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Productive Performance and Blood Parameters of Local Lactating Ewes Fed Rations Supplemented with Different Forms of Garlic

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Abstract

THIS study evaluated the impact of dietary supplementation for garlic juice (GJ) or garlic oil macerate (GOM) on feed intake, milk production and composition, rumen properties and blood attributes of local lactating ewes. Twelve lactating ewes (average weight 35.84 ± 5.3 kg) were divided into three equal experimental groups. The first group was fed a total mixed ration (TMR) without garlic supplementation (control group, C), and the other groups were fed TMR supplemented with 200 mg GJ or GOM for 60 d experimental period. The results indicated that feed intake (FI) was not affected by garlic forms supplementation, significantly decreased rumen NH_3-N and increased rumen VFAs. Moreover, supplemented garlic in the two forms numerically increased rumen microbiota (anaerobic bacteria), and the highest ($P<0.05$) value was observed with supplemented GOM compared to the C ration. Supplemented GJ or GOM had beneficial effects on milk yield, composition and its fatty acids profile, while the better effect was recorded with GOM supplementation. On the other hand, blood constituents of ewes were in the reference values. The supplemented garlic products significantly decreased glucose, cholesterol, and triglyceride concentrations. In conclusion, rations of GJ or GOM have advantageous effects on lactating ewes' milk yield and its fatty acids profile, and the best influence was noticed with GOM.

Keywords: Lactating Ewes, Garlic Juice, Garlic Oil Macerate, Milk Yield and Compositions.

Introduction

Garlic (*Allium sativum L.*) follows the family Alliaceae (Allium group) and is one of the most important medicinal herbs, it has therapeutic activities related to its content of bioactive compounds such as allicin, diallyl sulfide (DAS), diallyl disulfide (DADS), diallyl trisulfide (DATS) and Allyl mercaptan (AM) [1]. The plant is widely distributed in North America, Europe, Asia, and North Africa, and the major garlic-growing countries are China, India, the Korean Republic, Spain, Egypt, and the U.S.A. [2,3]. Garlic products can be categorized as garlic powder, garlic juice, garlic essential oil, garlic oil macerate, and garlic extract [4] and they include bioactive compounds, such as phenolic compounds, saponins, polysaccharides, and organosulfur compounds (OSCs) [5]. Organosulfur compounds are phytochemical compounds that may protect from oxidative stress and hyper-inflammation [6]. The chemical compounds of garlic products depend on the duration and temperature of drying, the extraction solvents, the period of maceration before extraction, and the enzyme alliinase activity garlic allows alliinase to interact with alliin to form allicin which is the main active component responsible for the antimicrobial activity of garlic juice and macerate garlic oil. Garlic is the cheapest way to prevent fungal and bacterial infection. The OSCs in garlic juice content as determined by Yu and Wu [7] were made up of allicin, garlicin, Vinyldithiins, and allitridin, while in garlic oil macerate were (E/Z)-ajoene, allicin, allitridin, and Vinyldithiins as determined by Brace [8]. Bioactive compounds included in Garlic juice and oil macerate make them an alternative to synthetic antibiotics meanwhile have antioxidant effect [9]. Oil macerate is obtained through the process of maceration and

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extracting plant in a solvent (alcohol, oil, water), and this process can take one hour to a few weeks but it can't be used to extract all active substances. This oil macerate produced contains all fat-soluble substances present in the plant material, including fatty acids, essential oils, vitamins D, E, K, and A, and waxes [10]. Therefore, it is a great challenge to make a proper use of garlic and its useful effects, accordingly this study was designed to estimate dietary garlic either juice or oil macerate supplementation on the milk production and health state of lactating ewes.

Materials and Methods

Location of the study and garlic products preparation

This study was carried out at the Farm of Faculty of Agriculture, Al Azhar University, Cairo, Egypt. The garlic juice and garlic oil macerate were obtained from Pharmaceutical Research Division, National research Centre, Egypt.

The garlic juice was prepared according to Kekana et al. [11]. The peeled garlic cloves were washed and blended with a Waring Blender® for one minute, then the floating debris was removed from the extract through a strainer, and finally, the filtered garlic juice was through a nylon cloth to separate the remaining pulp to obtain the pure juice. Garlic oil Macerate was prepared according to Brace [8] by incubating crushed whole garlic cloves into vegetable oil at room temperature.

Experimental animals and design

Twelve healthy lactating ewes in their first lactation season were slotted into three groups one-week post-partum. The ewes were fed in group feeding protocol twice daily (08:00 and 17:00 h.) with free access to water for the two-month lactation period. The basal ration as total mixed ration (TMR) has formulated to meet the requirements of lactating ewes according to NRC [13], was consisted of 40 % alfalfa hay, 25 % yellow corn, 10 % soybean meal, 15 % wheat bran, 6 % sunflower meal, 1.5 % limestone, 0.5 % salt and 1.7 % vitamins and minerals. Chemical composition of TMR (**Table 1**) was analysed according to AOAC (2005) for dry matter (DM), Crude fiber (CF), ash, crude protein (CP) and ether extract (EE). Organic matter and nitrogen free extract (NFE) were calculated by difference. Feed intake (FI) was calculated as the difference between the amount of ration offered and refused as dry matter. Ewes were grouped according to their average weight (35.84 ± 5.3 kg) in the three treatment groups (4 ewes in each group). The first group was fed the basal ration as control (C), and other two groups with garlic juice (GJ) or garlic oil macerate (GOM) supplementation at the rate of 200 mg per animal per day(**Table 1**).

Milk yield, composition and fatty acids profile

Daily milk was hand collected at 08:00 and 20:00 h., and the yield recorded twice weekly applying kids suckling technique during experimental period. Ten days later, 10% of each milking were taken and mixed for milk composition analysis (total solids, fat, protein and lactose) using infrared spectrophotometry (Lactostar Dairy Analyzer-Funke Gerber-Berlin-Germany). The ash content was calculated after burning at 550 ^{o}C in the muffle for 16 hours and solids not fat were calculated by the difference between total solids and fat. The fatty acids profile was analysed by gas chromatograph according to Cocks & Van Rede [14].

Rumen liquor

Rumen liquor samples were taken at the end of the trial, four hours post-feeding by a stomach tube, filtered through two layers of cheesecloth, and pH values were directly recorded using a pH meter (HI98127 pHep 4 pH/Temperature Tester, Hanna Instruments, Villafranca Padovano PD, Italy). Rumen liquor was used to determine the concentration of ammonia nitrogen (NH_3-N] according to Preston [15], volatile fatty acids (VFA's) according to Warner [16] and fatty acids molar proportions by gas chromatography according to Erwin et al. [17]. The anaerobic bacteria count was determined according to NMKL [18].

Blood parameters

At the end of the feeding trial, blood samples (5 ml) were collected via venipuncture of each animal, centrifuged at 4000 r.p.m. for 20 minutes, and separated plasma was kept under -20 °C until assay for urea, total protein (TP), glucose, cholesterol, aspartate aminotransferase (AST), alanine aminotransferase (ALT), phospholipids, triglyceride and alkaline phosphatase using commercial kits (Bio diagnostic, Egypt).

Statistical analysis

Data of all parameters were statically analysed using SPSS [19] software program. Significant differences among means were separated at 5% level of probability by using Duncan's multiple range test [20].

Data were subjected to ANOVA according to the following mathematical model:

$Yij = \mu + Ti + Eij$

Where Yij= observation, μ = Overall mean, Ti= effect of garlic form supplementation, Eij = Error term.

Results

Feed intake, milk yield and milk composition

As shown in Table (2), the result of FI was approximately similar among the experimental groups. Milk yield for lactating ewes fed rations with different forms of garlic supplementation increased milk yield, and the highest yield ($P<0.05$) was

recorded with GOM compared to other groups. Dietary GOM decreased (P<0.05) the total solid, lactose and solids not fat compared to other rations, while dietary GJ didn't affect these values compared to control group, and it significantly increased (P<0.05) milk fat compared to other groups. Furthermore, the GJ or GOM supplementation decreased (P<0.05) milk ash compared to control group by 34.21 and 64.74 % respectively, and the lowest value recorded with GOM.

Milk fatty acid profile

The Table (3) revealed non-significant differences in butyric (C4:0) and lauric (C12:0) acids among the experimental groups, however, it tended to be higher in GJ or GOM groups compared to the control one. Compared to ewes fed C ration, caproic (C6:0) and capric (C10:0) acids concentrations increased (P<0.05) in GOM and increased numerically in GJ group. The highest (P<0.05) caprylic (C8:0) and palmitic (C16:0) concentrations were in GJ-supplemented group, meanwhile GOM didn't affect caprylic concentration compared to C group and the lowest concentration (P<0.05) of palmitic acid was in C group compared to other groups. The supplementation of GOM increased (P<0.05) myristic acid (C14:0) without significant differences between groups fed C or GJ rations, while, the GJ supplementation increased (P<0.05) oleic acid (C18:1, ω-3) and arachidonic acid (C20:4, ω-6) compared to the other groups. On the other hand, GJ or GOM supplementation decreased the concentration of stearic (C18:0) acid compared to the C group.

Rumen liquor parameters

Non- significant difference was observed in the pH value of rumen liquor for ewes fed GJ or GOM compared to C group (6.65), while GOM significantly decreased pH compared to GJ group being 6.53 and 6.74 respectively (Table 4).

Compared to the control ration, ewes supplemented with GJ or GOM significantly (P<0.05) revealed decreased NH_3-N by 14.54 and 21.724 % and increased VFA's by 10.87 and 15 %, respectively. Moreover, supplemented GJ or GOM significantly (P<0.05) enhanced rumen acetic, propionic and butyric acids and decreased acetic to propionic ratio compared to the basal ration. Different garlic forms supplementation increased (P≤0.05) anaerobic bacteria with GOM compared to C by 35.49 %, and non-significantly between C and GJ and between GJ and GOM groups.

Blood parameters

Results of Table (5) exposed the blood constituents of lactating ewes fed different forms of garlic. Garlic supplementation didn't affect blood urea concentration, increased (P<0.05) the concentrations of blood TP, and activities of ALT and AST. While, it decreased (P<0.05) blood cholesterol and triglyceride concentrations of ewes compared to those fed basal ration. The lowest cholesterol and triglyceride concentrations were recorded in animals fed ration with GOM followed by GJ supplementation. Compared to the control group, GOM increased (P<0.05) blood phospholipids and alkaline phosphatase concentrations, but GJ didn't affect phospholipids and decreased (P<0.05) alkaline phosphatase.

Discussion

Feed intake, Milk yield and composition

The non-significant effect of supplemented garlic in FI was agreed with Balamurugan et al. [21], Jagota et al. [22] and Khurana et al. [23]. Moreover, these results were agreed with Lad et al. [24] who demonstrated that a dietary supplement of garlic powder at a rate of 200 mg/ kg live weight didn't affect daily FI. Chouhan et al. [25] recorded similar results, that dietary supplement of 250 mg garlic powder didn't affect FI of goat kids.

Milk is beneficial for human health that contains several important nutrients that are affected by feed additives such as essential oils included in garlic. Increasing milk yield with both GJ or GOM supplementation was agreed with Khurana et al. [26] who demonstrated that the combination supplementation of garlic and citrus extracts in dairy cows' rations improved milk yield and significantly protein and fat yield and revealed this positive response to the presence of garlic extract which enhanced rumen fermentation. Similarly, garlic ration increased milk yield of Holstein dairy cows by 7.8 % [27]. The potential effect of GJ or GOM for increasing the production of VFA's was attributed to enhance the supply of metabolizable energy resulting in increased milk yield. Furthermore, bioactive compounds (OSCs and flavonoids) included in GJ or GOM have antioxidant, antimicrobial and immunomodulatory activities that could be improve animal health and productivity [28,29].

Milk fatty acids profile

Milk fatty acids (FAs) profile in lactating ewes supplemented with GJ or GOM refer to the active components of lipids which have high nutritional value and effect on the sensory, production and physicochemical properties of the dairy products [29]. Moreover, the essential FAs as linoleic acid (LA, C18:2, ω-6) and α-linolenic acid (ALA, C18:3, ω-3), cannot be synthesized by humans [30] and LA is required for arachidonic acid synthesis (ω-6) [31], that means increasing arachidonic acid with garlic supplementation indicates to the presence of LA. Increasing oleic acid (ω-3 FAs) in the milk with garlic supplementation enhances the quality of milk consumed by suckling lambs or by humans that oleic acid as a monounsaturated fatty acid decreases the

resistance to oxidative stress, increases glucose sensitivity and has a protective role in the nervous systems and cardiovascular by promoting the energy metabolism of mitochondria [32]. The nutritive value of milk is determined by its FAs profile [33], the essential FAs are linoleic acid (LA, C18:2, ω-6) and α-linolenic acid (ALA, C18:3, ω-3), humans cannot be synthesizing these FAs [30] and LA is required for arachidonic acid synthesis (ω-6) [31]. This means that increasing arachidonic acid with GJ or GOM supplementation indicates to the presence of LA. Moreover, dietary garlic supplementation recorded significantly higher levels of short- and medium-chain FAs (C6:0; C8:0; C10:0; and C12:0) which are associated with cheese flavors characteristic [34].

Rumen fermentation

The reduction of pH value in the GOM – supplemented group is attributed to the high concentration of acetate; however, it remains within the reference values [35]. In ruminant, the most important part for digestion is the rumen which provides the environment for rumen microbiota to live and ferment feed materials and the end product of rumen fermentation is VFA's which represents the main source of energy for ruminants and regulates rumen physiological functions [36]. Herin, the increase of total VFAs, may be attributed to the rumen microbiota diversification. Therefore, the beneficial effect of GJ or GOM groups appeared to modify rumen fermentation and increase total VFA's which related to the high degradation of carbohydrate and fiber [37]. The results of rumen parameters in this study agreed with Ma et al. [38] who found a reduction in rumen NH_3-N and increase VFA's with crossbred ewes fed a ration with daily allicin supplementation 2 g/head. Also, decreasing rumen NH_3-N indicates the high synthesis of rumen microbial protein [39]. Increasing rumen propionate with GOM ration may enhancing the supply of energy to the animal where propionate is considered the primary substrate for hepatic gluconeogenesis, which supplies ruminants by 25 to 60 % of their total energy requirements. It is worthy to mention that the pathway of propionate is a hydrogen consumer, which reduces methane synthesis and enhances the efficiency of feed utilization in the ruminants [40].

A tendency for increasing propionate concentration and reducing acetate-to-propionate ratio with garlic supplementation were similar to those observed when garlic extract was supplemented to a feedlot dairy cow [23] and with dairy cows fed a flavonoid-rich vegetable and fruit juice [41]. Also, the results were agreed with found by Castillo-Lopez et al. [42] when cattle fed a ration supplemented with garlic oil. In agreement with the current study, Kekana et al. [11] reported that the supplementation of garlic juice at 0.5 mL/100 ml rumen liquor of lactating cows in *in vitro* study increased VFA's and propionate production, and reduced the acetate to propionate ratio.

Increasing rumen anaerobic microbiota with GOM may be attributed to that garlic and its products are rich in OSCs, which have a variety of biological activities and have been widely used as natural additives in animal production and used as an alternative to antibiotics [40]. These results agreed with Ma et al. [38] and Khurana et al. [23] who demonstrated that dietary supplementation with secondary compounds of garlic bulbs modified rumen fermentation and microbiota of ewes and dairy cows.

Blood constituents

Blood parameters are an index of the nutritional, pathological and physiological status of animals and a slight change in these values could be used to the interpret metabolic state and the animal's health when compared to the normal values [43,44]. The current results were agreed with Canbolat et al. [35] who confirmed that garlic oil had reduced the levels of cholesterol, glucose and triglyceride as found currently with GJ and GOM supplementation. The results are also were agreed with Duvvu et al. [43], Ahmed and Al-Hamdani [45] and Taleb et al. [46] who observed that dietary supplemented of garlic powder or garlic extract to calves, fish or Quail, significantly improved serum TP and decreased serum glucose and cholesterol values. The increase in the TP level may be attributed to the OSCs presented in GJ or GOM [40] and their hepato-protective action [47]. This might be due to that garlic and its products have hypocholesterolaemia action which is revealed by inhibition of the hepatic activities of cholesterogenic and lipogenic enzymes [48] in animals which help to decrease the development of their cardiovascular diseases.

Conclusion

The garlic juice or garlic oil macerate supplementation improve growth performance and are able to affect rumen microbiota, leading to change the pattern of rumen fermentation, enhancing quality and quantity of milk yield and finally improving the health of animals.

Ethical approvals

The Medical Research Ethics Committee, National Research Centre, Egypt approved the experimental research, in accordance with Egyptian laws, Helsinki Declaration, GCP and GLP guidelines, IACUC guidelines, and WHO rules, granting final ethical approval No. 07441223.

Authors contribution

FISH designed the work and assisted in performing the experiments, RS assisted in performing the experiments. SE assisted in chemical analysis, did the statistical analysis, drafted and

wrote the manuscript and finally revised the manuscript. All authors read and approved the final manuscript.

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Conflict of interest

The authors declare that they have no conflict of interest.

TABLE 1. Chemical composition of total mixed ration

Item	%
Dry matter	90.0
Organic matter	89.0
Crude protein	15.4
Crude fiber	22.2
Ether extract	2.8
Ash	11.0
Nitrogen free extract	48.6

TABLE 2. Feed intake, body weight, Milk yield and its composition of lactating ewes supplemented with different garlic forms

Items	Experimental rations				
	C	GJ	GOM	±SEM	P value
Feed intake as DM (kg/ewe/d)	1.32	1.38	1.29	-	-
Live body weight (kg)	38.50	36.38	32.63	1.53	0.308
Daily milk yield (g)	938.25^{b}	1008.50^{b}	1330.75^{a}	59.61	0.002
Milk composition (%)					
Total solids	20.36^{a}	21.06^{a}	18.58^{b}	0.39	0.008
Fat	6.32^{b}	7.28^{a}	6.40^{b}	0.14	0.000
Protein	6.85^{b}	6.96^{b}	7.76^{a}	0.13	0.000
Lactose	5.49^{a}	5.68^{a}	5.10^{b}	0.09	0.009
Solids not fat	14.05^{a}	13.78^{a}	12.18^{b}	0.34	0.035
Ash	1.90^{a}	1.25^{b}	0.67^{c}	0.15	0.000

$^{a, b, c}$ Means with different superscripts indicate the significant difference (P≤0.05). abbreviation: DM, dry matter; C, basal ration; GJ, C ration + 200 ppm garlic juice; GOM, C ration + 200 ppm garlic oil macerate; SEM, standard error of mean; P value, probability value at <0.05.

TABLE 3. Effect of experimental ratios on milk fatty acids percentage of milk

Fatty acids (%)	Experimental rations				
	C	GJ	GOM	±SEM	P value
Butyric (C4:0)	3.83	4.04	4.18	0.09	0.281
Caproic (C6:0)	1.70^{b}	2.07^{ab}	2.50^{a}	0.14	0.057
Caprylic (C8:0)	1.57^{b}	1.90^{a}	1.58^{b}	0.07	0.067
Capric (C10:0)	3.02^{b}	3.38^{ab}	3.75^{a}	0.12	0.016
Lauric (C12:0)	6.15	6.28	6.75	0.13	0.110
Myristic (C14:0)	13.86^{b}	14.00^{b}	16.04^{a}	0.31	0.000
Palmitic (C16:0)	25.46^{c}	27.15^{a}	26.20^{b}	0.23	0.000
Stearic (C18:0)	11.08^{a}	10.01^{b}	10.22^{b}	0.19	0.036
Oleic (C18:1, ω-3)	28.14^{b}	30.73^{a}	30.46^{a}	0.47	0.025
Arachidonic (C20:4, ω-6)	1.49^{b}	2.00^{a}	2.03^{a}	0.10	0.017

$^{a, b, c}$ Means with different superscripts indicate the significant difference (P≤0.05). Abbreviation: C, basal ration; GJ, C ration with 200 ppm garlic juice; GOM, C ration with 200 ppm garlic oil macerate; SEM, standard error of mean; P value, probability value at <0.05.

TABLE 4. Effect of garlic supplementation on Rumen liquor (RL) parameters of lactating ewes

Items	Experimental rations				
	C	GJ	GOM	±SEM	P value
pH	6.65[ab]	6.74[a]	6.53[b]	0.04	0.012
NH_3-N (mg/100 ml)	43.18[a]	36.90[b]	33.80[b]	3.09	0.000
Total VFA's (meq/ 100 ml)	10.67[b]	11.83[a]	12.27[a]	0.27	0.013
Acetate (meq/ 100 ml)	61.26[c]	64.25[b]	66.30[a]	0.75	0.000
Propionate (meq/ 100 ml)	26.03[c]	28.00[b]	30.62[a]	0.53	0.003
Butyrate (meq/ 100 ml)	10.68[c]	12.14[b]	14.11[a]	0.72	0.001
Acetate: propionate ratio	2.36[a]	2.29[ab]	2.17[c]	0.04	0.078
Anaerobic bacteria, log (CFU/g)	15.17[b]	18.00[ab]	20.00[a]	0.89	0.014

[a, b, c] Means with different superscripts indicate the significant difference (P≤0.05). Abbreviation: meq, milliequivalent; CFU, colony forming unit; RL, rumen liquor; NH_3-N, ammonia nitrogen; VFA's, volatile fatty acids; C, basal ration; GJ, C ration + 200 ppm garlic juice; GOM, C ration + 200 ppm garlic oil macerate; P value, probability value at <0.05; SEM, standard error of mean.

TABLE 5. Blood parameters of lactating ewes fed experimental rations

Items	Experimental rations				
	C	GJ	GOM	±SEM	P value
Urea (mg/dl)	69.81	71.26	68.94	0.76	0.496
Total protein (g/dl)	7.58[b]	8.67[a]	8.56[a]	0.18	0.005
Glucose (mg/dl)	61.63[a]	45.69[b]	58.28[a]	2.21	0.000
Cholesterol (mg/dl)	83.68[a]	67.37[b]	49.90[c]	4.21	0.000
ALT, (IU/L)	8.57[b]	7.58[a]	8.08[a]	0.16	0.020
AST (IU/L)	55.65[b]	78.10[a]	81.95[a]	3.86	0.000
Phospholipids (mg/dl)	66.89[b]	67.44[b]	72.56[a]	0.93	0.006
Triglyceride (mg/dl)	32.49[a]	25.80[c]	28.50[b]	0.89	0.000
Alkaline phosphatase, (mg/dl)	29.71[b]	26.55[c]	32.74[a]	0.84	0.000

[a, b, c] Means with different superscripts indicate the significant difference (P<0.05). Abbreviation: C, basal ration; GJ, C ration with 200 ppm garlic juice; GOM, C ration with 200 ppm garlic oil macerate; SEM, standard error of mean; P value, probability value at <0.05.

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الأداء الإنتاجي ومقاييس الدم للنعاج المحلية المغذاة على علائق مدعمة بأشكال مختلفة من الثوم

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الملخص

الهدف من هذه الدراسة هو تقييم تأثير المكملات الغذائية لعصير الثوم (GJ) أو زيت الثوم المنقوع (GOM) على أداء النعاج الحلاب المحلية، وذلك من خلال قياس الإنتاج الكلي من الحليب، مكونات اللبن، خصائص الكرش ومقاييس الدم. تم تقسيم 12 نعجة حلابة (متوسط الوزن 35.84 ± 3 كجم) إلى ثلاث مجموعات تجريبية (4 نعاج لكل مجموعة)، المجموعة الأولى غذيت علي العليقة الكاملة (TMR) بدون إضافة (مجموعة الكنترول، C)، بينما غذيت المجموعات الأخرى على TMR مع إضافة 200 ملجم من عصير الثوم أو زيت الثوم المنقوع يوميا لكل نعجة وذلك لمدة 60 يوم. اشارت النتائج الي عدم تأثر المأكول اليومي (FI) بالمعاملات التجريبية. بينما كان هناك اختلافات ملحوظة في مقاييس سائل الكرش حيث انخفض انتاج الأمونيا نيتروجين وارتفعت الأحماض الدهنية الطيارة. وفي الوقت نفسه، أدى إضافة الثوم في كلا الشكلين إلى زيادة ميكروبيتا الكرش (البكتيريا اللاهوائية)، وكانت أعلى قيمة ($P<0.05$) مع إضافة GOM مقارنة بالعليقة الكنترول. كان لإضافة GJ أو GOM تأثيرات ايجابية على إنتاج الحليب وتركيبه وكذلك محتواه من الأحماض الدهنية، حيث تم تسجيل أعلى تأثير مع إضافة GOM. و من ناحية أخرى، كانت مكونات الدم في النعاج ضمن المعدل الطبيعي، كما أدت إضافة منتجات الثوم إلى انخفاض ملحوظ في مستويات الجلوكوز والكوليسترول والدهون الثلاثية في الدم.

نستنتج من ذلك أن العلائق المدعمة بعصير الثوم أو زيت الثوم المنقوع لها تأثيرات إيجابية على صحة النعاج الحلابة المحلية وبالتالي كميات الحليب المنتجة وكذلك محتواها من الأحماض الدهنية وقد تم تسجيل أفضل تأثير باستخدام زيت الثوم المنقوع.

الكلمات الدالة: النعاج الحلابة، عصير الثوم، زيت الثوم المنقوع، انتاج الحليب وتركيبه.