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UTILIZATION OF OLEIN OIL RESULTING FROM FRYING PROCESSES IN SOAP MANUFACTURE

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ABSTRACT

In Egypt most restaurants used olein oils for frying of many different kinds of foods. The quantity olein oil resulting from frying processes represents more than half of the total olein oils used in Egyptian restaurants. Olein oils resulting from frying processes were characterized via fatty acids composition and other physical and chemical characteristics (e.g. colour, odour, iodine value, saponification value, titer number etc…) and utilized in the preparation of soaps.

The solubility, foam volume, foam lasting time and consistency of soap were evaluated. Results reveal that high performance foam volume, foam lasting time and solubility properties were achieved. The importance of these soaps is due to their environmentally friendly nature, relatively safe utilization by humans, in addition to their economical feasibility.

Keywords: Olein oil, frying wastes, soap manufacture

INTRODUCTION

The most important triglycerides used for soap manufacture are tallow, and coconut oil (Helmy, 1996 and 1998), although many of the natural oils and fats are or have been used (Helmy and Shoeb, 1991). Presently used oils include palm oil and palm kernel oil (Ahmad, 1981; Kuntom *et al.,* 1996 and Joya *et al.,* 2000).

Olein oil is an important fraction of palm oil, it represents more than 50% of the oil, it is used essentially for frying (Tan and Flingoh, 1981).

In Egypt most frying restaurants use this fraction of palm oil for frying some foods, such as, potato, greenbell, eggplant and "Falafel" which is considerably a popular food in Egypt. The quantity of olein oil resulting from frying processes represents more than half of the total olein oil used in Egyptian restaurants (Holding company of food industries, Egypt, 2009). The large quantity of these oils resulting after frying processes causes pollution of environment, therefore if we can utilize these quantities of wasted oils for making soap, this will add an economical value to this waste and prevent environmental pollution.

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MATERIALS AND METHODS

Materials

Olein oil samples before and after frying were collected from some restaurants located in Giza, Egypt. Commercial grade of sodium hydroxide for saponification process was used. Chemicals used for different analysis of oil and soap were fine grade and supplied by international companies (Merk, Germany and BDH, England).

Methods

Physical and Chemical characteristics of oil

The colour and odour were determined as described by Raganna (1977). The acid value, peroxide value, saponification value, iodine value, titre number and unsaponifiable matters were measured according to the AOCS (1996). The iodine number saponification factor (INS) was estimated by subtracting the iodine value from saponification value (SV-IV).

Fatty acid composition of oil

Fatty acid methyl esters were prepared by IUPAC standard methods (1987). Determination of fatty acid composition was performed as described by Mitruke (1984) using Hewlett Packard 5890 series II gas chromatography, equipped with flame ionization detector (FID).

Manufacture of soap

Soap was manufactured using three different kinds of olein oil namely olein oil before frying (OL), olein oil after frying (OLF) and olein oil after frying and purification (POLF).

Oil after frying was purified by washing with 10% hot sodium chloride solution followed by washing with 5% hydrogen peroxide solution then washed with 1% sodium hydroxide solution. Soap was manufactured from the three previous kinds of olein oils (OL, OLF, POLF) by saponifying with sodium hydroxide according to the method of SBP (1976). Hundred grams of oil were heated at 80°C and stirred. The calculated amount of alkali depending on the saponification number of oil. Alkali was dissolved in twice its weight water and gradually added to the oil while stirring. After the saponification process was finished, soap samples were poured in moulds.

Evaluation of soaps

Chemical evaluation

Soaps were evaluated for chemical characteristics, such as, moisture content, total fatty acids, unsaponifiable matter and free alkali according to AOCS (1996).

Physical evaluation

Solubility

Five grams of soap were weighted in 100 ml beaker, then 25 ml 10% aqueous ethanol were added. The time required for complete dissolved of the soap sample heated by water bath at 40°C was determined.

Foam volume

Fifty grams of each type of soap were weighted in a beaker and dissolved in 500 ml distilled water containing 10% ethanol. Twenty ml of each

were taken in a 100 ml gradated stoppered cylinder, shaken ten times, then left to stand for 30 seconds. The volume of formed foams was measured.

Foam lasting time

It represents the remaining foam volume after 30 seconds. These characteristics as solubility, foam volume and foam lasting time were determined as described by kuntom *et al*. (1996) and Helmy (1998).

RESULTS AND DISCUSSION

Physical and chemical characteristics of olein oil before frying (OL) and after frying (OLF) have been extensively investigated. The data of colour, odour, saponification values, iodine value, INS factor, acid value, peroxide value, unsaponifiable matter and titer number are illustrated in Table (1).

Table (1): Physical and chemical characterisatics of olein oil before frying (OL) and after frying (OLF).

Characteristics	Olein oil	
	Before frying (OL)	After frying (OLF)
Colour	Pale yellow	Pale brownish
Odour	Normal	Undesirable
Saponification value (mg/g)	197.1	197.5
Iodine value (g/100g)	55.7	50.4
INS	141.4	147.1
Acid value (mg/g)	0.6	1.3
Peroxide value (meq/kg)	2.3	5.0
Unsaponifiable matter (%)	0.6	0.8
Titer number (°C)	27.6	28.0

From Table (1) it can be noticed that saponification value of both olein oil before and after frying were almost the same (197.1 and 197.5mg/g) respectively. While iodine value of olein oil before frying had higher value (55.7g/100g) compared with olein oil after frying (50.4g/100g). The difference between saponification and iodine value (INS) of olein oil before frying is lower (141.4) compared with olein oil after frying (147.1). The difference between saponification and iodine values (INS) may affect the consistency of prepared soap, as well as, it gives an idea about the solidity of the prepared soap. Increasing this factor means increase solidity of soap (Helmy, 1996 and Kuntom, *et al.* 1999).

From the obtained results it could be noticed that both the acid and peroxide values of olein oil increased after frying from 0.6 to1.3 , while peroxide values also increased from 2.3 to 5.0 meq/Kg, respectively, causing undesirable odour of olein oil sample after frying. It could be also noticed that unsaponifiable matters of olein oil after frying had slightly higher value (0.8%) compared with olein oil before frying (0.6%), this result may be due to the effect of high frying temperature causing distory of some glycerides (Tan & Flingoh, 1981 and PORIM, 1988).

On other hand the titer number of olein oil after frying had slightly higher value (28.0°C), compared with olein oil before frying (27.6°C). Titer number is another factor that affects the consistency property of prepared soap; however, increasing in titer number is reflected in the solidity of soap (SBP, 1976 and Helmy, 1996).

Fatty acids composition of olein oil before frying (OL) and after frying (OLF) is listed in Table (2).

Table (2): Fatty acids composition of olein oil before frying (OL) and after frying (OLF).

Fatty acids (%)	Olein oil	
	Before frying (OL)	After frying (OLF)
Saturated fatty acids:		
Myristic ($C_{14:0}$)	1.32	1.22
Palmitic ($C_{16:0}$)	37.34	42.62
Stearic ($C_{18:0}$)	3.54	4.21
Total:	42.20	48.05
Unsaturated fatty acids:		
Oleic ($C_{18:1}$)	47.84	42.37
Linoleic ($C_{18:2}$)	9.96	9.58
Total:	57.80	51.95

It can be seen from Table (2) that the fatty acids contents of olein oil before frying (OL) and after frying (OLF) were (42.2% and 48.8%) of saturated fatty acids, and (57.8% and 52.0%) of unsaturated fatty acids, where the saturated: unsaturated ratio were (1:1.37) and (1:1.08) respectively.

Oleic acid constitutes more than 82.0% and 81.0% of the unsaturated fatty acids of olein oil before frying and after frying respectively, while palmitic acids show more than 37.0% and 42.0% of the total fatty acids, respectively. On the other hand linoleic acid forms almost the same percentage (9.96% and 9.58%) of the total fatty acids of both olein oil before and after frying, respectively.

Chemical characteristics of soaps manufactured from olein oil before frying (OL), olein oil after frying (OLF) and olein oil after frying and purification (POLF) are investigated. The data of moisture content, total fatty acids, unsaponifiable matters and free alkali are given in Table (3).

Table (3): Chemical characteristics of manufactured soaps

Characteristics	OL	OLF	POLF
Moisture (%)	19.1	18.4	19.8
Total Fatty acids (%)	76.1	75.6	78.0
Unsaponhifiable matter (%)	3.0	4.0	2.1
Free alkali (%)	1.8	2.0	0.1

From Table (3) it can be concluded that the total fatty acids of soap manufactured from olein oil after frying and purification (POLF) has higher value (78.0%) compared with soap manufactured from olein oil before frying (OL) and olein oil after frying (OLF) (76.1% and 75.6%), respectively . These results may be due to the effect of purification process of olein oil after frying used in the manufacture of soap. The results also show that the soap manufactured from olein oil after frying (OLF) have higher unsaponifiable matters (4.0%) than other soaps manufactured from olein oil before frying (OL) and olein oil after frying and purification (POLF) (3.0% and 2.1%), respectively. The increase in unsaponifiable matter may be due to the effect of the frying temperature which destroy of some glycerides. On other hand the free alkali content of soap manufactured from (POLF) have lower value (0.1%) compared with other soaps manufactured from (OL) and (OLF) (1.8% and 2.0%), respectively. It is noteworthy to mention that these results are in accordance with those reported by many investigators (Kifli and Krishnan 1987; Ainie and hamirin, 1994; Helmy, 1996 and Kuntom and Spitz, 2004).

The physical properties of manufactured soaps are given in Table (4).

Table (4): Physical properties of manufactured soaps.

Properties	OL	OLF	POLF
Solubility	Slightly soluble	Slightly soluble	Soluble
Foam volume (ml^3)	15.0	10.0	35.0
Foam lasting time (sec.)	10.0	10.0	25.0
Consistency	Very hard	Very hard	Hard

Table (4) clearly indicates that soap manufactured from (POLF) is more soluble in water compared with soap manufactured from (OL) and (OLF). The results also show that soap manufactured from (POLF) have higher foam volume and more stable ($35.0ml^3$ for 25.0. sec.) compared with soap manufactured from (OL) and (OLF) ($15.0ml^3$ for 10.0 sec. and 10.0 ml^3 for 10.0sec.), respectively. On the other hand the consistency of soap manufactured from (OL) and (OLF) have very hard consistency compared with soap manufactured from (POLF). This difference in consistency may be due to the difference in the moisture content of the three kinds of soaps. It is noteworthy to mention that these results are in accordance with those reported by many investigators (Kuntom *et al.,* 1996; Helmy, 1996 and Kuntom and Kifli, 1998).

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الإستفادة من زيت الأولين الناتج من عمليات القلى فى تصنيع الصابون

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تم دراسة الخصائص الكيميائية و الصفات الطبيعية و كذلك المحتوى من الأحماض الدهنية المشبعة و الغير مشبعة لزيت الأولين الناتج من عمليات القلى بالمطاعم مقارنة بزيت الأولين قبل عمليات القلى.

أجريت هذه الدراسة بهدف تعظيم الإستفادة من زيت الأولين الناتج من عمليات القلى و ذلك باستخدامه فى تصنيع صابون و تم تحسين بعض صفات الزيت الطبيعية مثل دكانة اللون و الرائحة من خلال مجموعة من المعاملات الكيميائية التى أجريت عليه قبل إجراء عملية التصبن.

تم مقارنة الصابون الناتج من زيت القلى المحسن كيميائيا بالصابون المصنع من زيت القلى الغير محسن كيميائيا و أيضا بالصابون المصنع من زيت الأولين قبل عمليات القلى و ذلك من خلال دراسة الخصائص الكيميائية و الصفات الطبيعية للثلاثة أنواع من الصابون المصنع بالإضافة الى تقييم الصابون الناتج من حيث درجة الإذابة فى الماء، حجم الرغوة، ثبات الرغوة و أيضا خصائص القوام.

إنتهت هذه الدراسة الى أن الصابون المصنع من زيت الأولين الناتج من عمليات القلى و المحسن من خلال المعاملات الكيميائية أظهر صفات جودة عالية من حيث درجة الإذابة فى الماء و حجم الرغوة و درجة ثباتها و ذلك مقارنة بالصابون المصنع من زيت الأولين ناتج عمليات القلى الغير محسن و زيت الأولين قبل القلى.

قام بتحكيم البحث

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