68.8 and 69.9 %, respectively. These values in agreement with that (moisture less than 30.0%) obtained by Martin (1951), but higher in total fatty acids (60.0%), that reported by the same author. Free alkali (Na OH) in the same samples were 0.20, 0.22, 0.24, 0.28, 0.29 and 0.34%, respectively, these pattern which going within the range (should be less than 0.33% as NaOH) reported by E.O.S.Q.C. (2007), unless sample No. 8 which recorded high value (0.34%). The content of sodium chloride (NaCl) for soap samples No. 3,4,5,6 and 7 ranged from 0.26 to 0.36%, while in soap sample No.8 the content of sodium chloride was higher (0.44%) than those found in other soap samples. The free oil content in the same samples were 0.22, 0.26, 0.36, 0.42, 0.48 and 0.54%, respectively and similar values [less than 0.5%] given by E.O.S.Q.C. (2005).

Data in Table 4 showed some physical properties of resultant soap samples. Data can be

indicated that the produced soap samples No. 1, 2 and 8 were semi hard with medium erosion from hand washing. This may be attributed to the high percentage of chicken fat which was used (100.0, 85.0 and 50.0%) in soap samples No. 1, 2 and 8, respectively. On the other hand, soap samples No. 3, 4, 5, 6 and 7 had hard consistency with good lather and low erosion from hand washing. Therefore, soap samples No. 1, 2 and 8 were not suitable for using, while the other soap samples (No. 3, 4, 5, 6 and 7) were fit for using.

From the results represented in this work, it can be recommended that chicken fats can be used in the toilet soap manufacture until ratio of 40.0% of the total fatty materials, which gave good quality characteristics in the produced soap such as good hand lather with low erosion and hard consistency.

### **Conclusion**

Chicken abdominal and skin fats (which are very cheaper than palm oil) can be utilized up to 40% of the fatty blend as alternative to palm oil (which is more expensive) in toilet soap manufacturing.

**Table 1. Some of chemical and physical properties\* of chicken abdominal and skin fats**

Properties	Abdominal fat		Skin fat	
	Wet rendering	Dry rendering	Wet rendering	Dry rendering
Acidity as oleic acid (%)	0.26	0.29	0.25	0.26
Peroxide number (meq.O <sub>2</sub> /Kg oil)	8.2	8.7	7.1	7.3
Saponification value (mgKOH saponify/g. oil)	189.8	189.7	188.3	190.2
Melting point °C	36.2	37.0	36.4	36.6
Lovibond color	Y	20.0	20.0	20.0
	R	1.8	1.7	1.8
	B	0.2	0.3	0.2

\* Each number given in this table is a mean of two determinations

**Table 2. Fatty acid composition of chicken abdominal and skin fats (wt. % of total fatty acids)**

Fatty acids	Abdominal fat		Skin fat	
	Wet rendering	Dry rendering	Wet rendering	Dry rendering
Myristic acid C14:0	0.57	0.58	0.56	0.55
Palmitic acid C16:0	25.51	24.89	23.31	24.11
Palmitoleic acid C16:1	5.62	5.82	5.90	5.81
Heptadecanoic acid C17:0	0.11	--	0.07	--
Heptadecaenoic acid C17:1	0.08	--	0.09	--
Stearic acid C18:0	6.73	6.98	6.54	6.60
Oleic acid C18:1	42.82	42.40	43.97	42.97
Linoleic acid C18:2	17.19	17.28	17.90	18.30
Linolenic acid C18:3	0.78	1.13	0.82	0.89
Arachidic acid C20:0	0.10	0.24	0.15	0.16
Arachidoenic acid C20:1	0.46	0.64	0.65	0.57
Total of saturated acids	33.02	32.69	30.63	31.42
Total of monosaturated acids	48.90	48.86	50.61	49.35
Total of polysaturated acids	17.97	18.41	18.72	19.19

**Table 3. Some chemical properties of the resultant soap samples**

Soap samples	Moisture and volatile matter (%)	Total fatty acid (%)	Free alkali NaOH (%)	Salt NaCl (%)	Total electrolytes (%)	Free oil (%)
1	35.8	55.6	0.56	0.50	1.06	0.71
2	31.0	58.0	0.45	0.51	0.96	0.68
3	17.3	72.9	0.20	0.26	0.46	0.22
4	19.2	71.3	0.22	0.29	0.51	0.26
5	20.0	70.9	0.24	0.31	0.55	0.38
6	20.6	69.7	0.28	0.35	0.63	0.42
7	21.1	68.8	0.29	0.36	0.65	0.48
8	23.0	69.9	0.34	0.44	0.78	0.54

**Table 4. Some physical properties of the resultant soap samples**

Soap samples	Odor and color	Appearance	Consistency	Hand lather	Erosion from hand washing
1	Odorless	Unglossy	Semi hard	Fairly	Medium
2	Odorless	Unglossy	Semi hard	Good	Medium
3	Odorless	Glossy	Very hard	Excellent	Very low
4	Odorless	Glossy	Hard	Very good	Low
5	Odorless	Glossy	Hard	Very good	Low
6	Odorless	Glossy	Hard	Good	Medium
7	Odorless	Glossy	Hard	Fairly	Medium
8	Odorless	Not evidence	Semi- hard	Unable to determine	Unable to determine



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### الاستفادة من دهن الدجاج فى إنتاج صابون التواليت

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يهدف هذا العمل إلى الاستفادة من دهن أحشاء وجلد الدجاج فى صناعة صابون التواليت. تم إستخلاص دهن جلد وأحشاء الدجاج بطريقتى الصهر الجاف والرطب. وكانت نسبة الدهن ٣٥,٢% ، ٤٠,١% فى كل من الأحشاء والجلد على التوالى.

تم تصنيع ثمانى خلطات من صابون التواليت بنسب مختلفة من دهن السدجاج (خليط دهن الجلد والأحشاء بنسبة ١:١ بالوزن) وزيوت ثمار ونوى النخيل.

أوضحت الدراسة أن عينات الصابون الناتج من خلطات رقم ١ ، ٢ ، ٨ كانت ذات قوام نصف صلب مع خواص جودة رديئة بينما كانت عينات الصابون الناتج من الخلطات أرقام ٣ ، ٤ ، ٥ ، ٦ ، ٧ ذات خواص جودة جيدة سواء من حيث القوام الصلب او الرغوة الوفيرة. أظهرت النتائج أيضا أنه يمكن استخدام دهن الدجاج (جلد أو أحشاء) حتى ٤٠% من إجمالى الخلطة الدهنية فى صناعة صابون التواليت.