EFFECT OF ADDING DIETARY VEGETABLE OILS WITH/OR WITHOUT α-TOCOPHEROL ON LIPID OXIDATION IN SERUM AND TISSUE OF RABBITS

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SUMMARY

The aim of the study was to evaluate the addition of dietary vegetable oil rich in n-3 or n-6 unsaturated fatty acids and / or α-tocopherol supplements to the diet for rabbit performance on fatty acid profile in muscle fat and susceptibility of tissue and blood oxidation . Fifty apparently healthy male Newzeland White (NZW) rabbits aged 35-40 days with average live body weight / head 550 – 600 g were divided randomly into 5 equal groups.The diet given in groups , a control diet with no added oil (1st group), the 2nd and 3rd groups received sunflower and flax oil at the same level (20 g/kg) respectively (mixed ration). The 4th and the 5th group diet contain sunflower oil and flax oil with α-tocopheryl acetate (vitamin E) (150 mg/kg diet) respectively (mixed ration). Rabbits were fed experimental diets for 8 weeks and slaughtered. There is a significant increase in body mass all over the experimental period in rabbit fed the flax oil and the sunflower oil diets with or without vitamin E than the control one. While longissimus dorsi muscle of rabbits fed control diets had significant higher concentrations of saturated fatty acids ,On the same time group (2) and group (4) respectively had a significant higher concentration of omega 6 (n-6) or linoleic acid than other groups, whereas in group (3) and group (5) had significantly higher concentrations of omega 3 (n-3) or α – linolenic acid in longissimus dorsi muscle respectively. Rabbits in groups (3, 5) had significantly higher activity of serum and liver glutathione, glutathione peroxidase, superoxide dismutase and catalase enzymes than rabbit in groups (2, 4). This study show that intake of polyunsaturated flax oil (n-3) and sunflower oil (n-6) fatty acids lowers serum total lipids, cholesterol and triglycerides levels. Inclusion of oils rich in α- linolenic acid (n-3) as flax oil or linoleic acid (n-6) as sunflower oil in rabbit diets modifies muscle fatty acids composition and reduces lipid oxidation in serum and liver.

Keywords: polyunsaturated fatty acid, α-tocopherol acetate, rabbits, serum parameters, lipid peroxidation.

INTRODUCTION

Polyunsaturated fatty acids, especially those from n-3 group, become very important for nutritionists due to its role as prevention of stress induced diseases and of those induced by improper diets (Hilde *et al.* 2006). Moreover, they are necessary for

normal development of brain and nerve tissue (Baggio, *et al.* 2005). Plant sources of fats rich in n-3 fatty acids, are added to rations in order to improve the fatty acid profile of meat, keeping in mind the satisfactory flavor of the same product (Ajuyah *et al.* 1993) .

Feeding oil–added diets to farm animals can confer several economic advantages and is becoming a common practice. Several experiments have been conducted to assess the influence of dietary oil on growth and feed utilization in rabbits (Fernandez and Fraga, 1992). There is little evidence of any special problems associated with feeding fat to rabbits. Consequently, fat may be a useful material to extend the range of energy levels recommended in rabbits (Clemente, et al 1997).

Fat included in monogastric diets is partially incorporated into the animals polar and neutral lipids, thus leading to different lipid compositional characteristics (Cobos, *et al.* 1993). Oxidation of lipids in food has received considerable attention because of possible adverse health effects related to consumption of oxidized lipids (Addis and Park, 1989). The rate of lipid oxidation in meat system depends on a number of factors, including the polyunsaturated fatty acid content of muscle and the presence of antioxidants such as α – tocopherol (Monahan *et al.* 1992).

The most important lipid soluble chain breaking antioxidant in tissues, red cells and plasma is α – tocopherol (Burton and traber, 1990). This vitamin protect cellular components against peroxidative damage via the free radical scavenging mechanism or as a constituent of the membrane (Chow *et al.* 1995, and Wissam , *et al.* 1997). The negative consequences of lipid oxidation can be overcome by the use of antioxidants in the diet, such as α–tocopherol which prevent lipid oxidation and therefore, increases the shelf life of meat (Lin *et al.* 1989, and Francesco, *et al.* 2004). Thus, it is of great commercial interest to assess the protective effect of α–tocopherol during storage and cooking processes of meat (Lin *et al.* 1989).

There are a number of studies indicating that unsaturated oils in the diet accelerate oxidative deterioration of meat and meat products (Monahan, *et al.* 1992).

There are numerous information and studies on this problem but inconclusive. Cobos *et al.* (1993) and Clemente, *et al.* (1997) revealed that inclusion of vegetable oils rich in polyunsaturated fatty acids in rabbit diets reduces lipid oxidation in muscles.

The objectives of this study were to evaluate the influence of adding vegetable oil high in polyunsaturated fatty acids (omega-3 or omega–6) to rabbit diets on the body weight gain, fatty acid composition of muscle and the susceptibility of tissue and blood to oxidation, and to assess the effectiveness of dietary α-tocopheryl acetate supplementation in diets.

MATERIALS AND METHODS

Animals and experimental diets :

Fifty apparently healthy male Newzeland White (NZW) rabbits aged 35-40 days with average live body

weight/head 550 – 600 g were divided randomly into 5 equal groups reared under similar environmental and hygienic conditions, on isocaloric isonitrogenous experimentally formulated ration, (Table 1). Group 1 kept as a control, group 2 received 20 g/kg sunflower oil, group 3 received 20 g /kg flax oil while group 4 and 5 received a same level of sunflower oil and flax oil with 150 mg /kg vitamin E, respectively. The rations were given to animals as mixed ration and formulated to satisfy the nutrient requirements of the intensively reared rabbit according to NRC (1985) and Lebas et al (1998), for 8 weeks experimental period. Live body weight was recorded weekly .

Slaughter, sample collection and chemical analysis :

At the end of the experiment, the animals were sacrified. Blood was collected in heparinized tubes, samples from longissimus dorsi muscle were taken and frozen at -22° C until analyzed. The liver was dissected out, homogenized in bidistilled water (10% homogenates) and kept in ice.

Fatty acid profiles of longismus dorsi muscle were determined by gas chromatography equipped with a flame ionization detector and an HP capillary column (60 m ×0.25 mm i.d.) with a 0.25 μm film thickness of stationary phase. following the method described by Marmer and Maxwell , (1981) .

Reduced glutathione (GSH) content was estimated chemically in whole blood and liver homogenate by measuring the optical density (OD) of the yellow color that developed when 5,5 dithiol – bis (2-nitrobenzoic acid) is added to sulfhydral compounds, the absorbs light at 412 nm , according to Beutler , *et al.* (1963).

Estimation of glutathione peroxidase (GSH-Px) chemically in whole blood and liver homogenate was based on the measurement of the amount of residual GSH left after exposure to enzyme activity for a fixed time, the absorbs light at 412 nm (Gross *et al.* 1967). Superoxide dismutase activity was estimated chemically in whole blood and liver homogenate by the method that depends on detection superoxide anions by nitroblue tetrazoluim formazan color development, the absorbs light at 412 nm, according to Minami and Yoshikawa (1979). Estimation of catalase activity was done chemically, the absorbs light at 550 nm according to the methods of Johansson and Borg (1988) .

Determination of total lipids according to Frings *et al.* (1970) using bio Merieux test kit. But cholesterol was determined according to Allian et al (1974) using bio Merieux test kit. Also, Triglycerides according to Wahlefeled, (1974) in plasma using Human Gesellschaft test kit.

The results were presented as mean values ± standard error for groups were compared using one–way analysis of variance (ANOVA) according to Perrie and Watson (1999)

RESULTS AND DISCUSSION

Feeding oil–added diets to farm animals can confer several economic advantages and is becoming a common

Table (1): Composition of the experimental diets.

Ingredients %	Group1	Group2	Group3	Group4	Group5
-yellow corn	13	9	9	9	9
-Wheat bran	40	40	40	40	40
-Hay	28.6	30.6	30.6	30.45	30.45
-Soybean (44%)	16	16	16	16	16
-Sunflower oil	0	2	0	2	0
-Flax oil	0	0	2	0	0
-Lime stone	1.5	1.5	1.5	1.5	1.5
-Salt	0.5	0.5	0.5	0.5	0.5
-Vitamin / mineral mix	0.3	0.3	0.3	0.3	0.3
-Vitamin E	0	0	0	0.15	0.15
-Methionine	0.1	0.1	0.1	0.1	0.1
Calculated analysis(%)					
-Crude protein	17	17	17	17	17
-Fat (not more than)	2.94	5	5	5	5
-Crude fiber (not more than).	13.8	13.8	13.8	13.8	13.8
K cal/kg / (digestible energy) not less than.	2700	2700	2700	2700	2700

Mineral and vitamin composition (per kilogram of premix): S, 69 g; Mg, 52.2 g; Mn, 3.9 g; Zn, 11.75 g; I, 0.25 g; Fe, 21.55 g; Cu, 2.2 g; Co, 0.14 g; thiamine 0.2 g; riboflavin, 0.38 g; pyridoxine, 0.2 g; nicotinic acid, 4 g; choline, 52 g; menadione, 0.2 g; *dl*-α-tocopheryl acetate, 3.33 g; retinol, 0.55 g; cholecalciferol, 3.25 mg.

Table (2) : Fatty acids composition of the oils: According to Rey et al (1996).

Fatty acids (%)	Sunflower oil (n-6)	Flax oil (n-3)
14:0(meristic)	0.16	6.10
16:0(palmitic)	9.73	6.04
16:1(n-7)(palmitoleic)	-	8.89
18:0 (stearic)	2.00	2.70
18:1(n-9)(olic)	20.50	7.16
18:2(n-6)(linoleic)	48.05	1.47
18:3(n-3)(α-linolenic)	0.75	37.55
18:4(n-6)(stearidonic)	-	3.76
20:0(arachidic)	0.35	-
20:3(n-3)(eicosatrienoic)	6.31	7.54
20:4(n-6)(arachidonic)	12.15	7.52
20:5(n-3)(eicosapentaenoic)	-	4.20
22:6(n-3)(docosahexaenoic)	-	4.10
Others	-	2.97

practice. Several experiments have been conducted to assess the influence of dietary oil on growth and feed utilization in rabbits (Fernandez and Fraga, 1992). There is little evidence of any special problems associated with feeding fat to rabbits. Consequently, oil may be a useful material to extend the range of energy levels recommended in rabbits (Clemente, *et al.* 1997).

Table (2) revealed that the major fatty acid in sunflower oil was linoleic acid (n-6), while, in flax oil the major fatty acid was α-linolenic (n-3). Earlier studies, (Ellis and Isbell, 1926), have shown that the fatty acid content of fat from monogastric species is related to the fatty acid content of the diet.

Live body weight (Table, 3) revealed that all groups which received sunflower oil (omega-6) and flax oil (omega–3) with or without vitamin E, respectively, show a highly significant increase compared with the control one. This finding support the view that sunflower oil or flax oil intake associated with vitamin E supplementation cause a carcass protein deposition more than overall fat levels, and can be overcome the susceptibility of lipid polyunsaturated fatty acid to peroxidation (Javouhey–Donzel, et al 1993). Also, this result is in agreement with previous observations in mice (Cunnane, et al 1986) and normal wister rats (Pan and Storlien, 1993). While, Jandacek, et al (1991) and Jones and Schoeller (1988) show that dietary flax oil increase body mass gain but decrease adipose tissue and this result could be related to the preferential oxidation of these long–chain unsaturated fatty acid. Alternatively, it could be, also, as a result of a "Leaky membrane effect" and increased energy expenditure, as proposed by Else and Hulbert (1987) with concomitant alterations in metabolic rate (Pan and Storlien, 1993). The capacity of omega-3 in flax oil to limit adipocyte size and hypertrophy of abdominal adipose tissue is now well documented (Belzung, et al , 1993, and Maria *et al.* 1998).

Data in Table (4) illustrated the fatty acid composition of longissimus dorsi muscle as influenced by experimental diets. The major fatty acids were palmitic, stearic, linoleic, eicosatrienoic and arachidonic, their sum accounted for over 80% of the total fatty acids. These data are similar to those reported in the literature for intramuscular neutral lipids in rabbits (Cobos *et al.* 1993). Linoleic acid (n-6) and arachidonic acid (n-6) are significantly increased in group (2) and (4) which received sunflower oil with or without vitamin E respectively. While, α-linolenic (n-3) and eicosatrienoic acid (n-3) increased in group (3) and (5) which received flax oil with or without vitamin E respectively. The sum of omega -6 (n-6) in group2 and 4 were 39.98 and 43.38 respectively, and the sum of omega-3 (n-3) in group 3 and 5 were 15.20 and 17.79 respectively, (Table, 4) higher in muscle samples from rabbits fed neutral lipid in group (1). The different concentration of n-3 or n-6 fatty acids between rabbits fed the neutral fat and the fat–enriched diets led to other differences in the relative proportion of saturated fatty acids that allowed the phospholipid fraction to maintain an overall degree of unsaturation in a narrow range. These results are in agreement with other reports dealing with the effect of dietary

Table (3): Average live body weight (g) of the rabbits fed the five experimental diets:

Age / Weeks	Group 1 (control)	Group 2 Sunflower oil (n-6)	Group 3 Flax oil (n-3)	Group 4 Sunflower oil +vitamin E	Group 5 Flax oil + vitamin E
0	570.0	571.5	570.5	573.1	572.0
	± 33.5	±35.7	±35.3	±34.4	±33.4
1	754.5	769.8	755.7	775.3	763.5
	±47.3	±60.5	±62.4	±54.2	±52.5
2	988.9	900.5	980.2	910.8	900.5
	±69.7	±78.3	±69.5	±72.4	±77.6
3	1145.5	1125.8	1135.5	1150.5	1140.8
	±97.5	±99.5	±85.7	±89.2	±99.5
4	1270.7	1350.7	1360.8	1375.2	1375.5
	±100.3	±120.3	±99.5	±114.5	±110.5
5	1485.5	1515.3	1530.9	1545.5	1525.3
	±99.8	±120.2	±120.4	±124.3	±125.4
6	1630.7	1720.4	1745.2	1740.8	1745.5
	±120.3	±152.2	±154.2	±154.2	±175.5
7	1815.6	1940.3	1982.5	1925.5	1990.0
	±143.5	±185.5	±175.5	±188.6	±187.5
8	2050.5	2155.5	2209.5	2165.6	2217.2
	±175.6[a]	±197.4[b]	±199.3[b]	±200.1[b]	±210.2[b]

LSD between groups at 0.05 = 93.5 LSD between time at 0.05= 150.0
[a] = control group. [b]= a significant increase than control one.

Table (4): Fatty acid profiles(g/100g fatty acids) of longissimus dorsi muscle for rabbits fed diets containing Sunflower and Flax oil with /or without α-tocopheryl acetate:

Fatty acids	Group 1 (control)	Group 2 Sunflower oil (n-6)	Group 3 Flax oil (n-3)	Group 4 Sunflower oil+vit.E	Group 5 Flax oil + vit.E	LSD at 0.05
16:0(SFA)	27.19	24.29	22.75	23.67	20.97	2.12
palmitic acid	±2.40 c	±1.90	±2.10	±2.2	±1.70	
18:0(SFA)	10.98	9.45	8.90	7.50	7.25	1.1
stearic acid.	±1.10 c	±0.84	±0.74	±0.65	±0.59	
18:2 (n-6)	19.50	26.73	18.35	28.48	19.12	5.50
linoleic acid	±1.80[a]	±2.10[b]	±1.40	±2.50[b]	±1.62	
18:3 (n-3)	4.22	3.93	7.45	4.12	8.93	3.25
α-linolenic acid	±0.38[a]	±0.35	±0.65[b]	±0.32	±0.88[b]	
20:3 (n-3)	5.50	4.95	7.75	5.15	8.86	1.2
eicosatrienoic acid	±0.45[a]	±0.32	±0.64[b]	±0.52	±0.74[b]	
20:4(n-6)	9.18	13.25	10.25	14.90	9.33	1.35
arachidonic acid	±0.95[a]	±1.20[b]	±1.05	±1.30[b]	±0.87	
Σ n-3	9.72	8.88	15.20	9.27	17.79	
Σ n-6	28.68	39.98	28.60	43.38	28.45	
Σ sat.	38.17	33.74	31.65	31.17	28.22	

n-6 = omega 6 (sunflower oil), n-3 = omega 3 (flax oil), SFA= saturated fatty acid,
[a]= control group, [b]= significant increase than a control . c = increase in saturated fatty acid.

Table (5): Liver glutathione (GSH) and activity of glutathione peroxidase (GSH-Px) , super oxide dismutase (SOD) and catalase (CAT) , of Rabbits in different groups.

Items	Group 1 (contro)	Group 2 Sunflower Oil (n-6)	Group 3 Flax oil (n-3)	Group 4 Sunflower oil+vit.E	Group 5 Flax oil + vit.E	LSD at 0.05
GSH	75.3	76.5	79.7	77.5	81.3	1.85
(mg/g tissue)	±6.2[a]	±5.5	±6.3[b]	±5.7	±7.4[b]	
GSH-px	530.6	535.5	540.2	537.5	545.2	6.50
(U/g tissue)	±44.2[a]	±48.5	±45.5[b]	±43.8	±50.1[b]	
SOD	658.3	659.5	661.2	660.3	662.5	2.64
(ug/g tissue)	±54.4[a]	±50.8	±60.2[b]	±58.4	±62.4[b]	
CAT	7.62	7.85	8.20	7.93	8.27	0.35
(u/g protein)	±0.67[a]	±0.62	±0.75[b]	±0.66	±0.77[b]	

[a]= control group [b]= significant increase than control

fat on neutral and polar fatty acid composition in rabbits (Cobos, *et al.* 1993).

Rabbits fed Flax oil with or without vitamin E (G3 , G5) had significantly higher activity of glutathione, glutathione peroxidase, superoxide dismutase and catalase enzymes in liver than rabbit received sunflower oil with or without vitamin E (G2 , G4) , than the control one (Table, 5). Previous investigators remarked that diets rich in polyunsaturated fatty acids may provide higher susceptibility to oxidation of animal tissue (Monahan, *et al.* 1992). Susceptibility of animal tissues to oxidation should be expected. However, several studies indicate that membrane bound polar lipids are the sites at which oxidative changes are initiated in meat (Gray and Pearson , 1987).

Also, Hu *et al.* (1989) conducted an experiment in which they compared the susceptibility of tissue of rats fed diets high in (n-3) or (n-6) polyunsaturated fatty acid within vitro lipid peroxidation and observed higher levels of thiobarbituric acid reactive substances in tissues of those receiving higher levels of (n-3) fatty acids. This is consistent with other investigators who suggested enhanced susceptibility to lipid peroxidation of (n-6) and (n-3) fatty acids either as pure lipid or in tissues of rats fed fish oil compared with rats fed corn oil (Hammer and Wills, 1978).

Table (6) revealed an increase in the activity of blood glutathione, glutathione peroxidase, superoxide dismutase and catalase content at all groups than the control one, this result may be due to feeding dietary oils rich in unsaturated fatty acids which increase the activity of antioxidant enzymes which in particular constituent a major part of defense system .Lipid peroxidation is widely used as an indicator to reflect oxidative stress and cell membrane damage (Halliwell and Gutteridge, 1989). Superoxide dismutase detoxifies the superoxide radicals giving rise to hydrogen peroxide (H_2O_2) and is the only known enzyme that uses free radicals as a substrate. However, H_2O_2 is itself a potent free radical generator and can generate toxic hydroxyl radicals by reacting with ferrous ions, which can induce lipid peroxidation of cell membranes. Cellular catalase and glutathione peroxidase detoxify H_2O_2. It is important that an enhanced Superoxide dismutase activity be followed up by increased activities of catalase and glutathione peroxidase to prevent accumulation of toxic H_2O_2 (Arunabh, 2003).

Our data show that intake of polyunsaturated n-6 and n-3 fatty acids reduces serum total lipids, cholesterol and triglycerides levels, (Table 7). This hypolipemic effect is probably due to decreased formation of both chylomicrons from the intestine and VLDL (very low density lipoprotein) from the liver Harris (1996) reported that polyunsaturated oil may stimulate cholesterol excretion into the intestine and its oxidation to bile acids. Strum–Odin *et al.* (1987), also, demonstrated that n- 3 might reduce synthesis of triglyceride via reduction in diacylglycerol esterification. It is possible that mobilization of fatty acids from adipose tissues is decreased or that there is a general increase in fatty acid oxidation (Addis and Park, 1989) .

Table (6): Activity of blood glutathione (GSH) and activity of glutathione peroxidase (GSH-Px) , super oxide dismutase (SOD) and catalase (CAT) of Rabbits in different groups.

Item	Group 1 (control)	Group 2 Sunflower oil (n-6)	Group 3 Flax oil (n-3)	Group 4 Sunflower oil +vit.E	Group 5 Flax oil + vit.E	LSD at 0.05
GSH	247.2	248.5	255.3	250.2	257.5	5.50
(mg/g tissue)	±23.3 [a]	±21.8	±26.5 [b]	±24.3	±27.2 [b]	
GSH-px	267.9	269.5	275.6	271.3	276.9	3.75
(U/g tissue)	±23.4 [a]	±24.9	±23.5 [b]	±25.5	±26.2 [b]	
SOD	26.7	28.3	32.5	29.5	34.3	3.15
(ug/g tissue)	± 2.5 [a]	±2.6	±2.8 [b]	±2.7	±2.9 [b]	
CAT	67.2	67.9	70.2	68.5	70.8	2.10
(u/g protein)	±5.8 [a]	±5.5	±6.1 [b]	±6.3	±6.9 [b]	

[a]= control group [b]= significant increase than control

Table (7): Effect of sunflower oil and Flax oil on the level of serum lipid profile of rabbit in different groups.

Item	Group 1 (contro)	Group 2 Sunflower oil (n-6)	Group 3 Flax oil (n-3)	Group 4 Sunflower oil +vit.E	Group 5 Flax oil + vit.E	LSD at 0.05
T. Lipids	295.50	276.70	265.50	273.50	262.70	14.25
mg/dl)	±25.5 [a]	±24.8 [b]	±23.5 [b]	±25.7 [b]	±23.6 [b]	
Cholesterol	27.48	24.50	22.75	23.50	21.50	1.75
mg/dl	±1.90 [a]	±1.45 [b]	±2.1 [b]	±2.2 [b]	±1.90 [b]	
Triglycerides	125.50	122.50	120.50	121.75	119.50	2.03
mg/dl	±12.25 [a]	±12.50 [b]	±10.50 [b]	±11.50 [b]	±12.30 [b]	

[a]= control group [b]= significant decrease than control

In conclusion, our result show that inclusion of oils rich in α–linolenic (n–3) fatty acids with or without α-tocopherol in rabbit diets show increase in live body weight while study show that deposition of omega-3 or omega-6 in the muscle related to its presence in the content of the diet and modifies serum and tissues fatty acids composition and reduces lipid oxidation.

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تأثير إضافة الزيوت النباتية مع أو بدون الألفا توكوفيرول إلى علائق الأرانب على الأكسدة بالمصل والأنسجة

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أجرى هذا البحث لتقييم تأثير إضافة الزيوت النباتية فى علائق الأرانب النامية التى تحتوى على الأحماض الدهنية الغير مشبعة مع أو بدون فيتامين ه على الزيادة فى الوزن الحى و بعض التغيرات البيوكيميائية على أنسجة و أمصال الأرانب. أستخدم عدد ٥٠ أرنب نيوزيلاندى وزن ٥٥٠- ٦٠٠ جرام تم تقسيمهم عشوائياً بالتساوى إلى ٥ مجاميع :

المجموعة الأولى : ضابطة (عليقة بدون إضافة زيوت أو فيتامين) .
المجموعة الثانية و الثالثة عليقة مضاف إليها زيت عباد الشمس و زيت الكتان (٢٠ جم/كيلو) على التوالى.
المجموعة الرابعة و الخامسة نفس الإضافات + فيتامين ه.(١٥٠ ماجم / كيلو عليقة)
غذيت الأرانب على هذة العلائق لمدة ثمانى أسابيع (فترة التجربة).

خلصت الدراسة إلى أن إضافة زيت الكتان أو زيت عباد الشمس مع أو بدون فيتامين ه أدى إلى تحسن بمعدلات النمو بالمقارنة بالمجموعة الضابطة من ٢٠٥٠,٥٠ للكنترول إلى ٢١٥٥,٥٠ و ٢١٦٥,٦٠ فى حالة إضافة زيت عباد الشمس بدون أو مع فيتامينه (مجموعة ٢ و ٤) على التوالى أو إلى ٢٢٧٥,٨٠ و ٢٢٩٠,٥٠ فى حالة إضافة زيت الكتان بدون أو مع فيتامين ه (مجموعة ٣ و ٥) على التوالى .

أتضح أيضاً من خلال النتائج المدونة بالبحث أن أنسجة الأرانب المغذاة على عليقة ضابطة تحتوى على نسبة عالية من الأحماض الدهنية المشبعةفى حين أن التى تتغذى على زيت عباد الشمس بدون أو مع فيتامينه تحتوى على نسبة عالية من الأوميجا ٦ (المجموعة ٢ و ٤). و المجموعة المغذاة على زيت الكتان بدون أو مع فيتامينه تحتوى على نسبة عالية من الأوميجا ٣ (المجموعة ٣ و ٥).

أوضحت النتائج أيضاً زيادة معنوية بمستوى إنزيم الجلوتاثيون و الجلوتاثيون بيروكسيديز و السوبر أكسيد ديسميوتيز و الكتاليز بالمجموعة التى تتغذى على زيت الكتان (الأوميجا -٣) بدون أو مع فيتامينه (المجموعة ٣ و المجموعة ٥) .

كما لوحظ من النتائج المدونة بالبحث نقص فى نسبة الدهون الكلية و الكوليسترول و الجليسرات الثلاثية فى أمصال الأرانب المغذاة بجميع المجاميع المغذاة على زيت عباد الشمس و زيت الكتان بدون أو مع فيتامينه .

إتضح من التجربة أن إضافة زيت عباد الشمس و زيت الكتان بدون أو مع فيتامينه فى علائق النمو فى الأرانب أدى إلىترسيبها بالعضلات كما أدى إلى تقليل أكسدة الدهون بمصل و أكباد الأرانب و أيضاً أدى إلى نقص بخصائص الدهون بالمصل .