IMPACT OF INCORPORATING GARLIC OR CUMIN POWDER IN LAMBS RATION ON NUTRIENTS DIGESTIBILITY, BLOOD CONSTITUENTS AND GROWTH PERFORMANCE

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SUMMARY

This study was designed to investigate the effect of garlic powder (GAP) or cumin powder (CUP) supplementation in growing lambs ration on nutrients digestibility, rumen liquor parameters, blood constituents and growth performance,. Eighteen of growing Barki lambs (averaged 5-6 months of age and weighted 27.5 ± 0.90 kg) were divided into three equal groups (6 animals each) in a feeding trial lasted 100 days. Animals were fed on basal diet (control) or supplemented with 2% GAP (T1) or CUP (T2) of the concentrate feed mixture. The results showed that apparent digestibility of all nutrients and nutritive values as total digestible nutrients (TDN) and digestible crude protein (DCP) were significantly ($P<0.05$) higher for lambs fed rations of GAP or CUP compared with those fed the control ration. Ruminal ammonia nitrogen (NH3-N) was increased ($P<0.05$) for lambs fed rations GAP or CUP compared with those fed the control, however ruminal pH and TVFA's were comparable among the experimental treatments. The values of N balances and dietary N utilization were increased ($P<0.05$) for lambs fed GAP supplemented ration compared with those fed control or CUP-supplemented diet. Meanwhile Average daily gain and feed conversion were higher ($P<0.05$) for lambs fed GAP or CUP than those fed control ration. Dry matter intake was comparable among the experimental treatments. There were no significant differences in plasma albumin and cholesterol concentrations among treatments, while plasma concentrations of total protein, globulin and total antioxidant capacity were higher ($P<0.05$) for lambs fed GAP or CUP than those fed control ration. Plasma triglycerides concentrations was higher ($P<0.05$) for lambs fed CUP than those fed GAP or control. Plasma malonaldhyed (MDA) was decreased ($P<0.05$) for lambs fed rations of GAP or CUP than those fed control ration. There was a decrease ($P<0.05$) in plasma concentrations of HDL with feeding CUP ration and levels of LDL with feeding GAP compared to feeding the control ration. This study showed that dietary supplementation of either garlic or cumin powder at 2 % significantly improved nutrients digestibility and growth performance in growing lambs, without any adverse effect on rumen fermentation.

Keywords: *garlic, cumin, nutrients digestibility, growth performance, rumen liquor parameters, plasma biochemical parameters, lambs.*

INTRODUCTION

Using chemical additives, especially antibiotics, may result in accumulation of chemical residues in animal products, causing harmful effects for consumer (Foroozandeh and Ghaffari, 2015). Recently, using of supplemental herbal feed additives, in animal nutrition, has been paid more attention due to concerns of food safety and human health. The beneficial effects of such bioactive herbal additives may be included stimulation of animal appetite and feed intake, improvement of endogenous digestive enzyme secretion, enhancing immune response also, antibacterial, antiviral and antioxidant actions (Toghyani *et al*., 2011).

Garlic (*Allium sativum)* is an herb or spice plant that has been used as a source of antimicrobial agents for the gastro-intestinal tract (GIT). The extracts of these plant herbs have been shown to be manipulated ruminal fermentation, improving nutrient utilization in ruminants and maintain the microbial ecosystem of the GIT especially in tropical regions in order to enhance their productivity (Busquet *et al*., 2005; Wanapat *et al*., 2008 b and Patra- Kamra *et al*., 2011). Modulatory effects of garlic on antioxidant, antitumor and immune functions have been detected (Mohammadi and Oshaghi , 2014 and Schäfer and Kaschula, 2014). Cumin *(Cuminum cyminum)* is an annual herb and has been used as medicine and spices in food. Dietary supplementation of cumin could either influence the feeding pattern or growth of favorable microorganisms in the rumen. Also, stimulate the secretion of various digestive enzymes, which in turn may enhance the efficiency of nutrients utilization of animals (Patil *et al*., 2017). Essential oil of cumin acts as powerful internal or external antiseptic, anti-inflammatory, an analgesic, hemolytic and anti-enzymatic actions (Guenther, 1950). So, cumin as feed additives has many beneficial effects due to its aforesaid properties in improving nutrient utilization. Cumin as natural antioxidant was effective to improve rumen ecology of mastitis dairy cow's (Nurdin and Arief (2009).

Few studies have investigated the effects of garlic and cumin on feed intake, ruminal fermentation, digestion and performance in ruminants (Patil *et al*., 2017 and Sahli *et al*., 2018). There is also little information on the optimum levels of these feed additives on practical on-farm options for significantly improving productivity.The objective of this study was to study the effect of dietary supplementation of garlic or cumin powder on nutrients digestibility, rumen liquor parameters, plasma biochemical indicators and growth performance of Barki lambs.

MATERIALS AND METHODS

Experimental design:

This study used 18 of Barki lambs (average weight 27.50 ± 0.9 kg and aged 5-6 months old). The experiment was carried out at El-Nubaria experimental and production Station – National Research Centre during the months from March to June 2017.

Animals were fed on concentrate feed mixture (CFM) and peanut hulls at 70 and 30 %, respectively to cover their nutrients requirements according to their live body weight **(NRC, 2007)**. The CFM contained 60 % ground yellow corn, 22 % wheat bran, 15 % soybean meal, 1.5 % limestone, 1 % salts and 0.5% minerals and vitamins mixture. The animals were randomly divided into three equal groups (6 lambs each) of similar initial body weights. The lambs of control group were fed on basal diet (control) or supplemented with 2% GAP (T1) or CUP (T2) of concentrate feed mixture.

The animals were housed inside window stables for feeding lot groups. Feed were offered twice a day at 8 am and 2 pm and drinking water were available along the experiment. The measurements of lambs' body weights were recorded at starting of the experiment and biweekly thereafter, while feed intakes recorded daily. Averages of daily gain and feed conversion rates of lambs were calculated. All the parameters were recorded at the morning before animals access to feed or water.

Digestibility, N-balance and rumen fermentation:

At the end of the experimental period, three digestion trials were carried out to determine nutrients digestibility, feeding values and nitrogen balance of tested rations by using metabolic cages. Three animals from each group were fed individually for 14 days experimental period, 7 days for adaptation and 7 days for collection period. Feces and urine were collected quantitatively daily during the collection period as described by Maynard *et al.,* (1979). Amounts of feed intake, feces and urine were measured and recorded daily. Solution of 10 % H_2SO_4 was added to the representative feces samples before drying in oven at 60 ºC for 24 hrs. Dried samples were ground to pass through 1-mm sieve, and kept in closely tied jars for laboratory analysis. Urine were collected daily in glass bottles contain 50 ml diluted sulfuric acid (10 %). A representative samples (10 %) of urine volume were stored for nitrogen determination. Rumen fluid samples were taken from each animals at zero and 3 hrs. post feeding using stomach tube. Rumen fluid pH was measured immediately using digital pH meter, and then samples were filtered through four layers of sheath cloth. Two drops of diluted formalin solution (10 %) was added to stop microbial activity, acidified and kept frozen at – 20 ºC for the determination of ammonia (NH3-N) according to Conway (1957) and total volatile fatty acids (TVFA's) as described by Warner (1964).

Dietary Sampling and laboratory analysis:

Dietary samples were collected daily in the last week of each month along the experiment period and a composite sample was performed. A portion of the composite sample was dried at 105 °C in a forced air oven till constant weight for DM determination. The rest of composite sample was dried at 70 °C for a constant weight, ground and kept in closely tied jars for laboratory analysis. Diets and fecal samples were analyzed for dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF), ether extract (EE) and ash according to **AOAC (2012).** Nitrogen free extract (NFE) was calculated by the difference. Approximate analysis of CFM, GAP, CUP and peanut hulls are presented in Table (1); while the approximate analyses of experimental diets are presented in Table (2).

Table (1): Approximate analysis of concentrate feed mixture (CFM), garlic powder (GAP), cumin powder (CUP) and peanut hulls fed to growing Barki lambs on DM basis (%).

Item	CFM	GAP	CUP	Peanut hulls
DM	89.76	91.01	93.06	90.2
OM	94.50	93.03	90.58	89.80
CP	14.73	13.84	16.81	9.43
EE	3.60	2.99	15.56	4.00
CF	5.50	19.63	19.38	23.79
NFE	70.67	56.57	38.83	52.58
Ash	5.50	6.97	9.42	10.20

Table (2): Approximate analysis of experimental diets fed to growing Barki lambs on DM basis (%).

Item	Control	T1	T2
DM	89.89	91.17	91.19
OM	93.09	94.39	94.36
CP	13.14	13.33	13.38
EE	3.72	3.76	3.94
CF	10.99	11.26	11.26
NFE	65.24	66.03	65.79
Ash	6.91	7.01	7.04

Plasma constituents' analysis:

Heparinized blood samples were collected from the jugular vein of each animal at the end of feeding trials. Plasma samples were obtained by centrifugation of samples at 4000 r.p.m for 20 minutes and stored at – 20 ºC for later assay. Plasma total protein, albumin, total cholesterol, HDL-cholesterol, LDL- cholesterol, triglyceride were determined using colorimetric methods using specialized kits (Salucea, Haansberg, Netherlands). Total antioxidant capacity (TAC) and malonaldhyed (MDA) were determined using colorimetric methods (Biodiagnostic, Egypt).

Statistical analysis:

Data were subjected to statistical analysis as one-way analysis of variance according to SPSS (2008). The model used to analyze the different treatments studied for lambs was as follows:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where: Yij = Observation, μ = Overall mean; Ti = Effect of ith treatments and eij= Experimental error. Duncan's Multiple Range test was used to detect differences between means of the experimental groups (Duncan, 1955).

RESULTS AND DISCUSSION

Proximate analysis:

Data presented in Table (1) illustrated the proximate analysis of CFM, GAP, CUP and Peanut hulls. These results showed that, the CP concentrations were 14.73, 13.84 and 16.81 % for CFM, GAP and CUP, respectively. The EE concentrations of GAP and CUP were 2.99 and 15.56 %, respectively. In this respect, Lewis (1984) and Amagase *et al*., (2001) found that GAP and CUP contained 2–5 and 15 % EE on DM basis, respectively. The proximate analysis of whole rations is shown in Table (2). The concentrations of all nutrients were almost comparable among the experimental diet. It is acceptable that CP content of whole rations was similar to the recommendation of NRC (2007) for growing lambs diet.

Nutrients digestibility and nutritive values:

The data presented in Table (3) showed that digestibility of DM, OM, CP, EE, CF and NFE were higher (P<0.05) for lambs fed GAP (T1) and CUP (T2) supplemented diets than those fed control. However, the digestibility of lambs fed T1 and T2 were almost comparable. The results of nutritive values indicated that the DCP and TDN values were increased (P<0.05) with feeding T1 and T2 compared with those fed control.

Table (3): Effect of garlic powder (GAP) or cumin powder (CUP) supplementation on nutrients digestibility and nutritive values of experimental treatments (mean ± SEM).

Parameter	control	GAP	CUP	SEM
Nutrients digestibility (%)				
DM	76.66b	79.87a	80.22a	0.63
OM	78.65b	82.12a	81.76a	0.63
CP	73.36b	77.43a	77.33a	0.77
EE	73.68b	77.58a	77.49a	0.77
CF	57.06b	63.09a	65.48a	1.42
NFE	81.20b	85.12a	84.39a	0.72
Nutritive value (%)				
DCP	9.64b	10.32a	10.35a	0.13
TDN	74.69b	79.83a	79.91a	0.90

a,b Means within the same row having different superscripts significantly different (P<0.05).*

These results are in good agreement with similar observation that supplemental GAP had improved CP digestibility (Wanapat *et al.,* 2008 a, b), DM and OM digestibility (Patra- Kamra *et al.,* (2011) and Mirzaei *et al.,* (2012). The results also reinforced by a recent study showed that dietary GAP supplementation increased (P < 0.05) in vitro digestibility of DM (*Sahli et al.,* (2018). The significant improvement in nutrients digestibility noticed in the present study on lambs and reported by others (Zafarian and Manafi, 2013), may be referred as a result of GAP includes an oil containing organosulfur which could act as an antibacterial agent.

In the present study, supplemental CUP was effective to increase nutrients digestibility and nutritive values than control. These results agree with those reported by Khan and Chaudhry (2010) and Kurniawati *et al.,* (2017) who found that the digestibility of DM and OM were higher with feeding CUP than control. In addition, Cardozo *et al.,* (2005) reported that CUP supplementation increased CP digestibility.

The improvement noticed in nutrients digestibility with feeding CUP, in the present study, may be due to that cumin stimulates the secretion of pancreatic enzymes, compounds necessary for proper digestion and nutrient assimilation, and may also have anti- carcinogenic properties which improve animal status as reported by Nurdin and Arief (2009), and also improve cellulose digestion (Kilic *et al.,* 2011) as well as increase CF digestibility. In addition, the observed increase in nutrients digestibility with feeding GAP or CUP could be ascribed as a result of the antimicrobial properties of garlic and cumin which could lead to suppressed rumen digestion (Ikyume *et al* 2017).

Nitrogen balance and rumen liquor parameters:

Data presented in Table (4) showed that lambs fed GAP -supplemented diets had higher (P<0.05) values of nitrogen balance and dietary N utilization as a percentage from nitrogen intake and digestible nitrogen than those fed control or CUP-supplemented diet. While, there were no significant differences between CUP and the control diet. These findings are in good agreement with similar observation reported by Wanapat *et al*. (2008 a, b). They found an increase in nitrogen balance and nitrogen absorption when cattle were fed ration contained GAP.

The results in Table (5) showed no significant differences in ruminal pH and TVFA's concentrations among the experimental treatments. The results are consistent with similar observations reported by Ikyume *et al.*, (2017) and Kurniawati *et al.*, (2017). These findings could be indicated that GAP or CUP supplementation had no adverse effect on rumen fermentation.

Table (4): Effect of experimental diets on nitrogen utilization (mean ± SEM).

Parameter	Control	GAP	CUP	SEM
N intake, g/h/d	29.88	30.08	33.59	0.60
Fecal nitrogen, g/h/d	7.30[a]	6.23[b]	6.99[ab]	0.33
Urinary nitrogen, g/h/d	10.2[a]	7.27[b]	12.18[a]	0.82
Nitrogen balance, g	12.38[b]	16.58[a]	14.42[ab]	0.70
Dietary N utilization, %:				
of N intake	41.43[b]	55.12[a]	42.93[ab]	2.44
of digestible N	54.82[b]	69.52[a]	54.25[b]	3.11

a,b Means have different superscripts in the same row are significantly different at (P<0.05).

Table (5): Effect of experimental diets on rumen parameters (mean ± SEM).

Parameter	Control	GAP	CUP	SEM
Ruminal pH				
Zero time	6.33	6.33	6.33	0.06
3 h after feeding	5.43	5.37	5.40	0.04
Overall means	5.88	5.85	5.87	0.04
NH_3-N, mg/ ml RL				
Zero time	19.80[b]	23.40[a]	22.63[a]	0.58
3 h after feeding	24.21[c]	34.40[a]	28.40[b]	1.52
Overall means	22.01[b]	28.50[a]	25.52[a]	0.53
TVFA's, meq/dl RL				
Zero time	5.37	4.67	4.63	0.18
3 h after feeding	9.17	10.53	9.67	0.38
Overall means	7.27	7.60	7.15	0.85

a, b, c. Means with different superscripts in the same row differ significantly (P<0.05).

The data of NH_3-N values in Table (5) showed that ammonia values were greater (P<0.05) with feeding GAP and CUP-supplemented rations than control. Also, there were a significant increase (P<0.05) in NH_3-N values with feeding GAP-supplemented rations compared to control or CUP. Similar effects of supplemental GAP on NH_3-N were detected by Yang *et al,*. (2007), Kongmun *et al*., (2010) and Sahli *et al*., (2018). Ruminal NH3-N considered the most important nitrogen source for synthesis of microbial protein in the rumen (Wanapat and Pimpa, 1999). This may explain the beneficial effects of GAP and CUP on animal metabolism and nutrients digestibility signifying their role in improving rumen fermentation and feed utilization, stimulating rumen microbial activity, digestive microorganisms or enzyme activity.

Productive performance:

Data presented in Table (6) showed that averages of IBW and FBW were comparable for lambs fed control, GAP or CUP supplemented diet. Average daily gain (ADG) were increased (P<0.05) for lambs fed GAP and CUP compared with those fed control. However, there were no significant differences in ADG between T1 and T2. Data showed no significant differences in averages of feed intakes of peanut hulls, CFM and TDM for lambs fed GAP and CUP compared with control. Meanwhile, the intakes of DCP and TDN were tended to increase for lambs fed GAP and CUP compared with those fed control. The results also indicated that feed conversion (FC) of DM (FC-DM), DCP (FC-DCP) and TDN (FC-TDN) were significantly (P<0.05) improved for lambs fed GAP and CUP compared with those fed control.

Table (6): Effect of experimental diets on productive performance of growing Barki lambs (mean ± SEM).

Parameter	control	GAP	CUP	SEM
Body weight:				
Initial body weight (kg)	28.70	27.75	27.37	0.84
Final body weight (kg)	48.62	50.37	49.13	0.89
Daily gain (g/day)	199.25^{b}	226.25^{a}	217.5^{a}	3.95
Feed intake: (g/head/day)				
Peanut hulls	465	468	450	0.03
CFM	1082	1092	1032	0.04
TDM	1547	1560	1482	0.01
DCP	149.1	161.0	153.4	0.09
TDN	1155.5	1245.4	1184.3	0.11
Feed conversion:				
FC-DMI/kg gain	7.76^{a}	6.90^{b}	6.81^{b}	0.13
FC-DCPI/gain	0.748^{a}	0.712^{b}	0.705^{b}	0.07
FC-TDNI/gain	5.799^{a}	5.504^{b}	5.445^{b}	0.05

a,b Means within the same row having different superscripts significantly different (P<0.05).*

The present results indicated that supplemental GAP and CUP improved (P<0.05) the averages of ADG of lambs could be related to the increase (P<0.05) in their nutrients digestibility, DCPI, TDNI and nutritive value of DCP and TDN (Table 3). Similar effects of supplemental GAP on ADG were detected in buffalo calves (Duvvu *et al.,* 2018). In the same way, a significant increase in ADG has been reviewed with dietary supplemental GAP in lambs (Badias and Yaniz, 2004) and in crossbred calves (Ghosh *et al.,* (2010) and Balamurugan *et al.*, (2014). Also, Ikyume *et al*., (2017) that garlic powder supplementation up to 1.5% in concentrate diet of goats did not exert any adverse effect on performance.

In the present study, supplemental GAP had beneficial effect to improve productive performance such as ADG, FC-DM, FC-DCP and FC-TDN of lambs (Table, 6). These results were supported by the findings of Duvvu *et al*., (2018) who reported that growth rate and feed conversion efficiency were significantly enhanced (P<0.01) when buffalo calves fed diets supplemented with garlic compared to those fed control. This result may be related to the compound allicin, in garlic, which promotes the performance of the intestinal flora thereby enhancing digestion and improved growth rates (Pourali *et al.,* 2010).

The present study illustrated that the differences in feed intakes of peanut hulls, CFM and TDMI were not significantly differ among lambs fed GAP and CUP compared with control. This result is consistent with similar observations in beef cow or goats fed garlic (Wanapat *et al*., 2013 and Rasoul *et al.,* 2014); and lactating goat fed dietary supplemental cumin (Miri *et al.*, 2013).

Plasma biochemical indicators:

Data presented in Table (7) showed that lambs fed GAP- or CUP-supplemented diets had higher ($P<0.05$) values of plasma total protein (TP) and globulin concentrations *vs.* control. However, albumin concentrations were comparable among the experimental diets. Such increment could be related to a significant improvement noticed in CP digestibility, DCPI and nutritive value of DCP for lambs fed GAP and CUP. This response was also noticed in goats fed diet-supplemented garlic on (Kholif *et al.,* 2012) and Ikyume *et al.,* (2017).

Table (7): Effect of garlic powder (GAP) or cumin powder (CUP) supplementation on plasma biochemical parameters of growing Barki lambs (mean ± SEM).

Parameters	Control	GAP	CUP	SEM
Total protein, g/dl	6.45^{c}	6.83^{b}	7.96^{a}	0.23
Albumin, g/dl	3.13	3.04	3.15	0.03
Globulin, g/dl	3.32^{c}	3.79^{b}	4.81^{a}	0.23
Cholesterol, mg/dl	75.93	75.32	76.00	0.97
Triglycerides, mg/dl	28.10^{b}	30.35^{b}	34.94^{a}	1.12
HDL, mg/dl	35.13^{a}	32.09^{ab}	30.78^{b}	0.78
LDL, mg/dl	41.24^{a}	37.90^{b}	41.60^{a}	0.64
MDA, nmol/ml	4.01^{a}	2.57^{b}	2.63^{b}	0.26
TAC, mM/l	0.84^{b}	1.51^{a}	1.37^{a}	0.11

a, b, c. Means with different superscripts in the same row differ significantly ($P<0.05$).

The differences in plasma cholesterol concentrations, in the current study, were not significantly different between treatments. However, plasma concentrations of HDL were decreased ($P<0.05$) for lambs fed CUP compared with those fed GAP and control. Also, lambs fed GAP and CUP had a lower ($P<0.05$) LDL concentrations compared with those fed control diet. This finding agrees with similar trend of unchanged blood cholesterol concentrations in sheep fed garlic (Adewumi, 2008). In the same way, Foroozandeh and Ghaffari (2015) observed that blood cholesterol was not significantly affected by the supplemental cumin. Data revealed that plasma triglycerides concentrations were increased ($P<0.05$) for lambs fed CUP compared to those fed GAP or control diet. In this respect, Sabry *et al.*, (2017) showed that dietary supplementation of garlic powder proved to have positive effect on growth performance and serum lipid profile. On the other hand, GAP and CUP supplementation decreased ($P<0.05$) MDA concentration compared to control. The decrease in MDA concentrations with dietary supplemental garlic was also detected in rat (Sabry *et al.,* 2017).

The data indicated that plasma TAC concentrations were higher ($P<0.05$) with feeding GAP and CUP than control. In this way, Juhaimi and Ghafoor, (2013) stated that phenolic compounds content of cumin is responsible for improving antioxidant activities. Also, Park *et al.*, (2009) found that garlic and cumin oils led to high antioxidant activity due to phenolic and flavonoids content.

CONCLUSION:

Based on the present results, it could be concluded that dietary supplementation of either garlic or cumin powder at 2 % was significantly effective to improve the nutrients digestibility and productive performance in growing lambs without any adverse effect on their rumen fermentation. These improvements were concomitant with favorable signs in plasma biochemical parameters related to immune and antioxidant status.

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تاثير امداد عليقة الحملان بمسحوق الثوم أوالكمون على معاملات الهضم، قياسات سائل الكرش ومقاييس الدم والنمو

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صممت هذه الدراسة لتقييم تاثير إضافة مسحوق الثوم أوالكمون في علائق الحملان النامية على معاملات الهضم، الاداء الانتاجى، مقاييس سائل الكرش وبعض مؤشرات البلازما البيوكيميائية. تم تقسيم سته عشر حمل برقي (متوسط أعمارهم 5-6 شهور وأوزانهم 27.5 ± 0.9 كجم) إلى ثلاثة مجموعات متساوية (6 حملان في كل منها) في تجربة غذائية لمده 100 يوم. غذيت الحيوانات على عليقة أساسية (كنترول) مضافاً إليها 2 % من مسحوق الثوم أو مسحوق الكمون.

أظهرت النتائج ارتفاع معاملات الهضم الغذائية و القيم الغذائية للبروتين المهضوم و المركبات الغذائية المهضومة (P<0.05) للحملان المغذاه على مسحوق الثوم أو الكمون مقارنة بالحملان المغذاه على الكنترول. زادت أمونيا الكرش (P<0.05) للحملان المغذاه على مسحوق الثوم أو الكمون مقارنة بالحملان المغذاه على الكنترول، بينما تساوت درجة حموضه الكرش والاحماض الدهنية الطياره بين المعاملات. تحسنت قيم ميزان الأزوت ومعدل الاستفاده من النيتروجين (P<0.05) للحملان المغذاه على مسحوق الثوم مقارنة بتلك المغذاه على مسحوق الكمون أو الكنترول. ارتفع معدل الزيادة اليومية فى الوزن و معدلات التحويل الغذائي (P<0.05) للحملان المغذاه على مسحوق الثوم أو الكمون مقارنة بالحملان المغذاه على الكنترول. تساوي المأكول من الجافه بين المعاملات. لم يلاحظ أي فروق معنوية في تركيزات البلازما من الألبيومين والكوليستيرول بين المعاملات بينما ارتفعت (P<0.05) تركيزات البلازما من البروتين الكلي، الجلوبيولين و القدره الكلية المضاده للأكسده للحملان المغذاه على مسحوق الثوم أو الكمون مقارنة بالحملان المغذاه على الكنترول. انخفض تركيز المالونالدهيد (MDA) معنوياً للحملان المغذاه على مسحوق الثوم أو الكمون مقارنة بالحملان المغذاه على الكنترول. كان هناك انخفاض (P<0.05) في تركيز الكوليستيرول من النوع HDL مع التغذية على مسحوق الكمون وانخفاض معنوي في تركيز الكوليستيرول من النوع LDL مع التغذية على مسحوق الثوم مقارنه بالتغذية على العليقة الكنترول.

أظهرت نتائج هذه الدراسه أن الإمداد الغذائي سواء بمسحوق الثوم أو مسحوق الكمون بمعدل 2 % أدى إلى تحسين معنوي في معاملات الهضم والأداء الإنتاجي للحملان النامية دون أي تأثيرات سلبية على تخمرات الكرش كما حسنً الحالة المناعة بزيادة مضادات الأكسده.