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POTENCY OF SOMALI RED SESAME SEED OIL AS A PROPHYLACTIC AGENT AGAINST HYPERLIPIDEMIA IN MALE ALBINO RATS FED ON FATTY DIET

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ABSTRACT: This study was conducted to investigate the effect of Somali red sesame oil derived from red sesame seeds on liver function enzymes including, Alanine aminotransferase (ALT) and Aspartate aminotransferase (AST) and lipid profile including total cholesterol (TC), low density lipoprotein (LDL), high density lipoprotein (HDL) and triglycerides (TG) in male albino rats fed on fatty diet. Twenty one rats were randomly divided into equal three groups of seven animals each for 30 days as follows: The first group (control) was fed on basal diet and water, the second group was fed on fatty diet and the third group was given orally red sesame seed oil daily dose (1ml/100-120 g of body weight). Blood samples was collected in initial time and after 30 days of treatment, serum was separated for determination of liver functions and lipid profile. Results indicated that oral intake of sesame oil at dose 1 ml for 30 days (group III) decreased the serum levels of liver enzymes (AST) and (ALT) and lowering (TC), LDL and (TG) while, caused markedly increases in HDL values when compared to the control (positive group). Finally, it could be seen from the preceding results that, the utilization of the red sesame seed oil is safe for human health. Also, it can be assumed that the oil under study proved to be a prophylactic agent against hyperlipidemia.

Key word: Somali red sesame seed oil, liver function enzymes, lipid profile, albino rats.

INTRODUCTION

Hyperlipidemia has been classed as one of the greatest risk factors contributing to the prevalence and severity of heart diseases **(Kamesh and Sumathi, 2012)**. Heart disease, stroke, atherosclerosis and hyperlipidemia are the primary cause of death **(Uthandi and Ramasamy, 2011)**. Hyperlipidmia refers to level of lipid profile in the blood that is higher than normal**. (Krishnakumari and Priya, 2006)**. Hyperlipidemia is characterized by elevated serum total cholesterol, low density lipoprotein, very low density lipoprotein and decreased high density lipoprotein levels. Hyperlipidmia increases the risk of heart diseases by depositing plaques, which are composed of fats deposited from the blood stream. Recently decades have seen that botanical dietary supplements can improve cardiovascular diseases as several steps. Certain nutritional factors appeared to cause elevation of lipid level. Therefore, plant derived antioxidant are now receiving special attention such as sesame seed oil. Sesame (*Sesamum indicum* L.) is one of the most important oil seed crops, having seeds and its edible oil that are highly valued as a traditional healthy food ingredient because of its high protein and antioxidant contents **(Abou-Gharbia *et al.,* 2000**). One of the most ancient crops cultivated by human is considered to be the sesame seed. It was described to have originated from Africa and it is south to be the oldest oil seeds known to man. Sesame plays an important role in human nutrition. These seeds have antioxidant effect against the free radicals originated from the environmental pollution **(Farhan *et al.,* 2015)**. Oils obtained from sesame seed have been shown to serve natural antioxidants for

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medicinal applications. **(Farouk *et al.,* 2015)**. Sesame oil an edible vegetable oil derived from sesame seeds. It is an edible vegetable oil used as cooking oil and it is used as flavor enhances in the Middle East and Africa Cuisines. Some nutraceutical characteristics of sesame oil have been identified, including oleic acid and it also contains a significant amount of linoleic and alpha-linoleic fatty acids. Also, it has been considered a source of polyunsaturated fatty acids (PUFAs). In addition, it contains some phyto-nutrients such as flavonoids, phenolic antioxidant, vitamins as well as health benefits. It has been proved that the supplemental sesame oil by human diet caused a significant prophylactic against lipid oxidation owing to it contains essential fatty acids **(Rowghani *et al.,* 2007; Skntic *et al.,* 2008).** Sesame oil is a source of vitamin E and polyunsaturated fatty acids which is widely reported to reduce serum cholesterol levels in animals and humans**.** Sesame oil is offers better protection against increased blood pressure, hyperlipidemia and lipid peroxidation by increasing enzymatic and nonenzymatic antioxidant activities **(Chandrasekaran *et al.,* 2014)**. Sesame oil attributed to increase the inhibition of intestinal absorption of cholesterol, interference with lipoprotein production which increased expression of hepatic LDL receptor and their protection, leading to an increase in the removal of LDL from the blood and its increased degradation and catabolism of cholesterol from the body **(Pooja and Priscilla, 2009). Nahed *et al.* (2017)** found that oral intake of sesame oil improved total cholesterol (TC), triglycerides (TG), lipoprotein fractions, decreased the elevated serum levels of liver enzymes aspartate aminotransferase (AST) and alanine aminotransferase (ALT), when compared to the control in albino rats.

Therefore, this investigation was carried out to study the potency of Somali red sesame oil as a prophylactic agent against hyperlipidemia in male albino rat.

MATERIALS and METHODS

Extraction of Red Sesame Oil

Red sesame oil was extracted from crushed Somali red seeds using a hydraulic press (10,000 Lb/inch^2 for 1 hr., at room temperature) as described by **Ustun *et al.* (1990)**.

Animal Nutrition Procedure

Adaption

The experimental was conducted at the animal house of National Organization of Drug and Research (NODCAR) to investigate the effect of red sesame seed oil extracted from sesame on liver function enzymes and lipid profile in induced rats upon fatty diet.

Experimental animals

Animal; 21 adult male albino rats each weights 100 – 120 g and acclimatized for seven days before the suggested experiment and they were fed on the control diet (basal diet).

Experimental of feeding techniques

The rats were housed under normal laboratory conditions. Then randomly distributed into three groups as flow: group I (fed on basal diet) (negative control group), group II fed on fatty diet (cholesterol and cholic acid at a ratio of 3:1), (positive control group) and group III was fed on oral daily dose (1ml red sesame seed oil /100-120 g of body weight) and fatty diet. The compositions of basal diet, salt mixture and vitamin mixture are shown in Tables 1, 2 and 3, respectively (**Mendel and Wakeman, 1937; Campell, 1961)**.

Sample Collection and Analysis

Blood sample were collected at time interval initial time and 30 days. Blood samples were withdrawn from retro-bulbun venous plexus of each according to the procedure of **Schermer (1967)**. Each blood sample was placed in dry and clean centrifuge tube and allowed to clot (undisturbed) for 1-2 hr., at 37°C. The serum was then removed using a Pasteur pipette and centrifuged for 10 min at 3000 rpm to remove any suspended red blood cells. The clean non haemolysed supernatant serum was then pipette into a wissenmann tube and kept frozen until analysis.

Determination of Liver Enzymes Activities

The activities of alanine aminotransferase (ALT), aspartate aminotransferase (AST) were determined in serum according to the methods described by **Reitman and Frankel (1957)**.

Table 1. Composition (g/100g) of the basal diet

Ingredient	g/100 g diet
Casein	12.0
Corn oil	8.0
Salt mixture	4.0
Vitamin mixture	1.0
Maize Starch	70.0
Fiber (bran)	5.0

Table 2. Composition of salt mixture (g/1 kg)

Salt	g	Salt	g
$CaCo_3$	381.4	$FeSo_4$. $7H_2O$	27.00
NaCl	139.3	$MnSo_4$. H_2O	4.1
KI	0.79	$ZnSo_4$. H_2O	0.548
KH_2PO_4	212.0	$CoCl_2.6H_2O$	0.023
$MgSo_4$ (anhy)	57.3	$CuSO_4$. $5H_2O$	0.477

Table 3. Composition of vitamin mixture per kg of basal diet

Vit. A	200 IU	**Riboflavin**	0.8 mg
Vit. D	200 IU	**Pyridoxine**	0.5 mg
Vit. E	10 IU	**Pantothenate**	4.0 mg
Vit. K	0.5 mg	**Amino benzoic acid**	10.0 mg
Choline chlorid	200 mg	**B12**	0.003mg
Inositol	10 mg	**Biotin**	0.04mg
Niacine	4 mg	**Folic acid**	0.2 mg
Thiamine	0.5 mg	**Cellulose to make**	1000g

The diet was freshly prepared every week and was stored in a refrigerator at 10°C.

Determination of Serum Lipid Parameters

Total cholesterol content

Total cholesterol content in rat serum was determined according to the method described by **Hewitt and Pardue (1973)**.

Calculation

The total cholesterol concentration was calculated by using the following equation

$$\text{Total cholesterol content (mg/dl)} = \frac{\text{A of the tested sample}}{\text{A of standard solution}} \times \text{Wt.}$$

Where:

A = Absorbance at 500 nm.

Wt = Weight of cholesterol in standard solution.

HDL-Cholesterol content

HDL-cholesterol was determined in the serum according to the method of **Lopes-Virella *et al.* (1997).**

Calculation

The HDL- cholesterol concentration was calculated by using the following equation

$$\text{HDL- Cholesterol conc. (mg/dl)} = \frac{\text{A of the tested sample}}{\text{A of standard solution}} \times \text{Wt.}$$

Where:

A = Absorbance at 500 nm.

Wt = Weight of cholesterol in standard solution.

LDL-Cholesterol content

LDL-Cholesterol was determined according to **Friedewald *et al.* (1972)**.

Calculation

The LDL-Cholesterol concentration was calculated by using the following equation

LDL-Cholesterol (mg/dl) = total cholesterol (mg/dl) – HDL–TG/5 (mg/dl).

Triglycerides content

Serum triglycerides were determined according to the method described by **Uwajima *et al.* (1984)**.

Calculation

The triglyceride concentration was calculated using the following equation

$$\text{Triglyceride conc. (mg/dl)} = \frac{\text{A of the tested sample}}{\text{A of standard solution}} \times \text{Wt.}$$

Where:

A = Absorbance at 500 nm.

Wt = Weight of triglyceride in standard solution.

Statistical Analysis

Statistical analysis of the obtained data was performed using the general linear model (GLM) produced by statistical system institute **(SAS, 2004)**. Significant differences among means were evaluated using Duncan Multiple Range Test according to **(Duncan, 1955)**.

RESULTS AND DISCUSSION

Effect of Red Sesame Seed Oil on Liver Enzymes Activities in Experimental Rats Fed on Fatty Diet

The results presented in Tables 4 and 5 shows the effect of red sesame oil on liver function enzymes activities namely ALT and AST in groups of albino rats fed on fatty diet. The results indicated significant decrease in ALT in manipulated group with oral daily dose of sesame seed oil (group III) as compared to positive control group. From Table 4 and Fig. 1 final ALT decreased from 34.8 to 32.4 U/L with oral daily dose of oil. Also, AST takes the same trend and this shown in Table 5 and Fig. 2, a significant decrease in AST value from 127.3 to 117.6 U/L in the group upon the oral ingestion of oil. Serum alanine aminotransferase enzyme (ALT) and aspartate aminotransferase (AST) are sensitive indicators of liver damages. Therefore, the increase in the serum ALT activity might perhaps be an indication of liver damages. **(Al-Mamary *et al.*, 2002)**. The decreasing in ALT and AST may be due to its antioxidant effect in sesame oil which found to protect against oxidative stress and hepatic injury **(Chavali *et al.*, 2001).** The obtained finding proved that the extracted oil from red sesame seeds had no harmful effect on liver enzymes and can be used safely. These results agreed with those reported by **Al-Ahdab (2015)**.

Table 4. Effect of red sesame seed oil on ALT activity of experimental rats fed on fatty diet

Group	ALT (U/L)	
	Initial ALT	Final ALT
Basal diet	36.9 ± 2.01	30.1 ± 0.5
Fatty diet	35.5 ± 1.16	34.8 ± 0.38
Oil + fatty diet	38.7± 0.7	32.4± 0.28

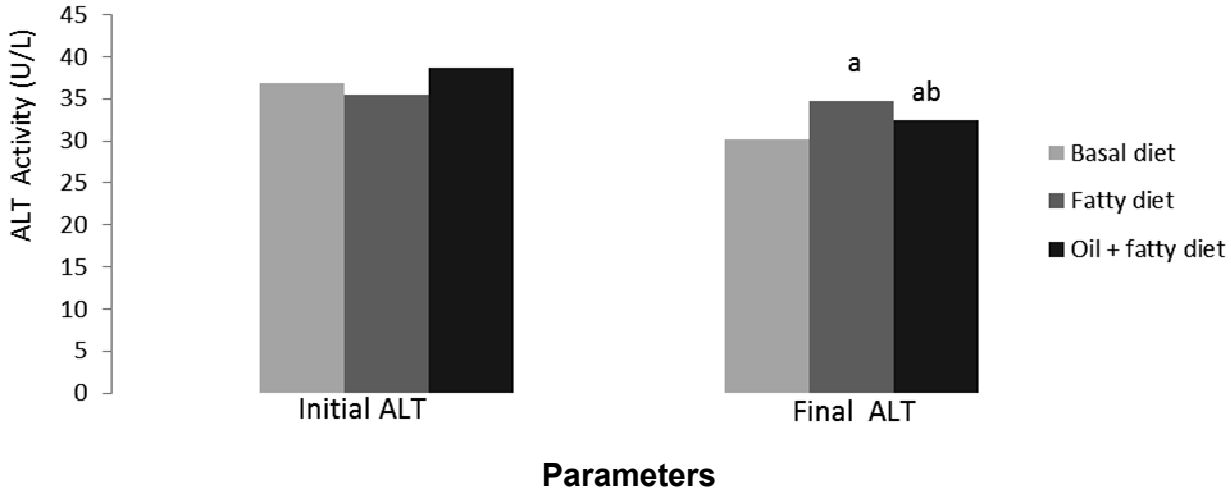

Fig. 1. Effect of red sesame seed oil on ALT activity of experimental rats fed on fatty diet

Table 5. Effect of red sesame seed oil on AST activity of experimental rats fed on fatty diet

Group	AST (U/L)	
	Initial AST	Final AST
Basal diet	127.5± 2.79	105 ±3.29
Fatty diet	125.1 ± 2.67	127.3 ±1.73
Oil + fatty diet	131.5 ± 0.67	117.6 ± 3.97

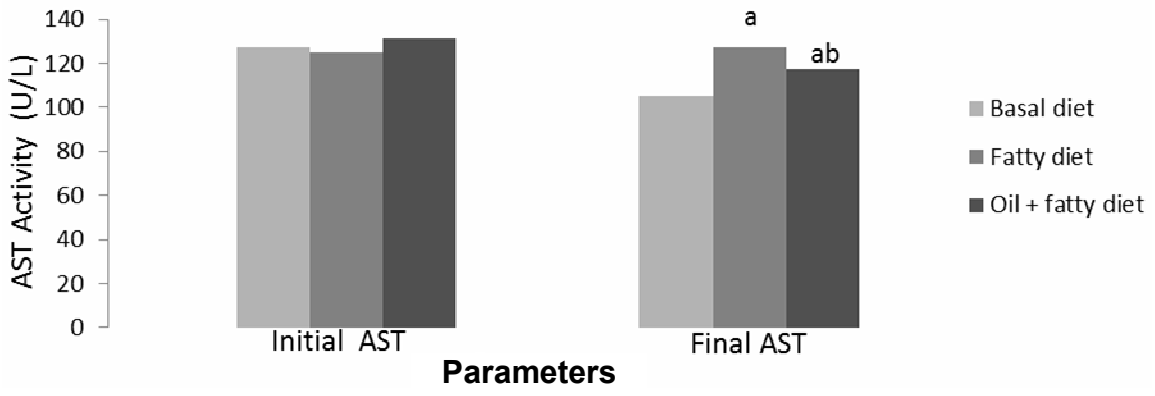

Fig. 2. Effect of red sesame seed oil on AST activity of experimental rats fed on fatty diet

Effect of Red Sesame Seed Oil on Total Cholesterol in Experimental Rats Fed on Fatty Diet

Results in Table 6 and Fig. 3 shows the effect of red sesame oil on total cholesterol in groups of albino rats fed on fatty diet. The results showed the decrease of total cholesterol values from 106.8 to 103.3 mg/dl with oral daily dose of sesame oil (group III) in comparison with positive control group. This result is in harmony with that reported by **Cunnane *et al.* (1995)** and **Nabil *et al.* (2014)** who reported that total cholesterol and LDL levels were decreased at feeding rats on sesame oil.

Effect of Red Sesame Seed Oil on HDL in Experimental Rats Fed on Fatty Diet

Results in Table 7 and Fig. 4 shows the effect of sesame oil on HDL values (good marker), the results showed that HDL significantly increased from 33.3 to 39.7 mg/dl in comparison with positive group after 30 days of treatment. HDL helps in bile formation, metabolism and the normal functioning of hormones and cells. Good cholesterol works hard to scour, remove and prevent plaque buildup in the arterial walls. It takes old discarded cholesterol away from the arteries to the liver to be processed and eliminated, may also reduce the risk of heart attack or stroke. Sesame oil could increase HDL due to phytoestrogen content as estrogen increasing HDL cholesterol while lowering LDL cholesterol **(Jillian, 2010)**. Also, the sesame oil is rich in mono-unsaturated fatty acids which help to reduced LDL and increase HDL in the blood. These results are in conformity with **Kalita *et al.* (2014)**.

Effect of Red Sesame Seed Oil on LDL in Experimental Rats Fed on Fatty Diet

It is clear from the results in Table 8 and Fig. 5 that the oral ingestion of sesame oil in (group III) caused decrease in LDL values from 47.22 to 43.94 mg/dl in comparison with positive control group. High LDL levels can cause cholesterol deposition within the arteries of the heart, a risk factor for the development of heart disease (**Kalita *et al.,* 2014**). Sesame oil reduce LDL because fiber content of sesame which reported lower plasma LDL by interrupting the cholesterol and bile acid. These results agreed with those reported by **Sharif *et al.* (2013)**.

Effect of Red Sesame Seed Oil on Triglycerides in Experimental Rats Fed on Fatty Diet

Effect of sesame oil on triglyceride in groups of albino rats fed on fatty diet showed in Table 9 and Fig. 6, the results showed a significant decrease in triglycerides values from 131.4 to 98.3 mg/dl upon oral ingestion of sesame oil (group III) after 30 days of treatment as compared with positive group (fed on fatty diet). The consumption of vegetable oils containing Polyunsaturated fatty acids reduces triglyceride levels, probably because of increased lipase activity **(Tzang *et al.,* 2009).** The obtained results are in agreement with that obtained by **Boulbaroud *et al.* (2012)** who found that sesame oil are beneficial in reducing plasma lipid profile. Furthermore, **(Krishnakumari and Priya, 2006)** reported that in experimental rats fed with diet containing sesame oil caused an improvement in lipid profile of the manipulated rats. On the other hand **(Kalita *et al.,* 2014)** reported that the sesame oil is especially rich in mono-unsaturated fatty acids which absorbed in the blood stream and liberated out unwanted cholesterol. Finally, **Nabil *et al.* (2014)** mentioned that sesame oil improve hyperlipidia and as hepatoprotective.

Conclusion

From the preceding results, it can be concluded that oral intake of sesame oil at dose (1 ml/ 100-120 g of body weight) for 30 days decreased the serum levels of liver enzymes (AST) and (ALT) and lowering (TC), LDL and (TG) while, caused marked increase in HDL values when compared to the control positive group (fed on fatty diet). Finally, the utilization of the red sesame seed oil is safe for human health and proved to be a prophylactic agent against hyperlipidemia.

Table 6. Effect of red sesame seed oil on total cholesterol in experimental rats fed on fatty diet

Group	TC (mg/dl)	
	Initial TC	Final TC
Basal diet	91.2± 0.95	90.7±3.05
Fatty diet	90.9 ± 0.73	106.8 ±4.8
Oil + fatty diet	89.4 ± 0.89	103.3 ± 2.27

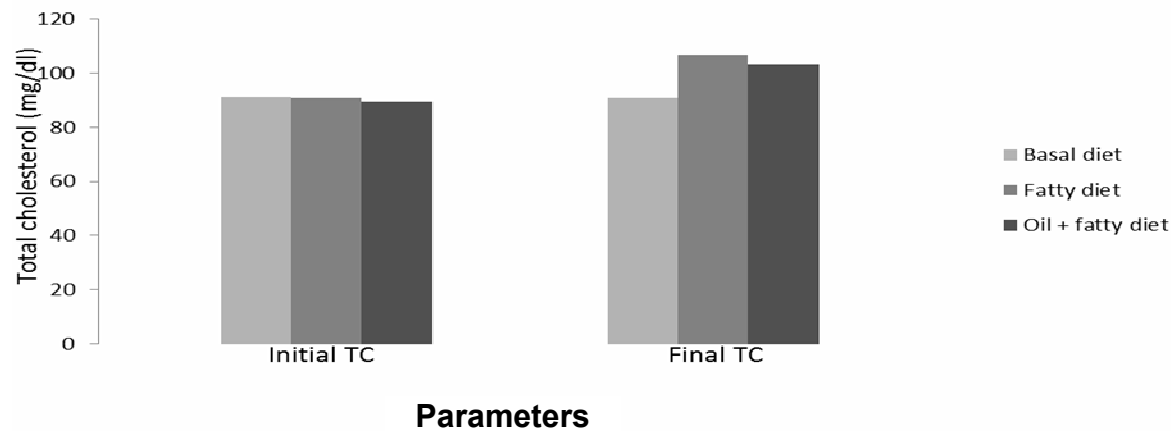

Fig. 3. Effect of red sesame seed oil on total cholesterol in experimental rats fed on fatty diet

Table 7. Effect of red sesame seed oil on HDL in experimental rats fed on fatty diet

Group	HDL (mg/dl)	
	Initial HDL	Final HDL
Basal diet	38.2± 1.78	39±1.66
Fatty diet	40.9 ± 1.6	33.3 ±1.54
Oil + fatty diet	36.8 ± 1.31	39.7 ± 1.84

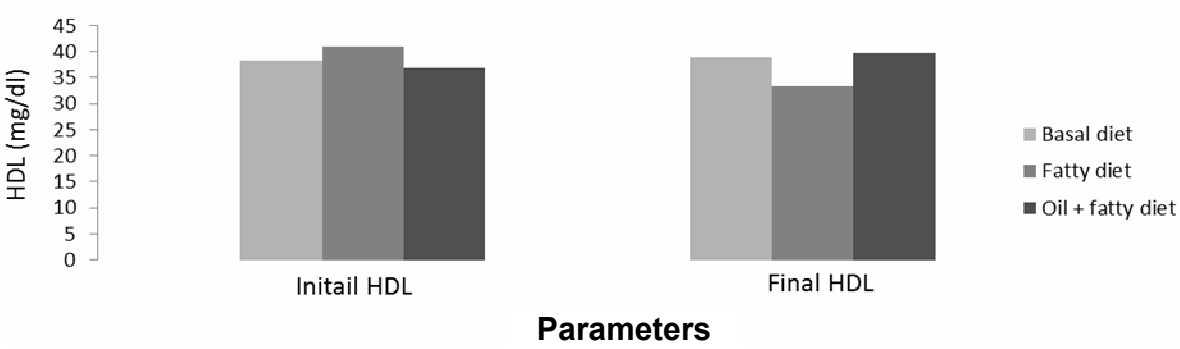

Fig. 4. Effect of red sesame seed oil on HDL in experimental rats fed on fatty diet

Table 8. Effect of red sesame seed oil on LDL in experimental rats fed on fatty diet

Group	LDL (mg/dl)	
	Initial LDL	Final LDL
Basal diet	31.2± 2.28	28.68± 1.07
Fatty diet	27.1 ± 1.81	47.22 ±3.12
Oil + fatty diet	30.22 ± 1.51	43.94 ± 2.22

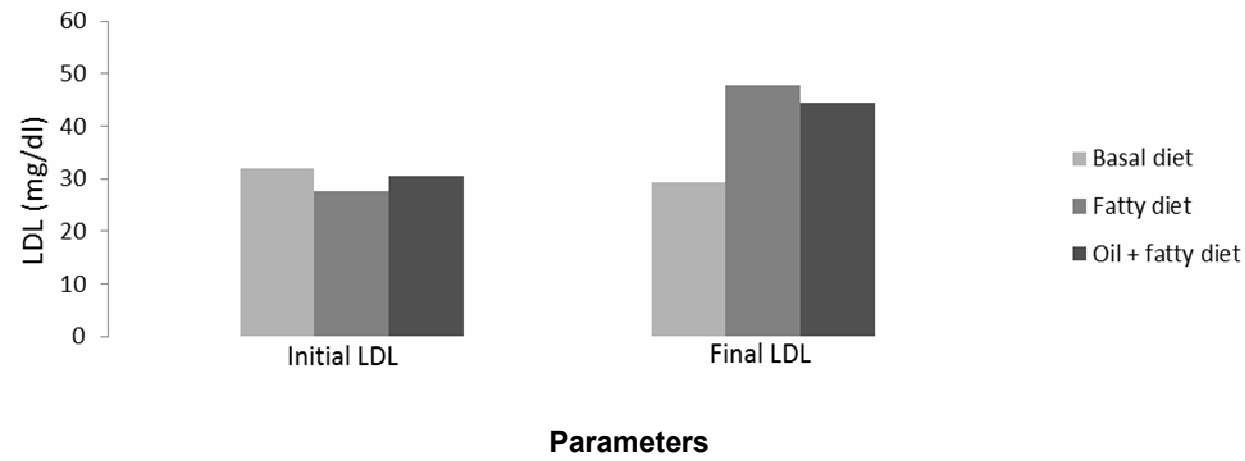

Fig. 5. Effect of red sesame seed oil on LDL in experimental rats fed on fatty diet

Table 9. Effect of red sesame seed oil on triglycerides in experimental rats fed on fatty diet

Group	TG (mg/dl)	
	Initial TG	Final TG
Basal diet	109 ± 2.07	115.1± 4.84
Fatty diet	114.5 ± 1.19	131.4 ±6.18
Oil + fatty diet	111.9 ± 2.34	98.3 ± 2.66

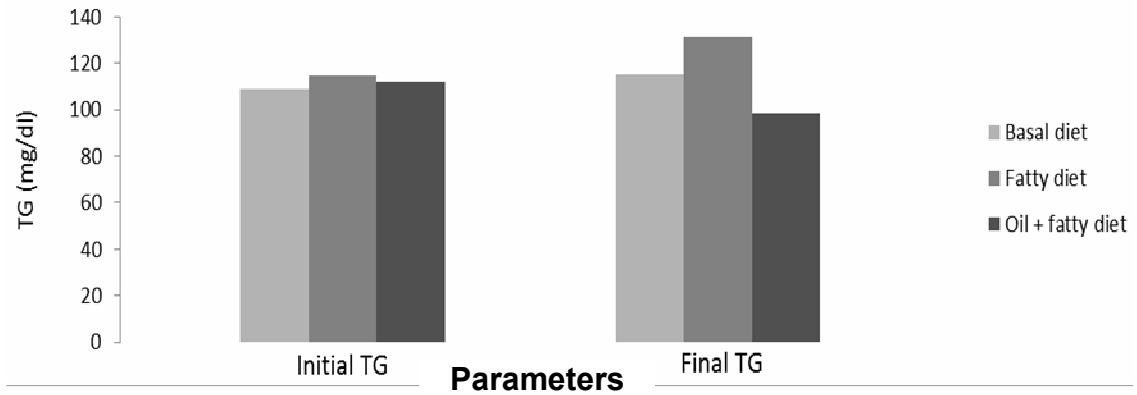

Fig. 6. Effect of red sesame seed oil on triglycerides in experimental rats fed on fatty diet

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فعالية زيت بذور السمسم الأحمر الصومالي كعامل وقائي ضد فرط شحميات الدم في ذكور الفئران البيضاء المتغذية على غذاء دهني

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أجريت هذه الدراسة لمعرفة تأثير زيت السمسم الأحمر الصومالى المستخلص من بذور السمسم الأحمر على نشاط إنزيمات الكبد وهى ألانين امينو ترانسفيراز(ALT) واسبارتات امينو ترانسفيراز (AST) ودهون الدم خاصة محتوى الكولسترول الكلى والبروتين الدهنى منخفض الكثافة والبروتين الدهنى عالى الكثافة و الدهون الثلاثية فى ذكور الفئران البيضاء المتغذية على غذاء دهنى، فقد تم تقسيم واحد وعشرون من الفئران البيضاء عشوائيا إلى ثلاث مجموعات متساوية (سبع فئران لكل مجموعة) وأجريت التجربة لمدة ٣٠ يوما على النحو التالي: تم تغذية المجموعة الأولى (الكنترول) على النظام الغذائي الأساسي والماء، تم تغذيت المجموعة الثانية على النظام الغذائي الدهني وأعطيت المجموعة الثالثة زيت السمسم عن طريق الفم جرعة يومية (١ مل/ ١٠٠-١٢٠ جرام من وزن الجسم) مع الغذاء الدهنى، تم جمع عينات الدم في البداية (قبل المعالجة) وبعد ٣٠ يوما من المعاملة، تم فصل المصل لقياسات نشاط انزيمات الكبد ودهون الدم، أوضحت النتائج إلى أن تناول زيت السمسم عن طريق الفم بجرعات ١ مل لمدة ٣٠ يوما (المجموعة الثالثة) أدى الى إنخفاض محتوى المصل من إنزيمات الكبد (الانين امينو ترانسفيراز واسبارتات امينو ترانسفيراز) وانخفض الكولسترول الكلى والبروتين الدهنى منخفض الكثافة والدهون الثلاثية في حين سبب زيادة ملحوظة في البروتين الدهنى عالى الكثافة بالمقارنة بمجموعة الكنترول الموجبة، وتشير النتائج إلى أن استخدام زيت بذور السمسم الأحمر أمن لصحة الإنسان، كما يظهر تحسناً فى استعادة الكبد لوظائفة وتحسين صورة الدهون ذات الفائدة.

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