

**EFFECT OF FEEDING ON PURE COTTON SEED OIL, SUNFLOWER SEED OIL PURE AND MIXED WITH RAPE SEED OIL USED FOR FRYING ON SOME BLOOD PARAMETERS AND LIVER AND KIDNEY WEIGHT IN RATS**

**EI-Shazly, Hoda A. E. \* and Wafaa M. El-Kholy \*\***

\* Fat and Oil Res. Dept. Food Techn. Res. Institute, Agric. Res. Center, Giza, Egypt.

\*\* Zoology Dept. Faculty of Science. Mansoura University. Mansoura, Egypt.

**ABSTRACT**

The effects of feeding on fresh or fried (12 or 24 hrs.) cotton seed oil (CSO) and sunflower seed oil (SUN); pure or mixed with 5 or 15% rape seed (LEAR) oil were studied in rats. The results of the present work showed that there were non significant changes in the levels of serum triglycerides and total cholesterol of rats fed on the fresh unheated oils either pure or mixed. On the other hand, significant increases were seen in serum triglycerides by using CSO mixed with 15% LEAR oil and in serum total cholesterol of SUN oil + 5% LEAR oil, while significant decrease was observed in case of SUN oil mixed with 5% LEAR oil fried for 12 hrs. compared to the pure fresh unheated CSO. Concerning oil fried for 24 hrs. there were marked significant increases in serum triglycerides by feeding on pure CSO and SUN oil or that mixed with 5 and 15% LEAR oil and in serum total cholesterol in case of pure or mixed CSO with 5 and 15% LEAR oil.

The enzyme activity of aspartate amino transferase (ASAT) in the serum did not change significantly by feeding on unheated or fried oils either pure or mixed. On the other hand, serum alanine amino transferase (ALAT) activity showed significant increase in case of the unheated pure SUN oil. Pure SUN oil and mixed with 5% LEAR oil fried for 12 hrs. showed significant decrease, while significant increase was seen in case of pure SUN oil, fried for 24 hrs. Concerning the serum alkaline phosphatase activity (ALP). It was not affected significantly by feeding on the unheated fresh oils either pure or mixed except CSO + 15% LEAR oil which showed significant increase. While it was increased significantly in case of CSO mixed with 5% LEAR oil and the SUN oil either pure or mixed with 15% LEAR oil fried for 12 hrs. Oils fried for 24 hrs. exhibited significant increase in serum ALP in case of pure CSO and CSO + 5% LEAR oil, while significant decrease was observed in case of CSO + 15% LEAR oil as well as in pure SUN oil.

However, feed efficiency ratio revealed no significant increases in the rats fed on the fresh unheated oils except that fed on CSO mixed with 15% LEAR oil and SUN oil mixed with 5% LEAR oil which exhibited high feed efficiency ratio. Meanwhile, the feed efficiency ratios of oils fried for 12 or 24 hrs. Whether pure or mixed did not change significantly except CSO mixed with 5% LEAR oil which exhibited low feed efficiency ratio.

The results also indicated a significant increase in the weight of the liver of rats fed on unheated SUN oil pure or mixed with 5 or 15% LEAR oil. Concerning oils fried for 12 hrs. SUN oil mixed with 5 and 15% LEAR oil showed significant increase in the liver weight. However, significant increases were seen liver weight in case of CSO + 5% LEAR oil and SUN oil + 15% LEAR oil after 24 hrs. frying. Meanwhile, there were no significant differences in the weight of the kidney in the different groups

except significant increase in CSO + 15% LEAR oil fried for 12 hrs. . and CSO + 5% LEAR oil fried for 24 hrs. .

## INTRODUCTION

The world's annual production of oils and fats is about 48 million tons from which nearly 80% is extracted from plant sources. The main source of the edible oil in Egypt is cotton seed oil which is either produced locally or imported. Local production does not cover more than 50% of consumption. This great shortage of edible oils requires for other oil sources. The large scale production of rape seed oil may be feasible in these areas, and accordingly the partial solution of the problem of edible oils in Egypt. On the other hand, such product is cheaper and more suitable in nutrition from a hygienic point of view for its low content cholesterol. Use rape seed oil attracted the attention of some investigators.

Heating of fats brings about measurable changes in their chemical and physical characteristics. Heat is applied in processing for food manufacture, such as during hydrogenation of oils with a catalyst, and in frying for meal preparation (Perkins and Lambonic, 1998). Partially hydrogenated products generally contain substantial quantities of geometric and positional isomers of the original unsaturated fatty acids (Alexander, 1981; and Liu and Huang, 1995). During deep fat frying, when the fat is used repeatedly, oxidative and thermal effects result in the formation of many volatile and non volatile products, some of which are potentially toxic, depending on the level of intake (Alexander, 1981; and Liu and Lee, 1998).

Furthermore, Laser and Agerhm (1989) showed that, three of the several mutagenic compounds which formed during frying were carcinogenic in animal studies and that creatine was important precursor. Creatine was partly converted to creatinine depending on the frying time and temperature. Thus, the more creatinine that was formed and the brower the crust, the more mutagenic activity was found in the crust of the beef steaks. They also concluded that, frying under normal conditions (180°C for 3 min / side) will result in low mutagenicity, a good flavour and also in a low weight loss, which is important for the tenderness and juiciness of a beef steak.

However, Kok et al (1988) and Narasimhamurthy and Raina (1999a) reported that long term feeding of thermally oxidized oils increased the activity of catalyst while decreased the activity of hepatic some other hepatic antioxidant enzymes in rats. These changes may be related to several factors like heating and frying conditions, extent of peroxidation, duration of feeding and nature of fat.

On the other hand, long term feeding of heated and fried oils may not cause any deleterious effect on growth, plasma and tissue lipid profile of rats as the conditions employed for heating / frying were not too drastic and the oils were not heated abused (Narasimhamurthy and Raina, 1999b).

Recently Battino et al (2002) found that feeding fried oil changes antioxidant and fatty acid pattern of rat and affects rat liver mitochondrial respiratory chain components.

Since even practical processing and frying conditions can produce some nutritionally undesirable products an effort should be made to minimize the accumulation of these in our dietary fats.

## **MATERIALS AND METHODS**

### **Experimental animals :**

Male albino rats of sprange Dawely strain with an average weight of 90 gm. were used in the present experiment. They were fed stock diet for a week before starting the experimental investigation. The rats were then divided into 18 groups each of 6 rats for each diet. All animals were kept under constant experimental conditions for 30 days.

### **Oils :**

Completely refined cotton seed oil (CSO) and sunflower seed oil (SUN) used for this study were obtained from Mansoura Oil and Soap Company.

Canola oil [Low Erucic Acid Rape (LEAR)] or rape seed oil used for blending procedures was obtained from Food Technology Department, Cairo University.

### **Animal grouping:**

- 1- Pure cotton seed oil (control).
- 2- Cotton seed oil (CSO) after 12 hrs. frying.
- 3- Cotton seed oil (CSO) after 24 hrs. frying.
- 4- 95% CSO + 5% LEAR oil (unheated).
- 5- 95% CSO + 5% LEAR oil after 12 hrs. frying.
- 6- 95% CSO + 5% LEAR oil after 24 hrs. frying.
- 7- 85% CSO + 15% LEAR oil unheated.
- 8- 85% CSO + 15% LEAR oil after 12 hrs. frying.
- 9- 85% CSO + 15% LEAR oil after 24hrs. frying.
- 10- Pure sunflower seed oil (SUN) unheated.
- 11- Sunflower seed oil (SUN) after 12hrs frying.
- 12- Sunflower seed oil (SUN) after 24hrs frying.
- 13- 95% SUN oil + 5% LEAR oil unheated.
- 14- 95% SUN oil + 5% LEAR oil after 12hrs frying.
- 15- 95% SUN oil + 5% LEAR oil after 24hrs frying.
- 16- 85% SUN oil + 15% LEAR oil unheated.
- 17- 85% SUN oil + 15% LEAR oil after 12hrs frying.
- 18- 85% SUN oil + 15% LEAR oil after 24hrs frying.

### **Blending Procedures :**

\* Cotton seed oil (CSO) and LEAR oil were blended as :

B (1) 95% CSO + 5% LEAR oil.

B (2) 85% CSO + 15% LEAR oil.

\* Sunflower seed oil (SUN) and LEAR oil were blended as :

B (3) 95% SUN + 5% LEAR oil.

B (4) 85% SUN + 15% LEAR oil.

**Frying process :**

Two kilograms of cotton seed oil (CSO); and kilogram of sunflower seed oil (SUN), were used in the frying process, at 160°C±5 for 6 hours daily for 4 consecutive days. After frying, the oil was left to cool overnight and one hundred grams of oil were taken for biological evaluation and kept in brown glass bottles and stored in a deep – freezer at - 20°C.

Three types of diet containing 95% or 85% of cotton or sunflower seed oils unheated or fried oils (for 12 or 24 hrs. ) used as either pure oils or mixed with 5% or 15% rape seed oil (LEAR oil) were used as indicated in the following table :

**Table (1) Composition of experimental Diets (gm%) :**

Ingredient	Diet I (Fresh control)	Diet II (12h frying)	Diet III (24h frying)
Casein (a)	13.3	13.3	13.3
L-methionine	0.3	0.3	0.3
Fiber	4.0	4.0	4.0
Corn starch	40.0	40.0	40.0
Sucrose	22.4	22.4	22.4
Salt mixture (b)	4.0	4.0	4.0
Vit. Mixture (c)	1.0	1.0	1.0
Cotton seed oil	15.0		
B (1)		15.0	
B (2)			15.0
Sunflower seed oil	15.0		
B (3)		15.0	
B (4)			15.0
a-	13.3% casein equal protein.		B (1) = 95%CSO + 5% LEAR oil.
b-	According to Briggs and William (1963).		B (2) = 85%CSO + 15% LEAR oil.
c-	According to A.O.A.C. (1975)		B (3) = 95%SUN + 5% LEAR oil.
	Each diet include 3 treatments of oil.		B (4) = 85%SUN + 15% LEAR oil.
	- Fresh (unfrying) pure.		
	- After 12 hours of frying.		
	- After 24 hours of frying.		

At the end of expression period rats in all treated groups were killed by sudden blade stroke. Immediately the animals were dissected for the excision of liver and kidney. These organs were quickly cleaned and weighed. Blood samples were collected and centrifuged for serum separation.

**Biochemical determinations:**

Triglycerides in the serum were determined according to the method of Fossati and Prencipe (1982).

Total cholesterol in the serum was determined according to the enzymatic method of Allain et al (1974).

The determination of the activities of aspartate amino transferase (ASAT) and alanine amino transferase (ALAT) in the serum were carried out according to the procedures accomplished by Reitman and Frankel (1957).

The determination of serum Alkaline phosphatase (ALP) was done according to the method of Belified and Goldberg (1971).

The data were analyzed statistically using student's t-test according to Bailey (1959).

## RESULTS

### 1- Serum triglycerides:

Table (2) showed that the mean values of serum triglycerides of rats fed unheated oils either pure or mixed revealed no significant differences comparing with the fresh pure CSO. For oils heated for 12 hrs. serum triglycerides level exhibited highly significant increase in rats fed 85% CSO mixed with 15% LEAR oil and low significant decrease in rats fed 95% SUN oil mixed with 5% LEAR oil. Concerning rats fed frying oils for 24 hrs. highly significant increase was shown in case of CSO pure or mixed (in the ratio of 5 and 15% LEAR oil) and SUN oil mixed (5 and 15% LEAR oil). Meanwhile pure SUN oil shows low significant increase.

### 2- Serum total cholesterol :

The results presented in table (2) revealed that serum total cholesterol of rats fed unheated oils pure or mixed showed no significant differences in comparison with pure unheated CSO. However, similar results were obtained in rats fed fried oils except low significant increase shown in rats fed 95% SUN oil + 5% LEAR oil fried for 12 hrs. and rats fed CSO pure and mixed with 5% LEAR oil fried for 24 hrs. On the other hand, high significant increase was shown in rats fed 85% CSO + 15% LEAR oil fried for 24 hrs.

### 3- Serum ASAT, ALAT and ALP :

The data in table (3) illustrated non significant changes in the serum levels of ASAT enzyme in all groups or rats whether fed on unheated oils or oils frying for 12 or 24 hrs. either pure or mixed. For ALAT, table (3) shows that feeding on pure mixed unheated and frying CSO either heated for 12 or 24 hrs. have no significant decreases in serum ALAT levels. Meanwhile, feeding on pure SUN oil unheated or heated for 24 hrs. showed significant increase while SUN oil pure or mixed with 5% LEAR oil and heated for 12 hrs. showed significant decrease.

Data in table (3) showed also that unheated 85% CSO mixed with 15% LEAR oil revealed significant increase in serum ALP level as compared with the unheated pure CSO. Other unheated oils showed non significant changes in serum ALP level. Concerning oils heated for 12 hrs. highly significant increases were seen in CSO mixed with 5% LEAR oil, pure SUN oil and SUN oil mixed with 15% LEAR oils, other oils showed no differences. For oils heated for 24 hrs. CSO whether pure or mixed (with 5 LEAR showed significant increase. While 85% CSO + 15% LEAR oil and pure SUN oil showed significant decrease in serum ALP level.

**Table (2) : Mean values of serum triglycerides (g/L) and total cholesterol (mg/dl) of rats fed the different oils  $\pm$  S.E.**

Oils		CSO	B (1)	B (2)	SUN	B (3)	B (4)
Triglycerides	Unheated oils	(control) 55.91 $\pm$ 0.004	N.S. 53.98 $\pm$ 0.08	N.S. 50.18 $\pm$ 0.54	N.S. 50.0 $\pm$ 0.56	N.S. 54.22 $\pm$ 0.06	N.S. 55.64 $\pm$ 0.01
	After 12hrs frying	N.S. 43.75 $\pm$ 2.23	N.S. 44.22 $\pm$ 2.07	** 74.63 $\pm$ 4.61	N.S. 53.52 $\pm$ 0.11	* 55.25 $\pm$ 0.02	N.S. 54.47 $\pm$ 0.05
	After 24 hrs frying.	** 57.38 $\pm$ 0.01	** 63.48 $\pm$ 0.69	** 64.25 $\pm$ 0.85	* 66.35 $\pm$ 1.38	** 57.27 $\pm$ 0.01	** 60.62 $\pm$ 0.25
Total cholesterol	Unheated oils	Control 62.29 $\pm$ 0.11	N.S. 64.88 $\pm$ 0.002	N.S. 61.00 $\pm$ 0.23	N.S. 52.96 $\pm$ 0.35	N.S. 52.70 $\pm$ 0.39	N.S. 53.11 $\pm$ 0.33
	After 12hrs frying	N.S. 59.15 $\pm$ 0.48	N.S. 61.75 $\pm$ 0.15	N.S. 62.37 $\pm$ 0.10	N.S. 57.52 $\pm$ 0.003	* 67.12 $\pm$ 0.16	N.S. 59.72 $\pm$ 0.04
	After 24 hrs frying	* 71.50 $\pm$ 0.58	* 68.74 $\pm$ 0.01	** 73.75 $\pm$ 1.05	N.S. 59.87 $\pm$ 0.05	N.S. 60.65 $\pm$ 0.10	N.S. 58.35 $\pm$ 0.002

CSO : Pure cotton seed oil.

B (1) : 95% CSO + 5% LEAR oil.

B (2) : 85% CSO + 15% LEAR oil.

SUN : Pure sunflower seed oil.

B (3) : 95% SUN + 5% LEAR oil

B (4) : 85% SUN + 15% LEAR oil.

\* : Low significant at P < 0.5

\*\* : High significant at P < 0.01

As compared with the group fed pure unheated CSO.

**Table (3) Serum ASAT (/100ml), ALAT (/100ml) and ALP (U/100ml) of rats fed the different oils + S.E**

Time of frying	Oils	CSO	B (1)	B (2)	SUN	B (3)	B (4)
Unheated oil (control)	ASAT	Control 185.90 ± 30.16	N.S. 145.38 ± 0.51	N.S. 143.17 ± 0.21	N.S. 134.35 ± 0.05	N.S. 106.33 ± 6.72	N.S. 97.11 ± 13.54
	ALAT	Control 72.41 ± 1.89	N.S. 57.16 ± 0.18	N.S. 59.33 ± 0.03	** 76.34 ± 0.57	N.S. 61.66 ± 0.95	N.S. 60.08 ± 1.35
	ALP	Control 70.50 ± 0.05	N.S. 52.16 ± 3.76	** 71.33 ± 0.10	N.S. 50.38 ± 2.76	N.S. 66.17 ± 0.04	N.S. 59.50 ± 0.34
After 12 hrs. Frying	ASAT	N.S. 110.50 ± 11.52	N.S. 129.12 ± 1.44	N.S. 123.52 ± 3.46	N.S. 118.36 ± 1.38	N.S. 139.87 ± 1.85	N.S. 129.92 ± 0.04
	ALAT	N.S. 58.02 ± 0.10	N.S. 69.22 ± 1.00	N.S. 60.62 ± 0.0002	* 70.5 ± 0.004	* 70.87 ± 0.01	N.S. 66.63 ± 0.15
	ALP	N.S. 53.75 ± 3.07	** 73.25 ± 0.30	N.S. 66.63 ± 0.06	** 73.62 ± 1.16	N.S. 65.00 ± 0.003	** 81.50 ± 4.02
After 24 hrs. Frying	ASAT	N.S. 141.37 ± 0.06	N.S. 147.50 ± 0.93	N.S. 127.25 ± 2.02	N.S. 160.65 ± 14.51	N.S. 120.51 ± 0.85	N.S. 147.88 ± 5.31
	ALAT	N.S. 59.26 ± 0.03	N.S. 54.25 ± 0.59	N.S. 56.50 ± 0.25	** 93.97 ± 8.02	N.S. 66.65 ± 0.15	N.S. 62.77 ± 0.71
	ALP	** 78.87 ± 1.46	** 82.75 ± 2.77	* 68.37 ± 0.001	* 69.12 ± 0.30	N.S. 54.50 ± 1.38	N.S. 60.50 ± 0.22

CSO : Pure cotton seed oil.  
 B (1) : 95% CSO + 5% LEAR oil.  
 B (2) : 85% CSO + 15% LEAR oil.  
 SUN : Pure sunflower seed oil.  
 B (3) : 95% SUN + 5% LEAR oil.  
 B (4) : 85% SUN + 15% LEAR oil.  
 \* : Low significant at P < 0.5  
 \*\* : Highly significant at P < 0.01  
 As compared with the group fed pure unheated cotton seed oil (CSO).

**4- Feed efficiency ratio of tested oils:**

Table (4) showed that either of unheated pure oils showed non significant differences in the feed efficiency ratio, whereas oils containing 85% CSO + 15% LEAR oil and 95% SUN oil and 5% LEAR oil showed significant increases in feed efficiency ratio. Frying oils for 12 or 24 hrs. . revealed non significant increases for feed efficiency ratio except 95% CSO mixed with 5% LEAR oil, heated for 24 hrs. which indicated (highly) significant decrease.

**5- Weight of liver and kidney:**

The results in table (5) showed that diet containing unheated oils of SUN oil pure or mixed (5 and 15% LEAR oil) caused significant increase in the liver weight, while CSO pure or mixed did not affect the liver weight significantly. Oil fried for 12 hrs. . did not change the liver weight significantly except SUN oil mixed with 5 and 15% LEAR oil which showed very marked significant increase in the liver weight. However, the mixed oils 95% (CSO +5% LEAR oil and 85% SUN oil + 15% LEAR oil) that heated for 24 hrs. increased the liver weight significantly.

Concerning the kidney weight, all used unheated and frying oils caused non significant decreases in the kidney weight except 85% SUN oil + 15% LEAR oils heated for 12 hrs. and 95% CSO + 5% LEAR oil heated for 24hrs which caused low significant increase.

**Table (4) Feed Efficiency Ratio (FER) of rats fed the different oils.**

Groups Treatment	CSO (pure)	B (1) (95%)	B (2) (85%)	SUN pure	B (3) (95)%	B (4) (85%)
Unheated oils (Zero)	Control 0.207	N.S. 0.199	* 0.219	N.S. 0.210	* 0.224	N.S. 0.184
After 12hr. frying	N.S. 0.073	N.S. 0.009	N.S. 0.109	N.S. 0.047	N.S. 0.114	N.S. 0.125
After 24hr frying	N.S. 0.056	** 0.198	N.S. 0.029	N.S. 0.025	N.S. 0.065	N.S. 0.116

CSO : Pure cotton seed oil.  
 B (1) : 95% CSO + 5% LEAR oil.  
 B (2) : 85% CSO + 15% LEAR oil.  
 SUN : Pure sunflower seed oil.  
 B (3) : 95% SUN + 5% LEAR oil  
 B (4) : 85% SUN + 15% LEAR oil  
 \* : Low significant at P < 0.5  
 \*\* : High significant at P < 0.01

As compared with the group fed pure unheated CSO.



**Table (5) : Mean weight of liver and kidney in mg / 100 gm body weight of rats fed the different oils. + S.E.**

Time of frying	Oils	CSO	B (1)	B (2)	SUN	B (3)	B (4)
Unheated oils (control)	Weight of liver	Control 4.72 ± 0.003	N.S. 4.46 ± 0.0004	N.S. 4.79 ± 0.003	** 6.01 ± 0.01	** 5.22 ± 0.001	* 5.13 ± 0
	Weight of kidney	Control 1.23 ± 0.00	N.S. 1.216	N.S. 1.247	N.S. 1.200	N.S. 1.144	N.S. 1.027
After frying 12hr	Weight of liver	N.S. 4.34 ± 0.00	N.S. 3.95 ± 0.002	N.S. 4.47 ± 0.001	N.S. 4.51 ± 0.004	** 5.30 ± 0.001	*** 5.45 ± 0.002
	Weight of kidney	N.S. 1.194	N.S. 1.00	* 1.262	N.S. 0.895	N.S. 1.104	N.S. 1.117
After frying 24hr	Weight of liver	N.S. 2.991 ± 0.02	* 4.80 ± 0.004	N.S. 4.39 ± 0.001	N.S. 4.10 ± 0.01	N.S. 4.50 ± 0.004	* 5.15 ± 0
	Weight of kidney	N.S. 1.187	* 1.266	N.S. 1.225	N.S. 0.654	N.S. 0.787	N.S. 0.725

CSO : Pure cotton seed oil.  
 B (1) : 95% CSO + 5% LEAR oil.  
 B (2) : 85% CSO + 15% LEAR oil.  
 SUN : Pure sunflower seed oil.  
 B (3) : 95% SUN + 5% LEAR oil  
 B (4) : 85% SUN + 15% LEAR oil.  
 \* : Low significant at P < 0.5  
 \*\* : High significant at P < 0.01

As compared with the group fed pure unheated cotton seed oil (CSO).

## DISCUSSION

### **Biological assay:**

Much of the fat in our diet has been exposed to heat during processing and in the preparation of foods during cooking. Over the years there have been concern about changes taking place in heating fats and what effects these derivatives might have on individuals consuming them. In view of this, many feeding studies with experimental animals have been carried out.

In the present study cotton seed oil (CSO) and sunflower seed oil (SUN) alone or mixed with low curcic acid rape seed (LEAR) oil in different ratios whether fresh or heated for 12 and 24 hours were fed to rats. The effect of these oils on some serum parameters and on the weight of some internal organs (liver and kidney) was investigated.

### **\* Effect of frying oils on serum triglycerides and total cholesterol levels:**

It is quiet evident that unheated oils as pure or mixed with LEAR oil showed non significant differences in serum triglycerides and serum total cholesterol levels in comparison with fresh pure CSO. For frying oils heated for 12 hours, triglycerdes were highly elevated in the sera of rats fed mixed oils (85% CSO + 15% LEAR oil) and low significant elevation in rats fed 95% SUN oil + 5% LEAR oil. Meanwhile serum total cholesterol was significantly elevated only in rats fed SUN oil + 5% LEAR oil. However, rats fed frying oils for 24 hours indicated significant increase in the serum triglyceride levels of rats fed CSO or SUN oil either pure or mixed with LEAR oils in the ratios of 5% and 15%, as well as in serum total cholesterol in rats fed CSO pure and mixed, but not in SUN oil.

Such results given in the present study are in good agreement with those reported by Billek, G., (1980) as well as with, Narasimhamurthy and Raina (1999a) who recorded higher plasma cholesterol levels in heated oil fed group of rats. In addition Liu and Lee (1998) observed that plasma cholesterol concentration was highest in guinea pigs fed oxidized frying oil. Furthermore Abdel Hamid *et al.* (1993) who reported hyperlipidaemia and hypercholesterolaemia by using boiled SUN oil.

These findings mean, that heating oils for prolonged time (either pure or mixed), might result in different fractions of low molecular weight compounds from such oxidized oils. Some of these compounds are most toxic and can alter the metabolism of lipids. (Alexander, 1981 and Lambonie *et al.*, 1998).

However, contrast results were reported by Alfin Slater *et al* (1959) who recorded depressed plasma cholesterol levels in female rats fed diet containing heated lard oil and in male rats ingested heated CSO. In addition, Liu and Lee (1998) and Narasimhamurtly and Raina (1999) repoted low levels of plasma triglycerides in rats and guinea pigs fed frying oils respectively. Such differences may result from the difference conditions of the experiments.

**\* Effect of frying oils on serum ASAT and ALAT levels :**

Results shown in the present work indicated non-significant changes in the serum levels of ASAT of rats fed the unheated and frying oils for 12 or 24 hours as compared with the group of rats fed the pure unheated CSO.

Meanwhile serum ALAT levels of unheated oils indicated only significant increase for pure SUN oil, whereas the other tested oils showed non-significant differences as compared by the levels of ALAT given by pure CSO. For frying oils all tested oils showed non-significant changes on the levels of serum ALAT except those of SUN oil (pure and mixed with 5% LEAR oil after 12hr frying) which indicated significant decreases as well as highly significant increase for the pure SUN oil fried for 24 hrs.

Such findings reflect nearly that frying may affect hepatic function. Our results were more or less compatible with the results obtained by Galal, *et al.* (1992) which indicated that continuous feeding for 10 weeks on diets containing 15% SUN oil (either fresh or used for frying) caused no significant changes in ASAT and ALAT. On the other hand, they noticed a significant decrease in serum in ALAT / ASAT ratio of rats that were fed SUN oil that was used for frying for 48 hours. They suggested that such significant decrease in ASAT / ALAT ratio was proposed as an additional means of detecting hepatitis regardless of the absolute transferase values.

**\* Effect of frying oils on serum ALP levels:**

Present data illustrated that unheated sample containing 85% CSO + 15% LEAR oil showed significant increase in serum ALP as compared with those of unheated pure CSO. The other unheated oils showed non-significant differences for the levels of serum ALP. Oils heated for 12 hours gave highly significant increase in serum ALP for samples containing 95% CSO + 5% LEAR oil, pure SUN oil and 85% SUN oil + 15% LEAR oil. Whereas the other tested oils indicated no differences as compared with those given pure CSO. For oils heated for 24 hours, the samples containing pure CSO or 95% CSO + 5% LEAR oil, showed higher levels for serum ALP. Samples containing 85% CSO + 15% LEAR oil or pure SUN oil showed fairly decreases in serum ALP, whereas those containing SUN oil + 5 or 15% LEAR oil indicated non-significant changes.

However, Morgado *et al.* (1998) found that the degree of fat hydrogenation and the trans fatty acid content of the diet affect the fatty acid composition of membranes and the amount and the activity of some membrane enzymes.

Such disturbances in serum ALP activity was more pronounced in CSO pure or mixed with 5% LEAR oil fried for 24hrs. and indicates, in addition to the disturbed lipid profile, to impaired liver function.

**\* Feed efficiency ratio of tested oils:**

The data given proved non significant changes for unheated pure SUN oils whereas CSO and SUN oil containing LEAR oil 15 and 5% respectively indicated significant increasing levels for feed efficiency ratio. Frying oils, for 12 hours proved remarkable decreasing levels of feed efficiency ratio, however, such levels were non significant as compared with

those of pure CSO. Oils heated for 24 hours showed lower significant levels for feed efficiency for sample containing 95% CSO + 5% LEAR oil. The other tested oils showed non significant values of feed efficiency.

Such results revealed that unheated CSO and SUN oil that mixed with 15 and 5% LEAR oil respectively are more valuable than pure CSO. The results indicated also the decreasing volubility of mixed oils 95% CSO + 5% LEAR that frying for 24 hrs. These findings agreed greatly with those of Alexander (1978); De -Fiellietaz and Hermus (1985) and Narasimhamurthy and Raina (1999a) who found no significant differences in the average feed efficiency between groups of rats that received the oxidized fats or their controls.

However, when Kok *et al.* (1988) investigated the canola (LEAR) oils heated for 72 hours at 180°C with 3 periods of 8 hours found that the oxidized oils caused no noticeable decrease in body weight gain and food intake. Anyhow feeding animals with frying fats had shown biological effects ranging from a slight depression in growth to very poor growth and diminished feed efficiency.

These results were in agreement with Galal, *et al.* (1992) who found that feeding adult albino rats on SUN oil which was used in frying potatoes at 180°C for 10 weeks lowered the feed efficiency of the diet by 60%. They added that the relative feed efficiency of diet containing oil that has been heated for 48 hours is less than 50% of the feed efficiency of the same diet containing fresh oils.

### **Effect of frying oils feeding on weight of liver and kidney:**

#### **Weight of the liver :**

Cotton seed oil either pure or mixed with rape seed oils, whether unheated or fried, however, indicated non significant changes in the weight of liver except CSO + 5% LEAR oil heated for 24 hrs. that exhibited significant increasing weight of liver.

The results also showed that rats fed diets containing unheated pure SUN oil or those mixed with rape seed oil in ratio of 5% and 15% have highly significant increasing liver weights.

Concerning samples containing SUN oil mixed with 5 and 15% LEAR oil (after 12 hrs. frying) and SUN oil + 15% LEAR oil (after 24 hrs. frying), they caused significant enlarged liver weight.

Similar results were also obtained by Billek (1980); Izaki and Fujiwara (1981); De-Fiellietaz and Hermus (1985); Abdel Hamid *et al.* (1993) and Lambonic and Perkins (1996) by feeding on oxidized frying oils.

Such increment in liver may be attributed to the signs of hyperlipiaema and hypercholesterollaemia observed previously in the liver of sheep fed on heated SUN oil Abdel Hamid *et al.* (1993) or to the increased liver microsomal proteins recorded by Lambonic and Perkins (1996) and Lambonic *et al.* (1998).

However, the increased liver weight may be related to the alterations in the desaturase activities of rat liver microsomes and the concomitant changes in fatty acid composition of these membranes induced by dietary heated oils [Ruiz and Muriane (1992) and Morgado *et al.* (1998)].

**Weight of kidney :**

The results revealed no significant differences in the weight of kidney of the different groups of rats fed the unheated oils. The same was observed for rats fed the heated oils for 12 and 24 hours except those fed diets containing CSO mixed with 15 and 5% LEAR oil respectively which showed fairly significant increased kidney weight comparing fresh pure CSO.

Those results are in accordance with those of De-Fiellietaz and Hermus (1985) and Lambonic and Perkins (1996). Such changes in the liver and kidney weights may reflect pathological changes in the liver and kidney as fatty necrosis (Alexander, 1978). However El-Zawahry, et al (1992) reported pathological changes in liver of rats fed on high fat diet containing SUN oil that has been used for frying for 24 or 48 hours with or without replenishment.

**Therefore, it can be concluded that :**

- 1- The use of fresh oils whether pure or mixed is more healthy.
- 2- Concerning fresh oils used in the present study, it is valuable to use mixture 2 (85% CSO + 15% LEAR oil) and 3 (95% SUN oil + 5% LEAR oil) where they have higher feed efficiency ratios.
- 3- For frying oils, it is preferable to use pure CSO or that mixed with 5% LEAR oil for no more than 12 hours.

## REFERENCES

- AbdelHamid, A.M.; A.A. Gabr and M.M. El-Shinaway (1993). Effect Of Partially Substituting Concentrate Feed Mixture By Either Fresh Or Waste Oil In Sheep Diets. *Arch. Tierernahr*; 44 (2): 187 – 94.
- Alexander, J.C. (1978). Biological Effects Due To Changes In Fats During Heating. *J.Am. Oil Chem. Soc.*, 55: 711 – 717.
- Alexander, J.C. (1981). Chemical And Biological Properties Related To Toxicity Of Heated Fats. *Toxicol. Environ. Health* Jan, 7(1) : 125 – 38.
- Alfin – Slater, R.B.; S; S. Auerbach, And L. Aftergood, (1959): Nutritional Evaluation Of Some Heated Oils. *J.Am. Oil Chem. Soc.*, 36, 638 – 641.
- Allain, C.C.; L.S. Poon; C.S. G; Chan; W. Richmonal and P.C. Fu (1974). Enzymatic Determination Of Total Serum Cholesterol. *Clin. Chem.*, 20(4) : 470.
- A.O.A.C. (1975). *Official Methods Of Analysis Of The Association Of Official Analytical Chemists 12<sup>th</sup> Ed.*, Washington ; D.C.
- Bailey, N.T.T. (1959). *Statistical Methods In Biology* English Universities Press. London.
- Battino, M.; J.L. Quiles; J.R. Huertas; M.C. Ramirez; M. Tortosa; M. Cassinello; Manas, Lopez – M. Frias and J. Mataix (2002). Feeding Fried Oil Changes Antioxidant And Fatty Acid Pattern Of Rat And Affects Rat Liver Mitochondrial Respiratory Chain Components. *Bioenerg. Biomembr. Apr.*, 34 (2): 127 – 34.
- Belifed and D.M. Goldberg (1971). Colorimetric Determination Of Alkaline Phosphates Activity. *Enzyme*, 12: 561.

- Billek, G. (1980). Heated Oils – Chemistry And Nutritional Aspects. *Nutrition Metab.*, 24(1): 200 – 10.
- Briggs and William (1963). Experimental Diets and ingredient for Laboratory Animals. 200600 U.S.P. X III No. 2 Salt Mixture.
- De-Fiellietaz, R.L. and R.J.J. Hermus (1985). Cooking In Oil : The Stability Of Frying Oils With A High Linoleic Acid Content. *Advances In Catering Technology* (3) London, Elsevier, Biz., 129 – 144.
- El-Zawahry, Abd El-Kareem; M.H. Aly; M.A. Bekheit and S.M. Galal (1992). Effect Of Feeding Sunflower Seed Oil Used For Frying On Histological Structure Of Rats Organs. *Bulletin Of The Nutrition Institute Of The Arab Republic Of Egypt*, 12 (1): 48 – 62.
- Fossati, P. and L. Prencipe (1982). Serum Triglycerides Determined Colorimetrically With An Enzyme That Produced Hydrogen Peroxidase. *Clin. Chem.*, 28 : 2077.
- Galal, S.M.; M.A. Bekheit and M.H. Aly (1992). Physical, Chemical And Biological Evaluation Of Sunflower Seed Oil Used For Frying. *Bulletin Of The Nutrition Inst. Of The Arab Republic Egypt*, 12 (1): 28 – 47.
- Izaki, Y. and M. Fujiwara (1981). The Influence Of Thermally Oxidized Frying Oil On Lipid Peroxidation In Rat. *Liver. J. Food Hyg. Soc. JPN.* 22 (2): 1981, 118 – 124.
- Kok, J.S.; P.G. Harris and J.C. Alexander (1988). Heated Canola Oil Oxidative Stress In Rats. *Nutrition Research* 8(6), 673 – 684. J.C. Alexander, Dep. Nutr. Science Univ., Guelph, Guelph, Ont. N1G2W1. Canada.
- Labronic, C. and E.G. Perkins (1996). Effects Of Dietary Heated Fats On Rat Liver Enzyme Activity. *Lipids*. Sep., 31(9): 955 – 62.
- Lambonic, C.; J.L. Sebedio and E.G. Perkins (1998). Cyclic Fatty Acid Monomers Dietary From Heated Fats Affect Rat Liver Enzyme Activity. *Lipids*, Jul, 33(7): 675 – 81.
- Laser, A.R. and K.S. Agerhem (1989). The Relation Ship Between Mutagenic Activity And Flavour Development In Fried Beef Steak. 35th International Congress Of Meat Science And Technology. August 20 – 25 Copenhagen, Denmark.
- Liu, J.F. and C.J. Haung (1995). Tissue Alpha-Tocopherol Retention In Male Rats In Compromised By Feeding Diets Containing Oxidized Frying Oil. *Nutr. Dec*; 125(12) : 3071 – 80.
- Liu, J.F. and Y.W. Lee (1998). Vitamin C Supplementation Restores The Impaired Vitamin E Status Of Guinea Pigs Fed Oxidized Frying Oil. *Nutr. Jan.*, 128(1) : 116 – 22.
- Morgado, N.; A. Galleguillos; J. Sanhueza; A. Garrido; S. Nieto and A. Valenzuela (1998). Effect Of The Degree Of Hydrogenation Of Dietary Fish Oil On The Trans Fatty Acid Content And Enzymatic Activity Of Rat Hepatic Microsomes. *Lipids*. Jul., 33(7): 669 – 73.
- Narasimhamurthy, K. and P.L. Raina (1999a). Long-Term Feeding Effect Of Thermally Oxidized Oils On Antioxidant Enzymes In Rats. *Indian J. Exp. Biol.* Oct., 37(10): 1042 – 5.

- Narasimhamurthy, K. and P.L. Raina (1999b). Long Term Feeding Effects Of Heated And Fried Oils On Lipids And Lipoproteins In Rats. Mol. Cell Biochem. May, 195(1 – 2) : 143 – 53.
- Perkins, E.G. and C. Lamboni (1998). Magnesium Silicate Treatment Of Dietary Heated Fats, Effects On Rat Liver Enzyme Activity. Lipids, Jul., 33(7): 683 – 7.
- Reitman, S. and S. Frankel (1957). A Colorimetric Method For The Determination Of Serum Glutamic Oxalo Acetic And Glutamic Pyruvic Tran Aminase. Amer. J.Clini. Path, V. 28: 56.
- Ruiz – Gutierrez V. and F.J.G. Muriana (1992). Effect Of Ingestion Of Thermally Oxidized Frying Oil On Desaturase Activities And Fluidity In Rat Liver Microsomes. J. Nutr. Biochem. 3, (2), 75 – 7g. Inst. Grasa Derivados, Apartada 1078, 41012, Sevilla, Spain.

تأثير التغذية على زيت بذرة القطن و زيت عباد الشمس النقية والمخلوطة بزيت الشلجم الطازج المستخدم في التخمير على بعض المعايير الدموية ووزن كل من الكبد والكلى في الجرذ الأبيض الكبير  
هدى أحمد عليوه الشاذلي \* و وفاء محمد الخولي \*\*  
\* قسم بحوث الزيوت والدهون – معهد بحوث تكنولوجيا الأغذية – مركز البحوث الزراعية بالجيزة – القاهرة .  
\*\* قسم علم الحيوان – كلية العلوم – جامعة المنصورة

عند مقارنة تأثير تغذية فئران التجارب (ذكور الجرذ الأبيض الكبير) لمدة ثلاثين يوما بزيت بذرة القطن النقي وبعض الزيوت الطازجة أو المستخدمة في التخمير لمدة ١٢ أو ٢٤ ساعة (زيت عباد الشمس النقي ، زيت بذرة القطن وزيت عباد الشمس المخلوطة بنسب ٥ و ١٥% بزيت الشلجم (الفت) على بعض المعايير الدموية ووزن كل من الكبد والكلى أظهرت النتائج ما يلي :-  
١- الجلوسيدات الثلاثية:

لا توجد فروق معنوية في نسبة الجلوسيدات الثلاثية بمصل الفئران التي تغذت على الزيوت الطازجة بأنواعها نقيه أو مخلوطة بنسبة ٥ أو ١٥% مع زيت بذرة الشلجم عند مقارنتها بزيت بذرة القطن الطازج النقي بينما ظهر ارتفاع معنوي واضح جدا بالنسبة لزيت بذرة القطن المخلوط بنسبة ١٥% بزيت بذرة الشلجم والمستخدم في التخمير لمدة ١٢ ساعة ونقص معنوي قليل عند التغذية على زيت عباد الشمس المخلوط بنسبة ٥% زيت الشلجم وذلك بمقارنتها بالتغذية على زيت بذرة القطن الطازج النقي. وبالنسبة لزيوت التخمير المستخدمة لمدة ٢٤ ساعة كانت زيادة معنوية واضحة عند التغذية على زيت بذرة القطن المخلوط بنسبة ٥ ، ١٥% بزيت الشلجم وزيت عباد الشمس المخلوط بنسبة ١٥% بزيت الشلجم بمقارنتها بالتغذية على زيت بذرة القطن الطازج النقي.

٢- الكوليسترول الكلي :

بالمقارنة بالتغذية على زيت بذرة القطن الطازج النقي اتضح أنه لا توجد أي فروق معنوية في نسبة كوليسترول مصل الدم للفئران التي تم تغذيتها على كل الزيوت للطازجة ، وكذلك كانت الفروق غير معنوية بالنسبة للفئران التي تم تغذيتها على الزيوت المستخدمة في التخمير لمدة ١٢ ساعة فيما عدا زيت عباد الشمس المخلوط بنسبة ٥% بزيت الشلجم حيث كانت زيادة معنوية بسيطة. أما بالنسبة لزيوت التخمير لمدة ٢٤ ساعة ، كانت زيادة معنوية عالية في حالة التغذية على زيت بذرة القطن النقي وزيت بذرة القطن المخلوط بنسبة ١٥% زيت شلجم .

٣- نشاط بعض الإنزيمات :

أ – نشاط إنزيم ASAT:

لم يكن هناك أي تغير معنوي في نشاط إنزيم ASAT في حالة التغذية على جميع الزيوت الطازجة أو المستخدمة في التخمير لمدة ١٢ أو ٢٤ ساعة.

#### ب- نشاط إنزيم ALAT:

كانت الفروق غير معنوية في حالة الزيوت الطازجة كلها فيما عدا زيت عباد الشمس النقي الذي أظهر زيادة معنوية مقارنة بزيت بذرة القطن النقي.

وبالنسبة للتغذية على زيوت التخمير لمدة ١٢ ساعة أظهرت جميع الزيوت فروقا غير معنوية وإن كان نشاط إنزيم ALAT به زيادة معنوية طفيفة وباستخدام عباد الشمس النقي أو المخلوط بنسبة ٥% زيت الشلج وبالنسبة لتغذية الفئران على زيوت التخمير لمدة ٢٤ ساعة كانت الفروق غير معنوية لجميع الزيوت فيما عدا زيت عباد الشمس النقي كانت زيادة معنوية واضحة وعالية .

#### ج- نشاط إنزيم الفوسفاتيز القلوي ALP :

لم تظهر أي فروق معنوية بالتغذية على كل الزيوت الطازجة مقارنة بزيت بذرة القطن النقي. كانت هناك زيادة معنوية عالية مع زيت عباد الشمس النقي والمخلوط بنسبة ١٥% زيت الشلج عند التخمير لمدة ١٢ ساعة وعند التخمير لمدة ٢٤ ساعة. كانت زيادة معنوية وواضحة عند التغذية على زيت بذرة القطن النقي، وأكثر وضوحا عند التغذية على زيت بذرة قطن مخلوط مع ٥% زيت الشلج.

#### ٤- الكفاءة الغذائية :

لا يوجد أي اختلافات معنوية في الكفاءة الغذائية لجميع الفئران التي تم تغذيتها على الزيوت الطازجة فيما عدا أن الفئران التي تغذت على زيت بذرة القطن المخلوط بنسبة ١٥% زيت شلج وزيت عباد الشمس المخلوط بنسبة ٥% زيت الشلج كانت الكفاءة الغذائية لها عالية .

أما الزيوت التي تم تحميرها لمدة ١٢ ، أو ٢٤ ساعة كانت الكفاءة الغذائية للفئران منخفضة بدرجة غير معنوية ماعدا المخلوط (١) كان به بقص معنوي طفيف بمقارنتها بالتغذية على زيت بذرة القطن الطازج النقي .

#### ٥ - وزن الكبد :

أوضحت النتائج أنه حدثت زيادة معنوية في وزن الكبد في الفئران التي تم تغذيتها على زيت عباد الشمس الطازج والمخلوط بنسبة ٥ ، ١٥% ، زيت الشلج مقارنة بزيت بذرة القطن الطازج النقي وكان المخلوط (٣) والمخلوط (٤) به زيادة معنوية في وزن الكبد عند التخمير لمدة ١٢ ساعة وكذلك المخلوط (٤) كان به زيادة معنوية في وزن الكبد عند التخمير لمدة ٢٤ ساعة.

وبالنسبة للفئران التي تم تغذيتها على زيت بذرة القطن الطازج والمخلوط والفئران التي تغذت على الزيوت المستخدمة في التخمير كلها لم يكن هناك أي تأثير واضح بالنسبة لوزن الكبد ماعدا المخلوط (١) عند التخمير لمدة ٢٤ ساعة كان به زيادة معنوية طفيفة في وزن الكبد .

#### ٦- وزن الكلى :

كان تأثير التغذية على الزيوت الطازجة المختلفة والزيوت المستخدمة في التخمير متشابهة من حيث وزن الكلى ماعدا المخلوط (٢) عند التخمير لمدة ١٢ ساعة والمخلوط (١) عند التخمير لمدة ٢٤ ساعة بهما زيادة معنوية طفيفة .

#### التوصية :

١- يفضل استخدام الزيوت الطازجة في التغذية .

٢- بالنسبة للزيوت الطازجة المخلوطة يفضل المخلوط (٢ ، ٣) وهو عبارة عن ٨٥% زيت بذرة القطن + ١٥% زيت شلج ، ٩٥% زيت عباد شمس + ٥% زيت شلج حيث كانت الكفاءة الغذائية لهما مرتفعة.

٣- يفضل زيت القطن النقي أو المخلوط بنسبة ٥% زيت شلج في التخمير لمدة ١٢ ساعة .

٤- يفضل ألا يزيد مدة استخدام الزيوت في التخمير عن ١٢ ساعة .