

## **Effect of Syrian Sumac Extract on Stability of Rice Bran oil And Canola oil**

\*Zenab Mostafa Mosa. \*\*Alshimaa Abdalla Hafez (specially education).  
\*\*Ereny Wilson Nagib

\*Assistant lecturer Nutrition and Food Sciences, Home economics Dept., Fac.  
of Education. Ain-Shams University.

\*\* lecturer Nutrition and Food Sciences, Home Economics Dept., Fac. of  
Education. Ain-Shams University.

### **ABSTRACT**

The antioxidants activities of sumac extract at various concentrations were evaluated in natural rice bran oil and canola oil stored at 65°C, for 35 days. The concentrations of extracts added into oil were 0.1%, 0.3% and 0.5%. Antioxidants effect was determined by the measurement of peroxide value. In addition determine the fatty acid and rancidity of fats in the rice bran oil and canola oil proximate composition and active groups of sumac powder. The results indicated that the mean gross rancidity of fats of rice bran oil was 1%, 3.7%, 205% and 0.8%, 5.58%, 202% of canola oil. The percentage of saturated fatty acids of rice bran oil was 16.73% and 11.70%, respectively which was higher than the canola oil (3.93% and 12.64% respectively). On the other hand the percentage of Poly Unsaturated Fatty Acid of of rice bran oil (30.17% and 2.14%, respectively) which were lower than the canola oil (30.71% and 15.40% respectively). Extract at 0.5% in the rice bran oil after 14 into 35 days of storage had better antioxidant activity (12.04%, 15.22%, 17.3% and 21.46%) than the control sample. On the other hand, extract at 0.5% in the canola oil had better antioxidant activity except for after 14 and 35 days of storage. The rate of inhibition of autoxidation in the rice bran oil and canola oil increases by increasing the concentration of extracts of sumach after 35 days of storage. On the other hand, the percentage rate of inhibition of autoxidation in the rice bran oil due to the presence of total natural antioxidants was 1.25% but it was 3.75% in the canola oil. The results showed that Sumac extract is also promising as a source of natural antioxidants.

Key words: Sumac- Antioxidant Activities- Rice Bran oil - Canola oil

### **Introduction**

Sumac is the common name for a genus (*Rhus*) that contains over 250 individual species of flowering plants in the family Anacardiaceae (**USDA ,2007**). In general, sumac can grow in non-agriculturally viable regions and various species have been used by indigenous people for medicinal and other

purposes, suggesting potential for commercializing the bioactivity of these plants without competing for food production land uses (**Van Wyk and Win ,2004**). For example, *Rhus glabra* (Smooth sumac) is traditionally used by native peoples of North America in the treatment of bacterial diseases such as syphilis, gonorrhoea, dysentery and gangrene (**Erichsen-Brown ,1989**).

The fruits of *Rhus coriaria* (Sicilian sumac) are commonly used as a condiment in the Mediterranean region and Middle East. *R. coriaria* is also used as a herbal remedy in traditional medicine due to its analgesic, antidiarrhetic, antiseptic, anorexic and antihyperglycaemic properties (**Rayne and Mazza ,2007**).

However, the extract of *R. coriaria*, which protects humans against oxidative DNA-damage (**Chakrabortya et al., ,2009**) is most notable for its antimicrobial and antioxidant activities (**Gulmez, Oral and Vatansever ,2006**).

Phenolic compounds, which are secondary metabolites in plant materials, are known to be responsible for antioxidant effect. Recent epidemiological studies have strongly suggested that consumption of certain plant materials may reduce the risk of chronic diseases related to oxidative stress on account of their antioxidant activity and promote general health benefits (**Halliwel ,1997**).

On the other hand, in the food industry, antioxidants are used to retard the oxidative degradation of fats by inhibiting the formation of free radicals. Synthetic antioxidants, such as butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT) and propylgallate (PG) are widely used; however, the use of synthetic antioxidants in food products is being questioned (**Branen, 1975**) and **Takajashi and Hiraga ,1978**). Consumers have also become more cautious about the nutritional quality and safety of food additives. In response to the growing consumer demand, investigations on antioxidants from natural sources have gained interest (**Pokorny, 1991**).

Fruits and vegetables are the main sources of phenolic compounds in human diet. Other sources, such as grains, herbs and spices, also have received particular attention as sources of antioxidants (**Hannum ,2004**). The Mediterranean diet is particularly rich in spices. Sumac is one example, which is widely used in Turkey and the Middle East. The fruits are red colored and contain one seed. Its dried and ground leaves have been used as a tanning agent due to their high tannin content (**Nakatani ,2000**).

Previous phytochemical studies of this plant reported that its leaves contained flavones, tannins, anthocyanins, and organic acids (**Karimdzhanov and Ismailov ,1997**). However, it is the fruit of the plant that is typically consumed as spice after drying and grinding. Other reports indicated that sumac has antimicrobial activity with limited information on its antioxidant activity

and potential as a new source of antioxidative substances (**Candan and Sokmen ,2004**).

Autoxidation and lipolysis are responsible for off flavors and chemical spoilage in lipid containing foods and the products formed via these reactions are potentially toxic (**Papadopoulou and Roussis, 2000**). Antioxidants play an important role in preventing undesirable changes in flavor and nutritional quality of foods (**Zielinski, Kozłowska, 2008**).

The oxidative stability of oils and fats may be influenced by many factors, such as light, metal ions, temperature, enzymes and oxygen. The addition of antioxidants to the oil helps to prevent or decrease oil oxidation (**Milos *et al.*, 2000**). During the last few decades an intensive testing of the safety of synthetic food additive has been carried out and many of them have been found to possess some toxic activity. Hence, the use of natural antioxidants having several functions (reducing agent, free radical scavengers, and potential complexers of prooxidant metals) is becoming a trend in both research and industrial application (**Ozcan ,2000**)

Canola oil emerged as recommendable dietary oil, which is rich in oleic acid similar to olive oil and with low levels of saturated fatty acids as compared to other vegetable oils. Moreover, compared to olive oil, canola oil contains higher levels of linoleic acid, which has a hypocholesterolemic potential (**Hunter ,1990**) and diets enriched with canola oil reduced total cholesterol, LDL cholesterol and apoB 100 in humans as compared to safflower oil (**Wardlaw *et al.*, 1991**).

In addition canola oil has been recommended because it contains high levels of  $\alpha$ -linolenic acid; marine sources of linolenic acid as well as vegetable sources have been shown to decrease cytokines which act as cellular mediators in the pathology of atherosclerosis in human and in mice (**Mortensen *et al.*, 1992**).

Canola oil was also found to be antithrombic, and had the ability to decrease platelet aggregation. It contains a lower ratio of n-6 to n-3 fatty acids which may allow for better conversion of linolenic acid to eicosapentenoic acid (EPA) known to decrease serum cholesterol in rats. Other benefits for canola oil include its ability to reduce the likelihood of a transient ischemic event that may lead to life threatening cardiac arrhythmia (**McLennan and Dallimore ,1995**).

Rice bran oil (RBO) contains an unusually high content of unsaponifiables (up to 4.4%), at a level which is several times greater than most other vegetable oils. The unsaponifiables of RBO are composed of plant sterols (43%), 4-methyl sterols (10%), triterpene alcohols (29%) and less polar components such as squalene or tocotrienols (19%). In addition, RBO contains up to 20% saturated fatty acids and approximately equal amounts of

polyunsaturated (40%) and monounsaturated fatty acids (40%), a fatty acid profile quite different from other often-utilized hypocholesterolemic vegetable oils (**Helrich ,1990**).

Only a little is known about the antioxidative activity of methanolic extract of sumac on oil stabilizing (**Ozcan and Akgul ,2000**). The aim of this study was to determine the antioxidant activity of sumac extract at various concentrations on rice bran oil & canola oil stored at 65°C. In addition determine the fatty acid and rancidity of fats.

### **Materials and Methods**

#### **Materials:**

##### **Source of samples:**

Syrian sumac powder was collected in May 2011 from local market in Egypt.

Rice bran oil and Canola oil were purchased from a local market as follow:

Rice bran oil: produced by Coagro Company in Thailand.

canola oil : produced by Smucker company in U.S.A. chemicals and reagents were obtained from the Egyptian international center for import, the agent of ( sigma Aldrich Co. USA) .

##### **Extract preparation:**

Plant material (10 g) was extracted with petroleum ether using a Soxhlet apparatus for 8 h. After drying, defatted plant material (3 g) was extracted with 40 mL of 70% (v/v) aqueous methanol in a shaker bath set at 40 °C for 30 min and filtered. This extraction step was repeated three times using the same batch of starting material. The filtrates were combined and methanol was evaporated at 40 °C using a rotavapor until dryness (extract 1). The solid residue was dissolved in 75 mL of water and extracted with 75 mL ethyl acetate three times. The ethyl acetate phases were combined and evaporated under vacuum at 40 °C using a rotavapor until dryness (extract 2) (**Gamez-Meza et al., 1999**).

##### **Assessment of antioxidant activity:**

The oils samples (40 g each) were placed in open 50 ml beakers in triplicate. Extract was indirectly melted at 40°C in a water bath and added to natural canola and rice bran oil in 10 x 100 mm open beakers at 1.0%, 3.0% and 5.0% (w/w) and dissolved by simple agitation. All samples of 40 g each were stored at 65 °C in the dark. The antioxidant activities of substances were evaluated by determining peroxide value (PV) at definite time intervals according to Method Cd 8-53 of the American Oil Chemists' Society. The inhibition rate of autoxidation was performed using **the following formula**

$$I = (M-L) \div M \times 100$$

Where I = inhibition (%), M = PV of control at the same time (Meq/kg), and L= PV of tested samples at the same time (Meq/kg) (**Duzgunes et al., 1987**).

## **Methods:**

### **Chemical Analysis:**

#### **Rancidity of Fats:**

Saponification number, acid value and peroxide value were determined in the Central Laboratory, National Nutrition Institute, Cairo. Egypt. According to the method of (AOAC, 2000).

#### **Fatty Acid:**

The fatty acids compositions of the oil samples were analyzed using Gas Liquid Chromatography Trace GC Ultra available at the Central Laboratory, National Nutrition Institute, Cairo. Egypt. According to the method of (AOAC, 2000).

#### **Proximate Composition:**

Sumac sample was analyzed for moisture, ash, crude protein, fat, carbohydrates and fiber contents using the methods described by (AOAC, 1990).

#### **Active Groups of Herbies :**

Active group of powder dried of Syrian sumac was analysis by {(Nicolet 6700) inverred (IR instrument)} in faculty of science Ain Shams University central laboratory in July 2011 according to (John ,1978 , john and sems ,1976).

#### **Statistical analysis:**

The obtained data were statistically analyzed according to SAS (1996). Data are expressed as means +SD. Effect Of Syrian Sumac Extract was determined by one-way analysis of variance (ANOVA) procedure (Steel and Torrie, 1980).

## **Results And Discussions**

### **Chemical analysis:**

The results in Table (1) indicated that the mean gross rancidity of fats of rice bran oil was 1%, 3.7%, 205% and 0.8%, 5.58%, 202% of canola oil for acid value, peroxide value and saponification respectively. These results was disagreement with (Perzybylski and Mag ,2002) who studied the composition and properties of vegetable oils used in food technology and reported that The rancidity of RBO was 0.9%, 97 – 115 % and 165 – 200 % for acid value, iodine number and saponification number, respectively.

**Table (1): Rancidity of fats of Rice bran and Canola oils**

<b>Rancidity of fats %</b>	<b>RBO</b>	<b>Canola</b>
AV	1.0	0.8
PV	3.7	5.58

SP	205	202
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AV= acid value    PV=peroxide value    SP= Saponification number

The present data (Table 2) indicated that the percentage of saturated fatty acids Palmitic acid (C16:0) and Arachidic acid (C20:0) of rice bran oil were 16.73% and 11.70%, respectively which were found to be higher than that of canola oil (3.93% and 12.64% respectively). On the other hand, the percentage of Poly Unsaturated Fatty Acid of Linoleic acid (C18:2) and Linolenic acid (C18:3) of rice bran oil (30.17% and 2.14%, respectively) which were found to be lower than the canola oil (30.71% and 15.40% respectively).

**Table (2): Fatty acids composition of rice bran oil and canola oil**

Type of Fatty acids	Fatty acids (Relative)	Rice Oil	Canola Oil
		%	%
Saturated Fatty Acids	Caprylic acid	0.04	0.08
	Capric acid	-	0.11
	Lauric acid	0.05	-
	Myristic acid	2.01	0.20
	Palmitic acid	16.73	3.93
	Arachidic acid	11.70	12.64
Mono Unsaturated Fatty Acid	Oleic acid	37.16	36.40
Poly Unsaturated Fatty Acid	Linoleic acid	30.17	30.71
	Linolenic acid	2.14	15.40
	Erucic acid	-	0.53
Total saturated fatty acids(T.S)		30.53	17.01
Total unsaturated fatty acids(U.T.S)		69.47	82.99

These results were agreement with **(Rukmini and Raghuram ,2010)** who demonstrated that RBO contained oleic acid (38.4%), linoleic acid (34.4%), and linolenic acid (2.2%) as unsaturated fatty acids, and palmitic (21.5%) and stearic (2.9%) acids as saturated fatty acids. On the other hand, these results were disagreement with **(BABA *et al.*; 2000)** who reported that canola oil contained Palmitic (16:0) (4.4%), Stearic (18:0) (1.9%), Oleic (18:1) (62.4%), Linoleic (18:2) (21.3%) and Linolenic (18:3) (9.9%).

**Table (3): Chemical composition of Syrian sumac powder**

Chemical composition (g)/ kg	Syrian sumac
protein	5± 1.56
fat	11.65±2.57

Carbohydrates	73.15± 1.98
moistures	6.4±0.45
Ash	3.8± 2.43
Fiber	19.76± 1.54

The present data (Table 3) indicated the nutrient values of dried Syrian sumac were 5, 11.65, 73.15, 6.4, 3.8 and 19.76 of protein, fats, carbohydrates, moistures, ash, and fiber, respectively. These results were agreement with (Akinci *et al.*, 2004) which compared between Syrian and Chinese sumac the results were the Chinese sumac showed a higher content in protein, fat, fiber and ash. The present results showed that the Syrian sumac can be considered as potential source of dietary fiber which is helpful in alleviating gastrointestinal disorders.

### Active Groups of Syrian sumac:

**Table (4): Active Groups of Syrian sumac powder**

peak	Function group
1053,1096	Bending O-C alcohol or ester
1320	Bending OH
1447	Bending CH
1616	yC=C
1738	yC =O of ester
2855,2926	yC =H for CH <sub>2</sub> and / or CH <sub>3</sub>
3354	VOH phenolic (or alcoholic)

The results present in the table (4) showed that Compound may be polycyclic aliphatic compound containing ester group and =C=C=

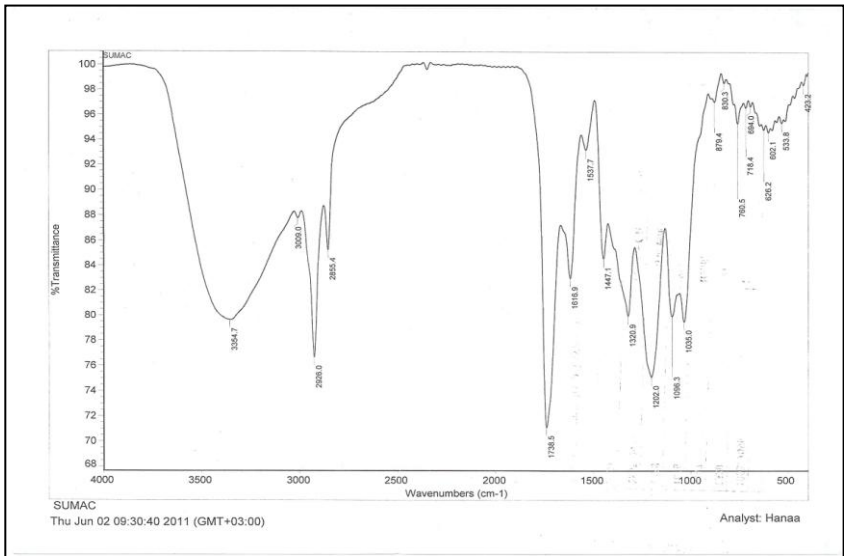
**Table (5): Active Groups of dried PE sumac extract as indicated by chromatograph**

peak	Function group
1036	OH bending or O-C stretching for 1 <sup>er</sup> ALC.
1101	OH bending or O-C stretching for 2 <sup>nd</sup> ALC.
1216	y O-C of ester (stretching)
1322	OH bending or C-O stretching of 1 <sup>er</sup> AL.
1394	CH bending
1623	Y C =C for stretching
1732	Y C=O of ester group (stretching)
2856 2928	Y C -H for stretching

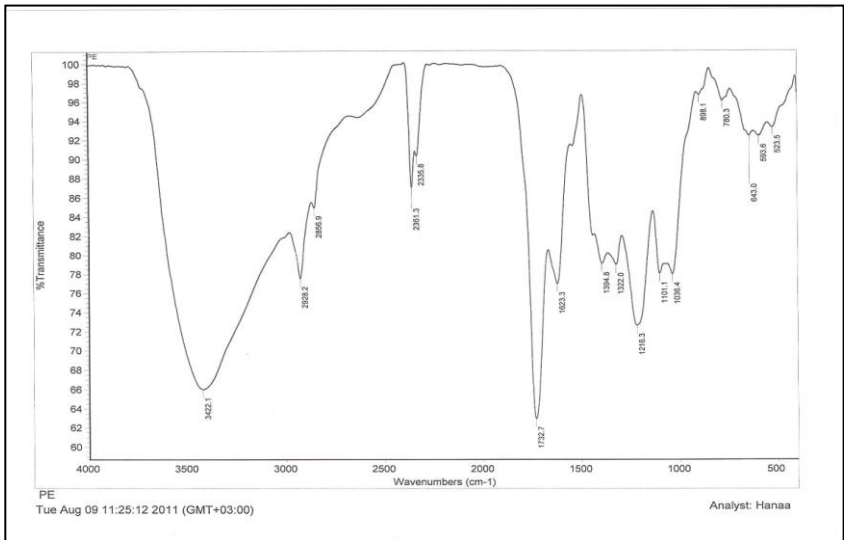
3422	YOH
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The results present in the table (5) showed that Compound containing ester group and  $=C=C=$  and OH group.





**Figure (1):  
Active  
Groups of  
Syrian  
sumac  
powder  
Figure (2):  
Active  
Groups of  
dried PE  
sumac  
extract**



The present data (fig. 1 and 2) showed that the phenolic compounds found in sumach extract by extraction of petroleum ether this means it's not found in the dry

sumach.

**Table (6) Peroxide Value of Rice Bran Oil and Canola Oil up on storage period for 35 days at 65°C**

Conc. (%)	Days				
	7	14	21	28	35
<b>Control Rice</b>	14.18±1.65	45.31±0.54	50.49±2.49	81.32±1.48	112.31±4.56
<b>E o.1</b>	11.6±1.15	30.49±1.34	35.21±1.37	37.9±2.04	43.3±3.29
<b>E o.3</b>	5±1.12	28.6±1.76	34.5±0.52	43.23±2.45	60.69±1.95
<b>E o.5</b>	9±2.43	12.04±2.50	15.22±3.65	17.3±1.50	21.46±1.59
<b>Control Canola</b>	13.03±1.07	23.2±1.59	43.67±1.71	56.28±1.48	64.32±1.50
<b>E o.1</b>	8±1.24	15.6±0.59	19.5±1.07	23.22±4.51	29.83±0.88
<b>E o.3</b>	7.8±0.68	16.28±2.54	22.37±0.45	11.63±2.58	28.74±4.62
<b>E o.5</b>	7.8±2.43	15.25±1.93	24.49±3.94	20.11±0.38	26.72±2.69

The results present in the table (6) showed that after 7 to 35 days of storage the peroxide value of rice bran oil and canola oil added to the extracts of sumach were lower than the control sample. This means that the sumac extract the content on the active groups in preventing autoxidation of rice bran oil and canola oil, therefore the increase in concentration of sumac extract increases the antioxidative effect. Extract at 0.5% in the rice bran oil after 14 to 35 days of storage had better antioxidant activity (12.04%, 15.22%, 17.3% and 21.46%) than the control sample. On the other hand, extract at 0.5% in the canola oil had better antioxidant activity except for after 14 and 35 days of storage. (**Musa Özcan, 2004**) who proved that the antioxidant effect of all extracts of Rosemary, Sage, and Sumac were low compared with that of butylated hydroxytoluene. Sumac extract exhibited the most antioxidant effect compared with other individual extracts. Of blends, the most effective ones were sage plus sumac combinations. Sumac extract is also promising as a source of natural antioxidants.

According to the data of Table (7) the rate of inhibition of autoxidation in the rice bran oil increases by increasing the concentration of extracts of sumach after 7 into 21 days of storage (E 0.1: 18.19%, 32.71% and 30.265 But E 0.5: 36.53%, 73.43% and 69.86%).

**Table (7) Inhibition Rate (%) of Autoxidation by extract of Syrian sumac**

Conc. (%)	Days									
	7		14		21		28		35	
	E	N	E	N	E	N	E	N	E	N

Rice Bran Oil										
<b>E o.1</b>	18.19	0.227	32.71	0.409	30.26	0.378	53.39	0.667	61.45	0.768
<b>E o.3</b>	64.74	0.809	36.88	0.461	31.67	0.396	46.84	0.586	45.96	0.575
<b>E o.5</b>	36.53	0.457	73.43	0.918	69.86	0.873	78.73	0.984	80.89	1.011
Canola Oil										
<b>E o.1</b>	38.60	1.448	32.76	1.229	55.35	2.076	58.74	2.203	53.62	2.011
<b>E o.3</b>	40.14	1.505	29.83	1.119	48.77	1.829	79.34	2.975	55.32	2.075
<b>E o.5</b>	40.14	1.505	34.27	1.285	43.92	1.647	64.27	2.410	58.46	2.192

**E= Inhibition Rate of extract  
Rate of total natural antioxidants**

**N= Inhibition**

On the other hand, the rate of inhibition of autoxidation in the canola oil was higher after 14 and 35 days of storage in the E 0.5% (34.27% and 58.46) but it was lower after 7, 28 and 35 days of storage in the E 0.1% (38.60%, 58.74% and 53.62%). The data of the same table also indicated that the percentage of inhibition of autoxidation in the rice bran oil due to the presence of total natural antioxidants was 1.25% but it was 3.75% in the canola oil. These results were agreement with (**Kosar *et al.*, 2006**) who proved that the extracts of sumac and fractions showed moderate lipid peroxidation inhibition effect compared with the synthetic antioxidants. The findings demonstrate that sumac can be used as a natural antioxidant.

## Conclusion

The results showed that different concentrations of sumac extract a strong influence on the inhibition of fat. The sumac extract is one of the articles of natural antioxidants that prevent oxidation of fatty food

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## المستخلص العربي

### تأثير مستخلص السماق السوري على ثبات زيت نخالة الارز والكانولا

\*زينب مصطفى موسى \*\* الشيماء عبد الله حافظ \*\* ايريني ولسن نجيب

\* استاذ مساعد تغذية وعلوم أطعمة- قسم الاقتصاد المنزلي- كلية التربية - جامعة عين شمس

\* مدرس تغذية وعلوم أطعمة- قسم الاقتصاد المنزلي- كلية التربية - جامعة عين شمس

تم اختبار نشاط مضادات الاكسدة بتركيزات متنوعه من مستخلص السماق على زيت الارز والكانولا بتخزين لمدته ٣٥ يوم تحت درجة حرارة ٦٥ درجة مئوية. تم اضافة المستخلص بتركيزات ٠,١، ٠,٢، ٠,٥ و ١,٥ و قياس تأثير مضادات الاكسدة عن طريق رقم البيروكسيد. بالاضافة الى قياس الاحماض الدهنية وتزنخ الدهون في زيت الارز والكانولا وقياس الاختبارات الكيميائية والمجموعات الفعالة في بودرة السماق.

اشارت النتائج الى ان متوسط اجمالي تزنخ الدهون في زيت الارز ١%، ٣,٧%، ٢٠,٥% و ٥٠,٨%، ٥,٥٨%، ٢٠,٢% في زيت الكانولا. كانت النسبة المئوية للامحاض الدهنية المشبعة من زيت نخالة الارز ١١,٧٠% و ١٢,٦٤% على التوالي التي كانت أعلى من زيت الكانولا (٣,٩٣% و ١٢,٦٤% على التوالي). من ناحية أخرى النسبة المئوية للامحاض الدهنية غير المشبعة من زيت نخالة الأرز (٣٠,١٧% و ٢,١٤% على التوالي) والتي كانت أقل من زيت الكانولا (٣٠,٧١% و ١٥,٤٠% على التوالي). اضافة المستخلص بنسبة ٠,٥% في زيت الأرز بعد ١٤ الى ٣٥ يوما من التخزين كان أفضل نشاط لمضادات الأكسدة (١٢,٠٤%، ١٥,٢٢%، ١٧,٣% و ٢١,٤٦%) من عينة الكنترول. من ناحية أخرى اضافة المستخلص بنسبة ٠,٥% في زيت الكانولا كان أفضل نشاط لمضادات الأكسدة بعد ١٤ و ٣٥ يوما من التخزين. معدل تثبيط الأكسدة في زيت الارز وزيت الكانولا يزيد بزيادة تركيز مستخلص السماق بعد ٣٥ يوما من التخزين. من ناحية أخرى، كان نسبة معدل تثبيط الأكسدة في زيت الأرز بسبب وجود مضادات الاكسدة الطبيعية هي ١,٢٥% وكانت ٣,٧٥% في زيت الكانولا. وأظهرت النتائج أن مستخلص السماق يعتبر مصدر لمضادات الاكسدة الطبيعية.

الكلمات الدالة: السوماق – نشاط مضادات الأكسدة- زيت نخالة الارز- زيت الكانولا.