

**EFFECT OF INTERESTERIFICATION PROCESS ON  
SOYBEAN OIL PROPERTY UNDER DIFFERENT  
EXPERIMENTAL CONDITIONS**

(Received:19.4.2003)

**By**  
**E. A. Mahmoud**

*Biochemistry Department, Faculty of Agriculture, Cairo University*

**ABSTRACT**

Modified soybean oil samples were prepared by interesterification of soybean oil with oleic acid at a ratio of 2:1 (w/w). The interesterification process was conducted at various reaction temperatures (60, 90 and 120 °C), stirring periods (2,4 and 6 hr) and nickel concentrations (0.2, 0.4 and 0.6%) as a catalyst. The fatty acid composition of the non-interesterified and interesterified soybean oil samples were determined by gas-liquid chromatography. The data demonstrated that the interesterification process altered the fatty acid composition of soybean oil. Under the various interesterification conditions, the levels of palmitic acid (16:0) and stearic acid (18:0) were nearly unchanged, whilst the level of oleic acid (18:1) was increased, linoleic acid (18:2) + linolenic acid (18:3) were decreased, respectively. The proposed interesterification reaction conditions to produce soybean oil characterized by low linolenic acid content (3.4%) were 0.2% or 0.4% nickel at 120°C and 4 hr stirring period. The recommended interesterification conditions for producing modified soybean oil distinguished by high oxidative stability were 0.2% nickel, 90°C reaction temperature and 4 hr stirring period.

**Key words:** *interesterification, oxidizability, soybean oil, stability.*

## 1. INTRODUCTION

Interesterification process is often desirable to alter the composition of acyl moieties of naturally occurring triacylglycerols in fats and oils in order to modify their physical and chemical properties (Young, 1985). It usually involves at least two oils that have different fatty acid composition (Konishi *et al.*, 1993). The classical interesterification is characterized by randomization in the distribution of acyl moieties in the triglyceride molecules by applying a chemical catalyst such as sodium methoxide, sodium potassium alloy, metallic sodium and sodium hydroperoxide (Sonntag, 1982). In this respect, refined soybean oil and edible beef tallow were interesterified with sodium methoxide as an alternative method to hydrogenation for the production of margarine oils (Lo and Handel, 1983). Palm oil and linoleic acid containing oils (soybean oil, rice oil, safflower oil, etc.) were interesterified in the presence of a catalyst (alkali metal compound and or lipase) to produce an edible oil with improved cold stability and flavour (Haga, 1986). Vanaspati-like fat was manufactured by interesterification of palm oil-soybean oil mixture (60:40, w/w) in the presence of 0.05-0.12% sodium methoxide at 90-150°C and reaction time of 30 min (Bhattacharyya and Newaz, 1987). Soft tube margarines were prepared by interesterification of 20% by weight of glycerol tristearate and 80% of olive oil in the presence of sodium methoxide as a catalyst (Gavriilidou and Boskou, 1993).

For the oils and fats industry, enzymic (lipase) interesterification processes offered a great potential to modify the properties of different triglycerides. Castor oil, excellent natural source for hydroxylated fatty acids, was used for interesterifications with beef tallow by the action of chromo-bacterium viscosum lipase (Haalck and Spener, 1989). Cocoa butter-like fat was prepared by interesterification from completely hydrogenated cottonseed oil and olive oil in the presence of lipase. The optimum reaction time to produce the major component of cocoa butter (1(3) palmitoyl-3(1) stearoyl-2- monoolein, POS) was 4 hr. The melting point of this product was 39°C which compared well to the 36°C melting point of natural cocoa butter (Chang *et al.*, 1990).

The main objective of the present study was to produce soybean oil characterized by a low level of linolenic acid since this component of soybean oil is responsible for the fishy odour during frying. Also, deduce the interesterification reaction conditions that lead to the production of soybean oil characterized by high oxidative stability.

## 2. MATERIALS AND METHODS

### 2.1. Sources of lipid materials

2.1.1. Bleached soybean oil was kindly supplied from the Cairo Company of Oils. Its peroxide value was  $1.8 \text{ meq. Kg}^{-1}$  and nearly free from free fatty acids.

2.1.2. Oleic acid was purchased from the Chemical Company, Egypt. The purity of oleic acid was checked by TLC and gave one spot.

### 2.2. Chemicals and solvents

Nickel catalyst was supplied from the Cairo Company of Oils with stated purity of 91%. All chemicals and solvents used throughout the present work were of analytical grade.

### 2.3. Interesterification process

The interesterification reaction was carried out by adding oleic acid to soybean oil at a ratio of 1:2 (w/w) in n-hexane. The reaction conditions were 0.2% nickel,  $60^\circ\text{C}$  reaction temperature and 2 hr stirring period. This experiment was repeated under the same conditions of temperature and catalyst concentration whilst the stirring period was extended to be 4 and 6 hr. This experiment was also reconducted at temperatures of  $90^\circ\text{C}$  and  $120^\circ\text{C}$  under the above mentioned same conditions of catalyst concentration. The aforementioned set of experiments were performed again using 0.4% and 0.6% nickel as a catalyst under the aforementioned conditions of temperatures and stirring periods instead of 0.2% catalyst. At the end of the experiment the reaction mixture was agitated with sat. sod. bicarbonate solution and the glycerides were extracted with ether, then the solvent was evaporated. The interesterified oil was analyzed. Table (1) summarises the whole experiments relevant to various

interesterification conditions.

#### 2.4. Preparation and methylation of fatty acids

Lipid samples (0.5 g) under study were saponified with KOH at room temperature (20%, w/v) overnight. The unsaponifiables were extracted three times with ether and the ether extract discarded. The remaining soap solution was acidified with sulphuric acid (20%, v/v) and the liberated fatty acids were extracted three times with ether. The combined ether extracts were washed several times with distilled water until the washings were neutral to phenolphthalein and dried over anhydrous sodium sulfate (Farag *et al.*, 1994). The fatty acids were methylated with diazomethane ethereal solution (Vogel, 1975), the solvent was removed and the residue was dissolved in chloroform. An aliquot from this solution was injected into gas-liquid chromatograph.

**Table (1): Interesterification process under different reaction conditions.**

Ni as Catalyst %	Temperature (°C)	Time (hr)
0.2	60	2, 4 and 6
0.2	90	2, 4 and 6
0.2	120	2, 4 and 6
0.4	60	2, 4 and 6
0.4	90	2, 4 and 6
0.4	120	2, 4 and 6
0.6	60	2, 4 and 6
0.6	90	2, 4 and 6
0.6	120	2, 4 and 6

#### 2.5. Gas-liquid chromatographic conditions for the determination of fatty acids

The fatty acid methyl esters were analysed by a GCV Pye Unicam gas chromatograph equipped with dual flame ionization detectors and fitted with coiled glass columns (1.5m X 4 mm O.D.) packed with chromosorb R (100-120 mesh, AAW) and coated with 10% polyethylene glycol adipate (PEGA). The column oven temperature was kept constant at 190°C with a nitrogen flow rate of 30 ml/min as a carrier gas. The flow rates for hydrogen and air were



33 ml/min and 330 ml/min, respectively. Detector and injector temperatures were 300°C and 250 °C, respectively. Peaks were identified using a standard methylated fatty acid mixture on the basis of retention times and measured by using a programmable PU 4810 Philips computing integrator. All samples were analysed in triplicate and the mean values agreed within 2%.

## 2.6. Statistical analysis

The standard analysis of variance procedure of the two factorial experiments in a completely randomized design was applied for all data according to the method outlined by Snedecor and Cochran (1980). The least significant difference (LSD) test at 5% level of probability was used to compare mean values of all treatments.

## 3. RESULTS AND DISCUSSION

There are several methods used to improve soybean oil oxidative stability such as partial hydrogenation, addition of synthetic antioxidants (Snyder *et al.* 1986 and Warner *et al.* 1986), natural selection and induce mutation to reduce the linolenic acid content (Anonymous 1990 and Scowcroft 1990). However, oxidative stability problem has not been completely solved (Mounts *et al.*, 1988 and Warner *et al.*, 1989). Moreover, there is presently concern about the nutritional safety of partially hydrogenated oils (Haumann, 1990). It is therefore, becoming more important to improve soybean oil stability through changes in triacylglycerol composition and structure through plant breeding (Scowcroft, 1990 and Haumann, 1990) and by enzyme directed interesterification with more stable fatty acids (Latta, 1990).

In the present study, soybean oil was interesterified by mixing with oleic acid at a ratio of 2:1 (w/w) under various conditions of temperatures, stirring periods and nickel concentrations as a catalyst. The interesterification process under these different conditions was conducted to establish the conditions that lead to the production of modified soybean oil characterized by low linolenic acid 18:3 content and long shelf-life.

The conditions of interesterification process under study might lead to increase the peroxide value of the interesterified product due to the presence of nickel. In this circumstance, it is well established that nickel acts as a poor prooxidant agent and, the interesterification process was conducted in an inert atmosphere (n-hexane). Therefore, the peroxidation of the interesterified lipid product is nearly limited.

### 3.1. Fatty acid profile of soybean oil

The fatty acid composition of the non-esterified soybean oil is shown in Table (2). For simplicity, the fatty acid concentration of soybean oil can be classified into three categories, *i.e.*, trace (<1%), minor (<10->1%) and major (>10%) component. Stearic (18:0) and linolenic (18:3) acids occurred as minor saturated and unsaturated constituents, respectively.

Palmitic (16:0), oleic (18:1) and linoleic (18:2) acids were present as major substances. The fatty acids of soybean oil can be arranged according to their concentrations as follows : linoleic > oleic > palmitic > linolenic > stearic acids.

### 3.2. Interesterification of soybean oil by oleic acid using 0.2% nickel.

Table 2 shows the fatty acid composition of interesterified soybean oil samples produced at 60, 90 and 120°C for 2.4 and 6 hr stirring periods. The data for the fatty acids pattern of the interesterified soybean oil samples showed that the level of oleic acids 18:1 was obviously increased compared with the non-interesterified oil. On the other hand, the concentrations of linoleic (18:2) and linolenic acids (18:3) were remarkably decreased compared with the non-interesterified soybean oil. In other words, the interesterified soybean oil samples had less linolenic and linoleic acids than the untreated soybean oil. The content of palmitic acid (16:0) and stearic acid (18:0) were nearly unchanged by interesterification. In general, the interesterification process caused an increase in the percentage of total low unsaturated fatty acids and a decrease in the percentage of total high unsaturated fatty acids. In this respect, Kaimal and Saroja (1989) reduced the level of linolenic

acid to 3% or less by interesterification (acidolysis) of the soybean oil using lipase as a catalyst.

The data in Table (2) demonstrate that various stirring periods at any temperature (60,90 and 120°C) had very little influence on the interchange of oleic, linoleic and linolenic acids. However, the rise in temperature altered the concentrations of these acids. For instance, the reaction temperatures at 90 C and 120°C exhibited a higher increase in oleic acid content than that at 60°C. Also, the reaction temperatures at 60 C and 120°C caused a decrease in linoleic acid level whilst, the reaction temperature at 90°C possessed much greater reduction in linoleic acid level. Since the main purpose of the interesterification process was to reduce the concentration of linolenic acid of soybean oil, the proposed interesterification reaction condition in this set of experiments to obtain an oil with low linoleic acid content (3.4%) were : 120°C reaction temperature, 0.2% Ni as a catalyst and 4 hr stirring period. The equation reported by Cosgrove *et al.* (1987) ( $\text{Oxidizability} = 0.02 \times \text{oleic acid\%} + 1 \times \text{linoleic acid\%} + 2 \times \text{linolenic acid\%}$ ) was used to estimate the oxidizability of various interesterified soybean oil samples. The oxidizability data (Table 2) indicate that, the interesterification reaction conditions necessary to produce soybean oil recognized by high stability were: 0.2% Ni, 90°C reaction temperature and 4 hr stirring period.

### **3.3. Interesterification of soybean oil by oleic acid using 0.4% nickel**

The fatty acid composition of the interesterified soybean oil samples under the reaction conditions at 60, 90, and 120°C and stirring periods of 2,4 and 6 hr are recorded in Table (3). Interesterification under the aforementioned conditions demonstrated that the level of palmitic acid 16:0 and stearic acid 18:0 were nearly unchanged; the levels of, oleic, linoleic and linolenic acids were significantly increased and decreased, respectively. The resultant interesterified soybean oil samples had less linoleic and linolenic acids than the nonesterified soybean oil. In other words,



**Table (2): Fatty acids profile (relative %) of modified soybean oil samples produced by interesterification using nickel (0.2%) at various temperatures and stirring periods.**

Stirring time (hr)	16:0 palmitic acid	18:0 stearic acid	18:1 oleic acid	18:2 linoleic acid	18:3 linolenic acid	Ts <sup>(a)</sup>	Tu <sup>(b)</sup>	Oxidizability <sup>(c)</sup>
Control	10.9	5.3	22.2	52.7	8.9	16.2	83.8	70.9
60C								
2	11.2	5.5	43.7	35.8	3.8	16.7	83.3	44.2
4	11.2	5.2	45.0	35.0	3.6	16.4	83.6	43.0
6	11.3	6.3	43.6	34.8	4.0	17.6	82.4	43.5
90C								
2	11.2	5.5	49.4	30.1	3.8	16.7	83.3	38.6
4	11.1	6.4	49.3	29.5	3.7	17.5	82.5	37.7
6	11.0	6.4	47.1	30.8	4.7	17.4	82.6	39.0
120C								
2	11.2	5.8	42.1	35.8	5.1	17.0	83.0	46.8
4	11.3	4.3	46.4	34.6	3.4	15.6	84.4	48.2
6	11.0	5.4	40.6	38.6	4.4	16.4	83.6	48.2
L.S.D	0.4	0.3	0.3	0.3	0.3			

A: refers to total saturated fatty acids.

B: refers to total unsaturated fatty acids.

C: Oxidizability = [ 0.02 x Oleic (%) + 1x Linoleic (%) + 2 x Linolenic (%) ]

**Table (3): Fatty acids profile (relative %) of modified soybean oil samples produced by interesterification using nickel (0.4%) at various temperatures and stirring periods.**

Stirring time (hr)	16:0 palmitic acid	18:0 stearic acid	18:1 oleic acid	18:2 linoleic acid	18:3 linolenic acid	Ts <sup>(a)</sup>	Tu <sup>(b)</sup>	Oxidizability <sup>(c)</sup>
Control	10.9	5.3	22.2	52.7	8.9	16.2	83.8	70.9
60C								
2	11.2	5.9	42.0	35.1	5.8	17.0	83.0	47.5
4	11.3	6.2	44.3	35.2	4.0	17.5	82.5	44.0
6	11.2	5.3	42.2	35.5	5.8	16.5	83.5	47.8
90C								
2	11.3	6.0	41.9	35.9	4.4	17.3	82.7	45.5
4	11.2	6.3	43.0	35.5	4.0	17.5	82.5	44.2
6	11.1	5.7	42.5	36.2	4.5	16.8	83.2	46.0
120C								
2	11.3	6.3	43.4	33.3	5.7	17.6	82.4	45.5
4	11.2	6.2	47.1	32.1	3.4	17.4	83.6	39.8
6	11.2	6.0	46.2	32.1	4.5	17.2	82.8	41.9
L.S.D	0.4	0.3	0.3	0.3	0.3			

A: refers to total saturated fatty acids.

B: refers to total unsaturated fatty acids.

C: Oxidizability = [ 0.02 x Oleic (%) + 1x Linoleic (%) + 2 x Linolenic (%) ]



interesterification possessed an increase in the percentage of total low unsaturated fatty acids and a decrease in the percentage of total high unsaturated fatty acids. Generally speaking, the stirring period at any reaction temperature had no effect on the levels of oleic, linoleic and linolenic acids. However, the rise in temperature in some cases altered the fatty acid levels. For example, the reaction temperatures at 60 and 90°C had no effect on the decrease of linolenic acids content whilst, the reaction temperature at 120°C caused more reduction on linolenic acids level compared with its levels at 60 and 90°C.

The data in Table 3 elucidate that the treatment under the following conditions: 0.4% Ni, 120°C reaction temperature and 4 hr stirring period produced an esterified soybean oil characterized by the lowest linolenic acids content (3.4%). Also, under these conditions the resultant modified soybean oil had a high stability towards oxidative rancidity since its oxidizability value was the lowest number (39.9) among the various modified soybean oil samples.

#### **3.4. Interesterification of soybean oil by oleic acid using 0.6% nickel**

The fatty acid composition of different interesterified soybean oil samples are shown in Table (4). The results showed that the level of linolenic acids was nearly unaffected by different interesterification conditions, but it was decreased compared with uninteresterified oil. The contents of linolenic acid was increased under the present interesterification conditions. Conversely, the percentages of linoleic and linolenic acids were obviously decreased. Once again, the modified soybean oil samples were recognized by less linoleic and linolenic acid content than the untreated soybean oil. In addition, interesterification exhibited an increase and decrease in the percentages of total low saturated and high unsaturated fatty acids, respectively. Hence, the present interesterification conditions had a role on the distribution of fatty acids in the triglycerides of modified soybean oil samples. For instance, stirring for 2 hr at any reaction temperature decreased the linolenic acid content compared with linolenic acid level after stirring for 4 and 6 hr. Also,

Table (4): Fatty acids profile (relative %) of modified soybean oil samples produced by interesterification using nickel (0.6%) at various temperatures and stirring periods.

Stirring time (hr)	16:0 palmitic acid	18:0 stearic acid	18:1 oleic acid	18:2 linoleic acid	18:3 linolenic acid	Ts <sup>(a)</sup>	Tu <sup>(b)</sup>	Oxidizability <sup>(c)</sup>
Control	10.9	5.3	22.2	52.7	8.9	16.2	86.8	70.9
60C								
2	11.0	6.0	42.4	34.8	5.8	17.0	83.3	47.2
4	11.2	5.5	44.5	35.4	3.4	16.7	83.3	43.0
6	11.2	5.8	41.3	37.3	4.4	17.0	83.3	46.8
90C								
2	11.2	5.5	46.4	30.1	6.3	16.7	83.3	43.6
4	11.2	5.7	49.3	29.4	4.4	16.9	83.1	39.1
6	11.1	5.7	46.4	32.0	4.8	16.8	83.2	42.4
120C								
2	11.2	5.6	45.4	31.4	6.4	16.8	83.2	45.0
4	11.2	5.8	45.7	32.0	5.3	17.0	83.0	43.4
6	11.1	6.0	47.3	30.5	5.1	17.1	82.9	41.9
L.S.D	0.4	0.3	0.3	0.3	0.3			

A: refers to total saturated fatty acids.

B: refers to total unsaturated fatty acids.

C: Oxidizability =  $[(0.02 \times \text{Oleic } (\%) + 1 \times \text{Linoleic } (\%) + 2 \times \text{Linolenic } (\%)]$

Table (5) : Influence of interesterification conditions on stearic + oleic + linoleic + linolenic acid ratios of the modified soybean oil samples.

Stirring time (hr)	60C	90C	120C	LSD
0.2% Nickel				
2	1.24	2.06	1.17	
4	1.57	2.15	1.34	0.003
6	1.57	1.53	0.93	
0.4 % Nickel				
2	1.11	1.20	1.27	
4	1.52	1.25	1.65	0.003
6	1.15	1.03	1.14	
0.6 % Nickel				
2	1.14	1.44	1.35	
4	1.56	1.63	2.25	0.003
6	1.13	1.35	1.73	
Control = 0.44				

interesterification at 90 and 120°C slightly decreased linolenic acid content compared with its level at 60°C. In this set of experiments, a modified soybean oil characterized by low linolenic acid content (3.4%) can be produced under the interesterification reaction conditions of 0.6% Ni, 60°C reaction temperature and 4 hr stirring period.

Looking at all the data presented in Tables (2,3 and 4), the interesterification reaction conditions required to produce soybean oil with low linolenic acids (3.4%) were 0.2% or 0.4% Ni, 120°C reaction temperature and 4 h stirring period or 0.6% Ni, 60°C reaction temperature and 4 h stirring period. To obtain soybean oil with high stability, the interesterification conditions would be : 0.2% Ni, 90°C reaction temperature and 4 hr stirring period.

As already mentioned, the interesterification process produced modified soybean oil samples distinguished by high content of low unsaturated fatty acids and low percentages of high unsaturated fatty acids compared with the non-interesterified soybean oil. In order to give more precise information on the distribution of various fatty acids in the triglycerides during the interesterification process, the ratios of stearic + oleic + linoleic + linolenic acids for the non- and interesterified soybean oil samples were calculated and the results are shown in Table (5). The ratios of stearic + oleic + linoleic + linolenic acids for the non-interesterified soybean oil was 0.44. The range of this ratio for the resultant soybean oil samples by interesterification at various conditions of nickel concentrations (0.2, 0.4 and 0.6%), reaction temperatures (60, 90 and 120°C) and stirring periods (2, 4 and 6 hr) was 0.93-2.25.

#### 4. REFERENCES

- Anonymous (1990). High-oleic sunflower patents challenged. INFORM 1 (3): 148-91.
- Bhattacharyya D.K. and Newaz A. (1987). A new process technology for the production of vanaspati-like nutritious modified fat of desired PUFA (poly-unsaturated fatty acids) level and varied



- glyceride composition, directly from commercially refined oils and fats interesterification under the catalytic influence of sodium methlyate powder. Indian IN 160,025 (C1 C11 C<sub>3</sub>/00).
- Chang M.K., Abraham G. and John V.T. (1990). Production of cocoa butter-like fat from interesterification of vegetable oils. *J. Am. Oil Chem. Soc.* 67(11): 832-834.
- Cosgrove J.P., Church D.F. and Pryor W.A. (1987). The kinetics of the auto-oxidation of polyunsaturated fatty acids. *Lipids* 22(5): 299-304.
- Farag R.S. (1994). Influence of microwave and conventional heating on the quality of lipids in model and food systems. *Fat Sci. Technol.* 96(6):215-221.
- Gavriilidou V. and Boskou D. (1993). Effect of chemical interesterification on the autoxidative stability of olive oil-tristearin blends. *Dev. Food Sci.* 32:313-319.
- Haalck L. and Spener F. (1989). Enzymic functionalization for alternative applications of natural fats. DEHEMA Biotechnol. Conf. 3 (Pt . A, Jt. Meet. SIM, DEHEMA, Presentation Biochem. Lab., Microb. Princ. Bioprocesses, Appl. Genet.) 113-116.
- Haga N. (1986). Manufacture of edible oils. *Jpn. kokkyo koho JP* (61, 296, 096) (86, 296, 096) C11. C11 C<sub>3</sub>/10). *Appl.* 85/137,802.
- Haumann B.F. (1990). The fats and oils industry in seeding natural sources of antioxidant. *INFORM 1* (12): 1002-1013.
- Kaimal T.N.B. and Saroja M. (1988). Selective removal of linoleic acid from soybean oil by lipase-catalysed interesterification at low temperature. *Biotechnol. Letter.* 10(5): 337-340.
- Konishi H., Neff W.E. and Mounts T.L. (1993). Chemical interesterification with regioselectivity of edible oils. *J. Am. Oil Chem. Soc.* 70(4): 411-415.
- Latta S. (1990). Structured lipids. *INFORM 1*(11) : 970-974.
- Lo Y.C., and Handel A.P. (1983). Physical and chemical properties of randomly interesterified blends of soybean oil and tallow for use as margarine. *J. Am. Oil Chem. Soc.* 60(4): 815-818.

- Mounts T.L., Warner K., List G.R., Kleiman R., Fehr W.R., Hammond E.G. and Wilcox J.R. (1988). Effect of altered fatty acids composition on soybean oil stability. *J. Am. Oil Chem. Soc.* 65(4): 624-628.
- Scowcroft W.R. (1990). New fats and oils through biotechnology. *INFORM* 1(11): 945-951.
- Snedecor G.W. and Cochran W.G. (1980). "Statistical methods", 7th edn., Ames, IA., Iowa State University Press.
- Snyder J.M., Frankel E.N. and Warner K. (1986). Headspace volatile analysis to evaluate oxidative and thermal stability of soybean oil. Effect of hydrogenation and additives. *J. Am. Oil Chem. Soc.* 63(8): 1055-1058.
- Sonntag N.O.V. (1982). in "Bailey's Industrial oil and Fat Products", vol.2 4<sup>th</sup> ed., Edited by D. Swern, John Wiley and Sons, New York, pp 147- 153.
- Vogel A.I. (1975). "A textbook of practical organic chemistry", 3<sup>rd</sup> edn. English Language Book Society and Longmans Group Ltd.
- Warner K., Frankel E.N., Snyder J.M. and Porter W.L. (1986). Storage stability of soybean oil-based salad dressings : Effects of antioxidants and hydrogenation. *J. Food Sci.* 51(3): 703-708.
- Warner K., Frankel E.N. and Mounts T.L. (1989). Flavour and oxidative stability of soybean, sunflower and low erucic rapeseed oils. *J. Am. Oil Chem. Soc.* 66(4): 558-564.
- Young F.V.K. (1985). Interchangeability of fats and oils. *J. Am Oil Chem. Soc.* 62(2): 372-376.

## تأثير عمليات الاسترة الداخلية تحت ظروف مختلفة على خواص زيت فول الصويا

ابتسام عبد المنعم محمود

قسم الكيمياء الحيوية - كلية الزراعة - جامعة القاهرة

### ملخص

تهدف هذه الدراسة إلى إنتاج نوعية من زيت فول الصويا تمتاز بانخفاض محتواها من حمض اللينولينك وزيادة ثباته ضد الأكسدة أثناء التخزين وذلك بعملية الاسترة الداخلية. خلط زيت فول الصويا مع حمض الأوليك بنسبة ٢:١ (وزن/وزن) و التسخين على درجات حرارة مختلفة (٦٠، ٩٠، ١٢٠م) مع الرج لفترات (٢، ٤، ٦ ساعات) في وجود النيكل كعامل مساعد بتركيزات (٠,٢، ٠,٤، ٠,٦%) . درس التركيب الكيماوي للأحماض الدهنية لعينات فول الصويا المختلفة الناتجة من عمليات الاسترة الداخلية بواسطة جهاز التحليل الكروماتوجرافي الغازي وتبين أن ظروف الاسترة الداخلية بصفة عامة لم تحدث تغييراً يذكر في تركيز الأحماض الدهنية بالميتيك وأستياريك. أما بالنسبة للحمض الدهني أوليك فقد حدث ارتفاع في كميته على العكس من الأحماض الدهنية لينولينك + لينولينك التي حدث لها انخفاض. كما أدت عملية الاسترة الداخلية إلى زيادة في النسبة المئوية للأحماض الدهنية منخفضة عدم التشبع وبالتبعية انخفاض في النسبة المئوية للأحماض الدهنية عالية عدم التشبع. هذا وقد أدت عملية الاسترة الداخلية لزيت فول الصويا على درجة حرارة ١٢٠م مع التقليب لمدة ٤ ساعات في وجود النيكل بتركيز ٠,٢% أو ٠,٤% إلى الحصول على نوعية من زيت فول الصويا تمتاز بانخفاض محتواها من الحمض الدهني لينولينك (٣,٤%). وتوصى الدراسة بإنتاج زيت فول صويا معدل بطريقة الاسترة الداخلية و التي لها خواص مضادة للأكسدة عالية باستخدام النيكل كعامل مساعد بنسبة ٠,٢% مع التسخين على ٩٠م والتقليب لمدة ٤ ساعات.

المجلة العلمية - لكلية الزراعة - جامعة القاهرة - المجلد (٥٥) العدد الأول  
(يناير ٢٠٠٤): ٧٠-٥٧.