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BIOLOGICAL EVALUATION OF SOME HYDROGENATED OILS

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ABSTRACT: Cotton seed oil, laboratory hydrogenated cotton seed oil and commercial hydrogenated cotton seed oil were biologically evaluated. Total cholesterol, triglycerides, HDL-cholesterol, glutamic pyruvic (GPT) and glutamic oxaloacetic (GOT) transaminases of rat serum blood were analyzed. The results showed that the hydrogenated oils under investigation, caused increase in the levels of total cholesterol, triglycerides and glutamic transaminases (GPT, GOT) compared with cotton seed oil and induced significant decreased in HDL-cholesterol of rat serum blood.

Key words: Hydrogenation, Biological evaluation, Cotton seed oil.

INTRODUCTION

Hydrogenation, which is one of the oldest and most important processes in edible oil modification, improves fat consistency for use in margarines and other edible fats (Widermann, 1978). The course of hydrogenation process, as well as the composition and properties of the final product depend on various operating factors, including catalyst type and concentration, agitation, hydrogen pressure and temperature (Garibay, 1981). The hydrogenation process generally leads to an increase in the degree of order in the fatty acid residues in two ways: (i) cis double bonds are converted to saturated bonds; (ii) cis double bonds are converted to trans double bonds by an summarization process. Both

changes lead to higher melting points and the farmer change facilitates crystallization due to increased chain flexibility (Allen, 1982).

Lo and Handel, 1983 reported that the formation of trans isomers is advantageous because trans isomers have higher melting points and greater stability than their cis counterparts. However, several reports have recently been published on the metabolic effects of trans fatly acids due to suspicion that may have an adverse effect on health. Results of investigations of the effects of trans fatty acid on plasma cholesterol levels, triacylglyceral levels and coronary heart disease have been equivocal (Sommerfield, 1983). Further disadvantage of hydrogenation is that when vegetable oil rich in linoleic acid are hydrogenated, a loss of essential fatty acids occurs, which decrease the original biological value of the product. Mahfouz and Osman, 1983 determined the trans and the essential fatty acid contents (Linoleic. 18:2) in some consumer-available Egyptian hydrogenated fats. The fats contain considerable amounts of trans fatty acids which are mainly trans-18:1; the favored isomers were Δ^9, Δ^{10} and Δ^{11} with small amounts of Δ^8 and Δ^{12}. in addition to the trans acids, the fats also contain a large amount of essential fatty acids, but much less than the original oils. The major objective of this paper was to study effect of hydrogenated cotton seed oil on human health compared with cotton see oil.

MATERIALS AND METHODS

1. Source of cotton seed oil:

Crude and hydrogenated cotton seed oil were obtained from Oils and Soap Company, El-Mansora, Egypt and Oils and Soap Company, El-Zagazig, Egypt (2001). respectively.

2. Hydrogenation of cotton seed oil:

Hydrogenation process was carried out in a laboratory-scale apparatus at Faculty of Agriculture, El-Mansora University using a commercially available Nickel catalyst.

3. Hydrogenation conditions:

Temperature (c°)	Time (min)	Nickel (w+ %)	pressure
200	240	0.5	1.5

4. Experimental animals:

The animals used in this study were male Albino rats, with an average weight of 95gms and

obtained form Research Institute of Ophthalmology, Giza, Egypt (2001).

5.Reagent methodology kits:

Total lipids, total cholesterol, and triglyceride, transaminases (Glutamic oxalate transferase (G. O.T) and glutamic pyravate transferase and high density lipoprotein cholesterol HDL were obtained from Boehringer Mannheim GmbH, Germany.

6. Feeding experiment:

(i) Animals and diets: the animals were dived into groups (each 10 rats). All rats were acclimatized for 16 weeks prior to commencement of the experiments and water available ad.libitum standard diet was formulated according to A. O. A. C. (1975). The first group was fed a complete standard diet (control). The other groups of rats were fed cotton seed oil laboratory hydrogenated cotton seed oil and hydrogenated cotton seed oil (15%).

(ii) Blood samples were taken at the start of the experiment and after 16 weeks of the administration of the tested materials. The blood samples were obtained from orbital plexus venous by means of fine capillary glass tubes according the method described by Schermer (1967).

Determination of HDL cholesterol:

Total lipids were determined according to Joseph *et al* (1972).

Determination of total cholesterol:

Total cholesterol was determined according to Allain *et al* (1974).

Determination of triglyceride:

Triglyceride was determined according to the method of Fossati and Prencipe (1982).

Determination activity of transaminase:

The determination of the activities of glutamate oxaloacetate trans amines (GOT) and glutamate private trans amines (GPT) were carried out according to the procedures accomplished by Reitman and Frankel (1957).

Statistical analysis:

The analysis of variance of two factorial designs was applied for all data under the present study according to the method out lined by Snedecar and Citron (1973). The new LSD test was used to compare the significant differences between means of treatments (Waller and Duncan, 1969).

RESULTS AND DISCUSSION

Influence of investigated hydrogenated oils on rat liver function:

There are several parameters, which can be used to envisage the situation of liver function. Some of these parameters are glutamic pyruvic (GPT) and glutamic oxaloacetic (GOT) transaminases, cholesterol content, HDL–cholesterol, total lipid content and triglycerides. Asset of nutritional experiments was performed in the present study to elucidate the effect of hydrogenated oils on rat liver function.

1. Glutamic oxalacetic trans amines (G.O.T): -

Glutanic oxalacetic tranaminase enzyme catalyzes amino group transfer from amino acids to keto acids with a high degree of specification. Such amino group transfers are essential to intermediary metabolic introversion in the kerbs cycle. G.O.T. level during feeding experiment (16 weeks) using cottonseed oil, hydrogenated cottonseed oil is shown in Table (1). From Table (1) it could be observed that the G.O.T. level was lower in rats fed diet containing cotton seed oil compared with the highly significant different values of hydrogenated cotton seed oil and laboratory cotton seed oil. From the above results it could be concluded that the different varieties of oils under investigation had effect on liver function of rats.

2. Glutamic–pyruvic transaminase (GPT) activity: -

Glutamic pyruvic transaminase enzymes catalyze amino group transfers from amino acids with a high degree of specification. Such amino group transfers are essential to intermediary metabolic introversion in the Krebs cycle GPT is found in particularly high concentrations in the liver. The changes in serum G.P.T level during feeding experiment (16 weeks) using cottonseed oil: hydrogenated cotton seed oil and laboratory hydrogenated cotton seed oil are shown in Table (2). From the data in Table (2) it could be observed that serum G.P.T. level was higher in rats fed diet containing hydrogenated cottonseed oil followed by those fed laboratory-hydrogenated cottonseed oil and no significant differences were observed between rates fed cottonseed oil.

3.Triglycerides: -

The changes in serum triglycerides level during feeding experiment for 16 weeks are shown in Table (3). The above mentioned Table (3) showed that the serum triglycerides level in rats fed diet containing cotton seed oil had the lowest average among other hydrogenated cotton seed oil and laboratory hydrogenated cotton seed oil during the experiment.The obtained results are agreed with those obtained by Toussant et al., (1981) and Lai et al., (1989) who reported that, dietary linoleic acid reduce plasma triglycerides in rats and high intakes of linoleic acid perhaps reduce hepatic synthesis of very low density lipoprotein (VLDL) triglycerides.

4.Total cholesterol: -

The changes in serum total cholesterol level during feeding experiment using cottonseed oil, hydrogenated cotton seed oil and laboratory cotton seed oil for 16 weeks are shown in Table (4). From the results tabulated in Table (4) it could be observed that the serum total cholesterol level was lower in rats fed diet containing cotton seed oil (rich in polyunsaturated fatty acids) during the experiment. Similar results were also obtained by Kinsell *et al.*, (1952) who found that vegetable oils rich in lionoleic acid lowered serum cholesterol. On the other hand, the same data (Table 4) showed that, total cholesterol in rats serum fed diet containing hydrogenated cotton seed oil (rich in saturated fatty acids) was highly significant differences than all other groups as total cholesterol during the experiment. These results are in agreement with those reported by Hegsted *et al.*, (1965) who suggested that the lionoleic acid lowered total cholesterol more than saturated fatty acids.

5.High-density lipoprotein cholesterol (HDL- cholesterol): -

HDL- cholesterol plays an important role in the transportation of triglycerieds, cholesterol and phospholipids through out plasma (Stein, 1987).

The changes in serum HDL-cholesterol level during feeding experiment for 16 weeks are shown in Table (5). From the results mentioned in Table (5) it could be noticed that cottonseed oil had the highest average levels of serum HDL- cholesterol. On the other hand, hydrogenated cottonseed oil and laboratory-hydrogenated cottonseed oil had the lowest average levels of serum HDL-cholesterol. These results are in

agreement with those obtained by Kris-Etherton *et al*, (1984).

RECOMMENDATION

According to the results obtained from the pervious studies it could be concluded that cotton seed oil had no hazard effect on the human being health comparing to the hydrogenated cotton seed oil. So, it may be adviced to consume the unhydrogenated cotton seed oil rather than the hydrogenated one.

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Table (1): Influence of feeding different oils on serum G.O.T (U/L) of rats.

Oils / Weeks	Control	Cotton seed oil	Laboratory hydrogenated cotton seed oil	Hydrogenated cotton seed oil
0	48.50 a	48.50 a	48.50 a	48.50 a
4	50.20 a	51.00 a	55.90 b	54.30 b
8	51.00 a	51.90 a	60.21 c	61.50 c
12	52.90 a	52.80 a	68.50 d	69.70 d
16	54.00 a	55.00 a	75.30 e	77.20 e

L.S.D at 5% =3.10

Table (2): Influence of feeding different oils on serum GPT (U/L) of rats.

Oils / Weeks	Control	Cotton seed oil	Laboratory hydrogenated cotton seed oil	Hydrogenated cotton seed oil
0	25.00 a	25.00 a	25.00 a	25.00 a
4	25.20 a	25.50 a	30.30 b	31.20 b
8	25.90 a	26.20 a	37.50 c	37.00 c
12	26.20 a	26.70 a	44.30 d	45.00 d
16	27.10 a	27.50 a	49.20 e	49.90 e

L.S.D at 5 % =1.62

Table (3): Influence of feeding different oils on serum triglycerides (mg/dl) of rats.

Oils / Weeks	Control	Cotton seed oil	Laboratory hydrogenated cotton seed oil	Hydrogenated cotton seed oil
0	69.30 a	69.30 a	69.30 a	69.30 a
4	70.00 a	70.10 a	77.00 b	77.50 b
8	70.20 a	71.00 a	85.50 c	86.30 c
12	71.30 a	72.30 a	91.30 d	93.50 d
16	72.50 a	72.90 a	99.20 e	100.20 e

L.S.D at 5 % =1.40

Table (4): Influence of feeding different oils on serum total cholesterol (mg/dl) of rats.

Oils / Weeks	Control	Cotton seed oil	Laboratory hydrogenated cotton seed oil	Hydrogenated cotton seed oil
0	62.00 a	62.00 a	62.00 a	62.00 a
4	62.50 a	62.30 a	69.10 b	70.00 b
8	63.00 a	62.90. a	74.50 c	75.30 c
12	63.30 a	63.10 a	82.30 d	83.00 d
16	64.00 a	63.50 a	89.30 e	90.10 e

L.S.D at 5 % =0.92

Table (5): Influence of feeding different oils on serum HDL–cholesterol (mg/dl) of rats.

Oils / Weeks	Control	Cotton seed oil	Laboratory hydrogenated cotton seed oil	Hydrogenated cotton seed oil
0	23.50 a	23.50 a	23.50 a	23.50 a
4	23.70 a	23.80 a	23.70 a	23.60 a
8	2560 a	26.10 a	23.90 a	23.80 a
12	29.50 a	29.30 a	23.90 a	23.90 a
16	33.30 a	33.50 a	24.10 a	24.00 a

L.S.D at 5 % =2.50

التقييم البيولوجي لبعض الزيوت المهدرجة

أماني محمد محمد بسيونى ، هدى أحمد عليوة ، داليا محمود محمد مصطفى
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تم أجراء تقييم بيولوجي لزيت القطن المهدرج معملياً وزيت القطن المهدرج تجارياً مقارنه بزيت القطن العادى حيث تم تقدير كلاً من الجليسريدات الثلاثية وأنزيمات الكبد والكوليسترول الكلى والكوليسترول عالى الكثافة فى سيرم دم الفئران المغذاه على الزيوت السابقة.

أشارت النتائج إلى أن عملية الهدرجة تؤدى إلى رفع مستويات كلاً من الجلسريدات الثلاثية وأنزيمات الكبد والكوليسترول الكلى وتؤدى لخفض مستوى الكوليسترول عالي الكثافة في سيرم دم فئران التجارب مقارنه بزيت بذرة القطن العادى.