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EFFECT OF FENUGREEK AND ANISE SEEDS AS NATURAL GROWTH PROMOTER ON THE PERFORMANCE, CARCASS, BLOOD CONSTITUENTS AND ANTIOXIDANT STATUS OF GROWING RABBITS

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ABSTRACT: The present study was conducted to determine the effect of fenugreek and anise seeds inclusionas a natural growth promoter and antioxidant on growth performance, carcass traits, lipid peroxide (Malondialdehyde) and the antioxidative status of growing V-line rabbits. Thirty-six V- Line growing rabbits of both sex 5 weeks old with average initial live body weight of 701.91±7.71 gm were randomly distributed into three treatment groups (n=12) and submitted to 3 dietary treatment. Every treatment contained 4 replicates, the experimental period extended for ten weeks. Group one fed basal control diet free of feed additives and served as a control group. Group 2 and 3 givens basal diet supplemented with 0.6% of Fenugreek seed and anise seed powder, respectively. The different feed additives significantly ($P \leq 0.01$) improved final body weight, body weight gain, feed intake, feed conversion ratio and performance index as compared to the control group. Including different feed additives in the rabbit diets resulted in increasing absolute carcass weight. However, the results showed no significant differences were observed in hot or cold carcass weight percent and organs relative weight as compared to the control group, except testes percent.Serum glucose significantly ($P \leq 0.05$) decreased with inclusion of fenugreek in the diet, however, anise supplementation resulted in non-significant decrease in this trait. Serum total protein, albumin and globulin were significantly increased by including fenugreek or anise in the diet as compared to the control group. Serum ALT and AST were insignificantly affected, while serum alkaline phosphatase (ALP) was significantly ($P \leq 0.05$) decreased by fenugreek or anise seeds supplementation. Serum total lipids, triglycerides, total cholesterol and LDL-cholesterol decreased; however, HDL-cholesterol was significantly increased due to fenugreek and anise supplementation. Total antioxidant capacity and glutathione peroxidase significantly increased with fenugreek and anise containing diets as compared with control,while, it decreased serum malondialdehyed (MDA). Generally, the present study concluded that the consumption of fenugreek and anise seeds had positive effects on rabbits' performance, blood lipid regulation which reflected to their antioxidant activity and the antioxidative status of growing V-line rabbits.

Key words: Rabbit, fenugreek, anise, performance, carcass, blood constituents.

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INTRODUCTION

Large number of feed additives is available forinclusion in animal and poultry diets toimprove performance. However, theuse of chemical products especially hormonesand antibiotics, may cause unfavorableside effects. Moreover, there isevidence indicating that this products couldbe considered as pollutants for human andthreaten their health on the long-run.Attempts to use the natural materials such asmedical plants could be widely accepted asfeed additives to improve the efficiency offeed utilization and animal productive performance (Zeweil *et al*., 2013).Itwas found that Fenugreek seeds are rich inprotein, fat, total carbohydrates and mineralssuch as calcium, phosphorus, iron, zinc andmagnesium (Gupta *et al*, 1996), andcontains active constituents such as alkaloids, flavonoids, steroids, Saponins (kor and Zadeh 2013). Moreover Fenugreek benefits the digestive system (Sahalian, 2004). Fenugreek contains phenolic and flavonoid compounds which help to enhance antioxidant capacity (Srinivasan, 2006). Anise is a natural herbal plant that grows widely in Egypt and many Arab countries. Anise is commonly used in human nutrition to regulate the balance of somatic and sexual hormones. It contains essential and fatty acids, the main component of the essential oils is anethol and the biological properties are inhibiting bacterial (Sagdic and Ozcan, 2003) and fungal (Soliman and Badea, 2002) stimulating secretion of digestive enzyme and appetizing (Seleem, 2008).The objectives of this study is to investigate the effect of fenugreek and anise as feed additives on growth performance, carcass traits and serum blood biochemistry of growing V-Line rabbits.

MATERIALS AND METHODS

The present study was carried out at the Rabbits Research Laboratory, Animal and fish production Department, Faculty of Agriculture (Saba Basha) Alexandria University during the period from October to December 2013according to the criteria of the Ethical Committee of Alexandria University. Rabbitry minimum and maximum temperatures and relative humidity during the experimental period were laid between 18.6- 26.2 C° and 48.7-58.4, respectively.

Thirty-six V- Line growing rabbits of both sexes 5 weeks old with average initial live body weight of 701.91±7.71 gm were randomly distributed into three treatment groups (n=12) and submitted to 3 dietary treatment. Every treatment contained 4 replicates, the experimental period extended for 10 weeks. Group one fed basal control diet free of feed additives and served as a control group. Group 2 and 3 givens basal diet supplemented with 0.6% of Fenugreek seed and anise seed powder, respectively. All the experimental diets were formulated to ensure they were both isonitrogenous and isocaloric in accordance with De Blas and Mateos (1998). The basal experimental diets and its chemical analysis (AOAC, 1995) are illustrated in Table 1.

The rabbits were housed in galvanized wire cages with flat deck (50 x 50 x 40 cm) three rabbits in each cage, in a well-ventilated building (natural through the windows). All animals were kept under the same managerial and environmental conditions. A cycle of 16 hours of light and 8 hours of dark were provided throughout the experiment. Animals were fed experimental diets in a pellet form. All cages were equipped with feeding hoppers made of galvanized steel sheets with automatic drinkers with nipples for drinking. Feed and water were provided *ad libitum* throughout the experimental period from 5 to 15 weeks of age by using high standard hygiene and careful management. Individual live body weight, feed consumption and feed conversion ratio were recorded. Performance index (PI) was calculated according to North (1981) as given below: PI= [BW (kg)/FCR] x 100 Where BW is final body weight and FCR is feed conversion ratio.

Blood samples were collected at 9th week of experiment from each rabbit from the marginal ear vein. Serum were obtained by blood samples centrifugation for 20 min at 4000 rpm and stored at -20°C in Eppendorf tubes until analysis. Total protein, albumin, triglycerides and total lipids were measured by means of spectrophotometer according to Armstrong and Carr, (1964), Doumas *et al.*, (1977) and Fringes *et al.*, (1972), respectively. Globulin values were obtained by subtracting albumin values from corresponding values of total protein. Total cholesterol, LDL and HDL cholesterol were determined according to Burstein *et al.*, (1970); Wieland and Seidel, (1983) and Bogin and Keller, (1987). Alkaline phosphatase was determined by calorimetric method of Szasz, (1969). Plasma creatinine was assayed according to Caraway, (1963). Total antioxidant capacity and lipid peroxidation (malondialdehyde) were determined by calorimetric method of Satoh, (1978), Ohkawa *et al.*, (1979) and Koracevic *et al.*, (2001). Glutathione peroxidase was carried out using the commercial Kits produced by Human (Max- Planck- Ring 21-D- 65205 Wiesbaden, Germany).

At the end of the experiment, four rabbits from each experimental group were randomly chosen for slaughter. Rabbits were fasted for 12 hours before slaughtering, and then they were weighed individually as pre-slaughter weight. Rabbits were slaughtered by cutting the jugular vein. After complete bleeding, they were weighed, skinned and eviscerated. Carcass, head, liver, fur, kidney fat, kidneys, heart, spleen, caecum, adrenal and thyroid glands were immediately weighed. Hot and cold carcass weight was calculated as a total weight of carcass without the head. All traits were calculated as percentage of the pre-slaughter weight.

The differences among treatments were statistically analyzed by one-way ANOVA using SPSS® statistical software package for windows version 16.0.1. The significant differences between treatment means were separated by Duncan's Multiple Range-test (Duncan, 1955).

RESULTS AND DISCUSSIONS

It is clearly shown that no significant differences in body weight could be detected in initial body weight at 5 weeks of age (Table 2). The different feed additives powder addition to growing rabbit diets in the present study improved the performance of the experimental rabbits compared to un-supplemented group. The apparent health of the experimental rabbits was good throughout the experimental period and in all treatments. This might be due to good sanitation or that supplementation of fenugreek and anise did not affect on mortality rate. The result was in agreement with finding of Rayes *et al*. (2009) who reported that the pharmacological properties of fenugreek have been explored to identify a role in cardiovascular health. The improvement of body weight gain of rabbits fed fenugreek diets might be attributed to increase in feed intake or to the fenugreek contents of active compounds such as antibacterial, antifungal, anti-inflammatory, carminative and antioxidant activities. Also, Hernandez *et al.* (2004) reported that the improvement due to fenugreek diets might be due to presence of the fatty acids or due to stimulating effect on the digestive system. The positive effect of fenugreek seed on feed intake can be evaluated on the basis of different perspectives, that fenugreek as a natural feed additives improved palatability and could be attributed to the carbohydrates and their main components, galactomannan, which stimulate the appetizing and digestive process.This result agrees with Michael and Kumawat (2003) and Alloui *et al.* (2012). They reported that fenugreek also contains neurin, biotin, trimthylamine which tends to stimulate the appetite by their action on the nervous system. On the other hand, El-Kloub (2006) indicated that fenugreek seeds at

level of 0.05 % revealed no significant effect on feed intake as compared to the control group. The improvements of feed conversion ratio might be related to the development of rabbit gut morphological changes of gastrointestinal tissues can be induced by differences in gut-floid of microbial content including their metabolites; the result was in line with finding of Amal *et al.* (2013) and Mamoun *et al.* (2014). Gomez *et al.* (1998) indicated that the improvement in performance characteristics in broilers may be due to antibacterial related to flavonoids in fenugreek that led to maintaining normal intestine microflora by competitive exclusion and antagonism, altering metabolism and increased liver muscle glycogen.

The improvement due to anise supplementation could be due to the active compounds that are present in anise (anothole, eugenol, methylchavicol, anisaldehyde and estragole) which exert their growth promoting activity, antioxidant and stimulate the immune and digestive system (Cabuk *et al.,* 2003). Also, Hernandez *et al.* (2004) stated that anise oil may improvenutrient digestion and absorption by increasing the activity of pancreas enzymes.In many studies reported that essential oil derived from anise has antimicrobial (Singh *et al.,* 2002; Tabanca *et al.,* 2003), and antifungal activity (Soliman and Badea, 2002). Additionally, anise has been used as an antiparasitic (Cabuk *et al.,* 2003), and antipyretic (Afifi *et al.,* 1994). Hamodi and Al-Khalani (2011) reported that anise reduce harmful bacteria count, *E. coli and Staphylococci*, in small intestine and colon of broiler chicks.

Results presented in Table 3 showed the effect of fenugreek and anise seeds feed additives on carcass traits. Including different feed additives in the rabbit diets resulted in increasing absolute carcass weight. Results of carcass weight were in harmony with final live body weight. However, the results showed no significant differences were observed in hot or cold carcass weight percent and organs relative weight as compared to the control group, except testes percent showed significant decrease due to feeding diet containing fenugreek seed which may be due to fenugreek phytoestrogens effect .Results presented by Kassem *et al.* (2006) reported that diets containing 30 % fenugreek seeds significantly reduced rabbit male testes weight as well as sperm concentration, indicating a toxic effect of fenugreek seeds on seminiferous tubules and the interstitial tissue (Leydig cells). Furthermore, their results showed that fenugreek lowered circulating androgen (testosterone). The results presented by Alloui *et al*. (2012) and Mamoun *et al.* (2014) showed an increase in dressing percentage of broiler chicks fed fenugreek seeds. Mukhtar *et al.* (2013) found that intestine weight, liver, gizzard and heart were insignificantly affected by fenugreek supplementation. Also, Hamodi and Al-Khalani (2011) found an increase in carcass dressing percentage, liver, heart and gizzard of broilers fed anise containing diet.

Results illustrated in Table 4 indicated that serum total protein, albumin and globulin were significantly ($P \leq 0.01$ or 0.05) increased due to different supplementations as compared to the control group. Serum glucose significantly ($P \leq 0.05$) decreased with inclusion of fenugreek in the diet, however, anise supplementation resulted in non-significant decrease in this trait. The hypoglycemic effect of fenugreek was in agreement with other studies like Al-Niumi (1999) and Alkattan (2006). This hypoglycemic effect may belongs to the pectin in the fenugreek seeds which delay the stomach empting and so delays glucose absorption from intestine (Ali *et al.,* 1995). Also Heafele *et al.* (1997) revealed that the fenugreek seeds possess the enzyme dioxygenase which activate the production of 4-hydroxyisoleusine the latter activate insulin secretion and so the glucose level

will be reduced. Soltan *et al.* (2008) reported that there was a significant reduction in glucose level group fed on the basal diet supplemented with 0.5 g anise / kg by about 5.7 % when compared with the control, while anise supplementation at 0.75, 1.0 and 1.25 g anise / kg non-significantly reduced serum glucose levels.

The results of serum metabolite showed reduction in serum total lipids, triglycerides, total cholesterol and LDL cholesterol, however, HDL-cholesterol was significantly increased due to fenugreek and anise supplementation. The hypocholesteremic effect of fenugreek seed may be due to its active ingredients such as saponins, hemicelluloses, mucilage, tannin and pectin and these compounds help in lowering blood LDL-cholesterol levels by inhibiting bile salts. These results confirmed by reports of Mukhtar *et al.* (2013). Results presented by Moosa *et al.* (2006) showed that fenugreek seed powder significantly reduced serum total cholesterol, triglycerides and LDL-cholesterol, but serum HDL-cholesterol level elevation is not significant. As Fenugreek contain saponins, Sharma (1986) and Sharma and Raghuram (1990) illustrated that saponins are known to have hypocholesterolemic effects. The results presented by Soltan *et al.* (2008) revealed that anise supplementation non-significantly decreased cholesterol concentration, while HDL-cholesterol increased with anise supplementation at 1.0, and 1.25 g/ kg.

Results presented in Table 4 showed that serum ALT and AST were insignificantly affected by fenugreek or anise seeds supplementation. Generally serum ALT and AST considered as liver enzyme which increased with liver damage(heptatocellular degeneration), so the non-significant effect on these enzymes mean that there was no detrimental effect due to fenugreek or anise supplementation. Moreover, the analysis of variance of the obtaineddata revealed that fenugreek and anise supplementation significantly ($P \leq 0.05$) decreased alkaline phosphatase (ALP) values. The decrease in serum ALP may provide evidence for the occurrence of hepatoprotective effect of fenugreek or anise and its essential oils (Langhout, 2000; Williams and Losa, 2001 and Hernandez *et al.*, 2004).

Total antioxidant capacity significantly increased with fenugreek and anise containing diets as compared with control. Supplemented seeds also significantly increased Glutathione peroxidase, while it decreased serum malondialdehyed (MDA).Hamadi (2012) reported that both isolated trigonelline and ethanol extract of fenugreek seeds reduced plasma MDA and increased Glutathione peroxidase, but the magnitude of the effect is different. The effect of ethanol extract of fenugreek seeds was more than that of isolated trigonelline. In addition, Ali et al. (2007) reported that supplementation of 0.25 % anise to laying hen diets increased antioxidant capacity in plasma, while decreased LDL, total cholesterol, triglycerides and total lipids in blood plasma, liver and yolk extract.

In conclusion the results of the present study revealed that fenugreek and anise seeds may have a favorable effect on the performance and blood chemistry of the grown rabbits, further studies are needed concerning the used inclusion levels in the commercial rabbit diets.

Table (1): Composition and calculated chemical analysis of experimental diets:

Ingredients %			**Dietary treatments**		
	fenugreek	**anise**	**Control**	**fenugreek**	**anise**
Yellow corn			11	11	11
Wheat bran			22	21.4	21.4
Barley			20	20	20
Clover Hay			22	22	22
Soybean meal (44%)			20.2	20.2	20.2
Molasses			3	3	3
Di- calcium phosphate			1	1	1
L-Lysine			0.1	0.1	0.1
DL-Methionine			0.1	0.1	0.1
Premix[1]			0.3	0.3	0.3
Salt			0.3	0.3	0.3
fenugreek			-	0.6	-
anise			-	-	0.6
Total			100	100	100
Price EP/Kg			2.82	2.87	2.99
Calculated analysis[2]	90.30	90.80	91.12	91.65	91.52
Dry matt (DM)	86.86	82.98	84.00	84.50	84.29
Organic matter(OM)	27.90	17.42	17.25	17.98	17.43
Crude protein(CP)	7.45	12.72	3.12	3.20	3.38
Ether extract(EE)	10.32	17.25	12.31	12.37	12.65
Crude fiber(CF)	41.19	33.59	51.32	50.95	50.83
NFE	3.44	7.82	7.12	7.15	7.23
Ash	3419.83	2560.79	2823.56	2817.27	2796.59
DE(kcal/kg DM)[3]					

[1]Each Kg of vitamin and mineral mixture contained:Vit A.2000.000 IU; E 10mg; B1 400 mg; B2 1200 mg; B6 400mg; B12 10 mg; D3 180000 IU ; Colin chloride 240 mg; Pantothenic acid 400 mg; Niacin 1000 mg; Folic acid 1000 mg; Biotin 40 mg; Maganese 1700 mg; Zinc 1400 mg; Iron 15 mg; Copper 600 mg; Selenium 20 mg; Iodine 40 mg; and Magnesium 8000 mg.

[2]According to NRC (1977) for rabbit's requirements

[3]Digestible energy (kcal/kg DM) was calculated according to Fekete and Gippert (1986) using the following equation: DE (kcal/kg DM) = 4253 - 32.6 (CF %) -144.4 (total ash).

Table (2): Means ± SE of productive performance of the rabbits fed the experimental diets.

Items	Dietary treatments			*P*. Value
	control	fenugreek	anise	
Initial weight (g)	699.16±17.94	693.33±22.26	700.83±16.46	0.958
Final weight (g)	2541.25±28.14[b]	2740.83±31.69[a]	2744.16±45.96[a]	0.0001
Total weight gain (g)	1842.09±20.87[b]	2047.50±18.86[a]	2043.33±19.74[a]	0.0001
weekly gain (g)	184.20±3.27[b]	204.75±2.79[a]	204.33±3.86[a]	0.0001
Weekly feed intake(g)	679.69±6.54[b]	708.87±2.82[a]	707.84±2.17[a]	0.0001
Feed conversion ratio	3.69±0.07[a]	3.46±0.04[b]	3.47±0.07[b]	0.008
Performance index %	68.86±1.64[b]	79.21±1.89[a]	79.08±2.05[a]	0.0001

a, b, : Values in the same row with different superscripts differ significantly (P≤ 0.05)

Table (3): Means ± SE of effect of fenugreek, anise seeds on carcass characteristic.

Items	Dietary treatments			*P.* Value
	control	fenugreek	anise	
Slaughter weight(kg)	2.45±0.06[b]	2.62±0.02[a]	2.61±0.05[a]	0.035
Carcass weight (kg)	1.34±0.34[b]	1.44±0.21[a]	1.40±0.27[a]	0.005
Hot carcass %	55.14±0.34	54.91±0.21	54.66±0.27	0.695
Cold carcass %	54.55±0.41	54.10±0.25	54.07±0.28	0.652
T Edible parts %	58.98±0.28	58.90±0.24	58.17±0.25	0.638
Non Edible parts %	41.01±0.28	41.09±0.24	40.82±0.25	0.726
Fur %	13.85±0.06	13.88±0.15	14.02±0.36	0.554
Head %	5.55±0.10	5.53±0.10	5.63±0.06	0.841
Small intestine %	3.99±0.14	4.16±0.06	4.07±0.15	0.718
Caecum %	4.72±0.05	4.85±0.04	4.80±0.04	0.684
Liver %	2.86±0.05	3.02±0.20	2.95±0.13	0.653
Heart %	0.36±0.03	0.36±0.01	0.36±0.06	0.960
Kidney %	0.67±0.015	0.70±0.009	0.69±0.019	0.457
Kidney fat %	0.42±0.10	0.46±0.04	0.47±0.05	0.263
Lung %	0.50±0.02	0.56±0.02	0.51±0.02	0.369
Spleen %	0.06±0.002	0.06±0.002	0.06±0.002	0.428
Testes %	0.42±0.02[a]	0.35±0.007[b]	0.44±0.02[a]	0.003
Giblets %	3.89±0.06	4.08±0.04	4.00±0.09	0.429

a, b, c, d: Values in the same row with different superscripts differ significantly (P≤ 0.05).
Giblets = kidney % + heart % + liver %.

Table (4): Means ± SE of effect of fenugreek, anise seeds on biochemical parameters in rabbit serum.

Items	Dietary treatments			
	Control	**fenugreek**	**anise**	***P.* Value**
Total protein (g/dl)	6.20±0.05^{c}	7.00±0.12^{a}	6.72±0.06^{b}	0.0001
Albumin (g/dl)	3.80±0.08^{b}	4.25±0.06^{a}	4.17±0.02^{ab}	0.0001
Globulin (g/dl)	2.40±0.12^{c}	2.75±0.13^{a}	2.55±0.06^{b}	0.020
Glucose (g/dl)	105.02±1.11^{a}	86.75±0.60^{b}	102.80±2.00^{ab}	0.0001
Total lipids (mg/dl)	389.50±7.47^{a}	345.00±2.04^{c}	360.00±2.04^{b}	0.0001
Triglycerides (mg/dl)	78.75±0.47^{a}	49.00±0.91^{c}	67.75±0.85^{b}	0.0001
Total cholesterol (mg/dl)	78.35±1.88^{a}	50.52±1.17^{c}	68.42±1.18^{b}	0.0001
HDL (mg/dl)	29.25±0.47^{b}	37.75±0.47^{a}	37.00±0.40^{a}	0.0001
LDL (mg/dl)	20.25±0.75^{a}	14.00±0.70^{c}	16.75±0.25^{b}	0.0001
AST (U/L)	25.43±0.75	26.63±0.33	25.52±0.12	0.620
ALT (U/L)	16.43±0.12	16.93±0.21	16.56±0.40	0.860
ALP (IU/L)	52.00±0.91^{a}	44.25±0.47^{b}	44.75±0.25^{b}	0.0001
TAC(mmol/l)	1.60±0.07^{b}	2.37±0.11^{a}	2.40±0.12^{a}	0.0001
GP(nmol/ml)	10.05±0.30^{b}	11.92±0.31^{a}	12.37±0.66^{a}	0.002
MDA(nmol/ml)	23.25±0.39^{a}	20.72±0.78^{b}	21.75±0.45^{ab}	0.021

a, b, c, d: Values in the same row with different superscripts differ significantly (P≤ 0.05). HDL=High Density Lipoprotein. LDL=Low Density Lipoprotein. AST= Aspartate amino transferase. ALT= Alanine amino transferase. ALP= Alkaline Phosphatase. TAC= Total antioxidant capacity.GP= Glutathion peroxidase.

MDA= Malondialdehyde

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الملخص العربى

تأثير بذور الحلبه والينسون كمنشطات نمو طبيعية على معدل الأداء ، الذبيحة ، مكونات الدم والحالة الضد تأكسدية للأرانب النامية

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أجريت التجربة لتقدير تأثير أضافةمسحوق بذور الحلبة والينسون كمنشطات نمو طبيعية ومضادات أكسدة على معدل أداء النمو، صفات الذبيحة ، أكسدة الدهون والحالة الضد تأكسدية لأرانب V-line النامية. أستخدم ٣٦ أرنب V-line نامى من كلا الجنسين عمر خمسة أسابيع ومتوسط وزنها الابتدائى 701.91±7.71 جرام تم توزيعها عشوائيا على ثلاث معاملات وبكل معاملة ١٢ أرنب تناولت ٣ معاملات غذائية وكل معامله مكونة من أربعة مكررات.وقد أستمرت التجربة لمدة ١٠ أسابيع. المجموعة الأولى من الأرانب تناولت عليقة أساسية خالية من الأضافات الغذائية وأستخدمت كمجموعة مقارنة. المجموعتان الثانية والثالثة تناولت عليقة أساسية مضاف لها بذور الحلبة وبذور الينسون المطحونه بمعدل ٠,٦ % على التوالى . كانت جميع العلائق التجريبية متساوية فى البروتين والطاقة. أوضحت نتائج التجربة أن الأضافات المختلفة لعلائق الأرانب حسنت معنويا من وزن الجسم النهائى ، معدل الزيادة فى وزن الجسم ، أستهلاك العليقة ، الكفاءة التحويلية ومعدل أداء الأرانب مقارنة بمجموعة الكونترول. أدت الأضافات الى زيادة فى الوزن المطلق للذبيحة ، بينما نسبة الذبيحة الساخن والبارد والوزن النسبى للأعضاء المختلفة لم تتأثر معنويا مقارنة بالكونترول ، ماعدا الوزن النسبى للخصيتين أنخفض معنويا نتيجة التغذية على العليقة المحتوية على مسحوق بذور الحلبة. أنخفض جلوكوز سيرم الدم معنويا نتيجة التغذية على بذور الحلبة بينما الأنخفاض كان غير معنوى فى حالة بذور الينسون . لم يتأثر كل من انزيمات AST،ALT نتيجة للمعاملات المختلفة بينما أنزيم ALP أنخفض معنويا نتيجة لاضافة الحلبة والينسون. لوحظ أنخفاض فى الدهون الكلية ، التراى جلسرايد ، الكولسترول الكلى ، الكولسترول منخفض الكثافة بينما أرتفعت نسبة الكولسترول مرتفع الكثافة نتيجة لأضافة بذور الحلبة والينسون. أرتفعت الصفات الضد تأكسدية معنويا نتيجة التغذية على العليقة المحتوية على مسحوق بذور الحلبة والينسون مقارنة بمجموعة الكونترول . أدت الأضافات الى زيادة فى أنزيم الجلوتاثيون بيروكسيديز بينما أنخفض نسبة المالونديهيد . وجد من هذه الدراسة أن أستخدام مسحوق بذور الحلبة والينسون له تأثير ايجابى على أداء الأرانب، وتأثير مفيد على تنظيم دهون الدم الذى يرجع الى تحسين الحالة الضد تأكسدية لأرانب V-line النامية.