

Effect of Dietary Onion, Garlic and Fenugreek Seeds Powder on Feed Intake, Blood Metabolites and Rumen Fermentation in Ossimi Ewes

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Abstract

This study was carried out to evaluate the effect of onion, garlic, fenugreek seeds as feed additives on feed intake, some blood plasma constituents and ruminal fermentation of ossimi ewes. Twenty pregnant ossimi ewes on day 90 \pm 7 of pregnancy, were randomly divided into four similar groups (5 animals each). Control group (T1) was fed the basal diet which consisted of 60 % concentrate feed mixture (44% yellow corn, 20% soybean meal, 20% wheat bran, 13% undecorticated cottonseeds meal, 2% lime stone and 1% salt) and 40 % roughages (20% wheat straw and 20% chopped alfalfa hay). While, the other three treatment groups were fed the same basal diet, supplemented with either 3% onion powder (T2), 3% garlic powder (T3) or 3% fenugreek seeds powder (T4) the rations (concentrate + roughages) were fed ad libitum. Feed intake was recorded daily. Blood samples were collected from the jugular vein from all animals before morning feeding. Rumen samples were collected from all ewes using a stomach tube to determine ruminal pH values, ammonia-N concentration and total VFA s concentration.

Feed intake increased ($P < 0.05$) during the late pregnancy of ewes fed onion, garlic and fenugreek seeds. While, after parturition feed intake was not significantly differ among groups except for that of onion and garlic groups at the first month of lactation, which was significantly ($P < 0.05$) increased as compared with control. Plasma total protein and albumin levels increased ($P < 0.05$) in treated groups as compared with control, while there were no significant differences in plasma globulin, albumin: globulin ratio, triglycerides and glucose between treated groups and control one. Plasma cholesterol concentration decreased ($P < 0.05$) in ewes fed garlic as compared with those fed control, onion and fenugreek diets. Also, plasma cholesterol concentration of ewes fed onion decreased ($P < 0.05$) as compared with fed control and fenugreek diets. There were no significant differences among groups in rumen pH values at zero h of feeding or 6 hrs after feeding. Ruminal ammonia-N concentration decreased ($P < 0.05$) in all treated groups as compared with control. Also, total volatile fatty acids concentration in rumen liquor increased ($P < 0.05$) in all treated groups as compared with control one. In conclusion onion, garlic or fenugreek seeds as feed additives may have a beneficial effect on feed intake, blood metabolites and rumen fermentation of ossimi ewes.

Keywords: onion, garlic, fenugreek, ewes.

1- Introduction

Medicinal plants were used for various purposes such as traditional medicine, industrial applications and food preservatives. In the last two decades substantial increase in use of herbs and their products not only as herbal medicinal products, but also as feed additives. Herbs and spices could be used in animal nutrition, to replace the use of antibiotics (after the ban of antibiotics in 2006). Medicinal plants contain various chemical substances such as polyphenols, quinines, flavonols /flavonoids, alkaloids, polypeptides or their oxygen-substituted derivatives (Cowan, 1999 and Negi, 2012). For example onion (*Allium cepa*) is the most widely cultivated *Allium* contains a heart stimulant, increases pulse volume and frequency of systolic pressure and coronary flow. Onion consumption lowers blood sugar, lipids and cholesterol (Mittal *et al.*, 1974). Garlic (*Allium sativum*) is the second most widely cultivated *Allium* after onion. Garlic oil contains several compounds, including sulfur compounds (thiosulfonates, allyl sulfides, glutamylcysteines, allicin), enzymes, free amino acids, sterols, steroids, triterpenoid glycosides, flavonoids, phenols and organoselenium compounds (Reuter and Sendl, 1994). Also, it has biological activities such as cholesterol lowering properties as reported by numerous studies (Reuter and Sendl, 1994 and Adler and Holub, 1997) as well as, significant lowering blood pressure (Silagy and Neil, 1994).

Fenugreek (*Trigonella foenum-graecum*) is such an herb and a member of the legume family, found in India, Middle East, North Africa and

South Europe. It is used as a natural herbal medicine to promote lactation in lactating women. It has also been shown to have a positive effect on lactation performance in ruminants such as dairy cows, water buffaloes and dairy goats (Kholif & El-Gawad, 2001).

Therefore the objective of this trail was to evaluate the effect of onion, garlic, fenugreek seeds as feed additives on feed intake, some blood plasma metabolites and ruminal fermentation parameters of ossimi ewes.

2- Material and Methods

2-1- Animals and rations

This study was conducted at the research farm of Animal Production Department, Faculty of Agriculture, Al-Azhar University, Assiut, Egypt, during the period from 2014 to 2016. Twenty pregnant Ossimi ewes on day 90 \pm 7 of pregnancy till four months after parturition, with an average live body weight of 52.50 \pm 2.5 kg and 14-18 months old. Animals were randomly divided into four similar groups (5 animals each). The control ration (T1) consisted of 60 % concentrate feed mixture (CFM) and 40% roughages. Concentrate feed mixture (CFM) (consisted of 44% yellow corn, 20% soybean meal, 20% wheat bran, 13% undecorticated cottonseeds meal, 2% lime stone and 1% salt) and roughages (consisted of 20% wheat straw and 20% chopped alfalfa hay). The treated rations were the same control ration plus 3% of either onion powder (T2), garlic powder (T3) or fenugreek seeds (T4). The ewes were fed ad libitum and the daily rations were offered two times /day on 9 am and 2 pm. Residuals (if found) were

recorded every day for daily feed intake calculation. Feed ingredient samples were analyzed for dry matter, ash, crude protein, crude fiber and

ether extract according to methods of AOAC (1990). The chemical composition of the ingredients is shown in Table (1).

Table 1. Chemical composition of control and supplemented rations fed to ewes

Feed nutrients	Treatments*			
	Control (T1)	Onion (T2)	Garlic (T3)	Fenugreek (T4)
Dry matter	92.58	92.58	92.58	92.58
Organic matter	86.78	86.78	86.78	86.78
Ash	5.80	5.80	5.80	5.80
Crude protein	13.90	14.10	14.10	14.10
Crude fiber	19.74	19.74	19.74	19.85
Ether extract	2.71	2.71	2.71	2.71
NFE	50.42	50.22	50.22	50.21

*Control=control ration, consisted of 60% and 40 % roughages; Onion = control ration supplemented with 3% onion powder, Garlic =control ration supplemented with 3% Garlic powder and Fenugreek = control ration supplemented with 3% fenugreek seeds powder.

2-2- Sampling and Analysis of Blood Plasma

Blood samples were collected from the jugular vein from all animals before morning feeding. Blood samples were directly collected into clean dried glass culture tubes with EDTA (Ethylene Diamine Tetra Acetic Acid) which work as anticoagulant then centrifuged at 4000 r.p.m. for 20 minutes; blood plasma was then separated into a clean dried glass vial and stored at -18°C till chemical analysis. Spectro-photometric determination of plasma total protein, albumin, cholesterol, triglycerides and glucose were done according to the methods described by Cannon (1974), Beng and Lim, (1973), Burtis *et al.*, (2006), Scheleter and Nussel (1975) and Howanitz and Howantiz (1984) respectively. Globulin concentrations (g/dl) were calculated by the subtraction of Albumin from Total protein.

2-3- Rumen liquor

Rumen samples were collected from ewes using a stomach tube.

Samples were taken three times monthly after parturition before morning feeding and 6 hrs after feeding. Rumen liquor samples were filtrated through 3 layers of cheese cloth. Rumen pH values were immediately determined after collection of rumen liquor using digital pH meter (Beckman, model 45, USA). Strained rumen liquor was stored in glass bottles (100 ml) with few drops of toluene and paraffin oil just to cover the surface and stored at a deep freeze (-18°C) till chemical analysis. Ruminant ammonia-N concentration was determined according to Konitzer and Voigt (1963) and total VFA s concentration was determined according to Warner (1964).

2-4- Statistical Analysis

The experimental design followed was complete randomized design. Data were statistically analyzed using general linear model (G.L.M) procedure of S.A.S (2002). For blood parameters, the following model was used $Y_{ij} = \mu + T_i + E_{ij}$

Where, Y_{ij} = experimental observation, μ = general mean, T_i = the effect of treatment, $i = T_1, T_2, T_3$ and T_4 and E_{ij} = the errors related to individual observation.

Feed intake and rumen liquor parameters data were analyzed according to the following statistical model.

$$Y_{ijk} = \mu + T_i + B_j + (TB)_{ij} + E_{ijk}$$

Where, Y_{ijk} = experimental observations, μ = general mean, T_i = the effect of treatment, $i = T_1, T_2, T_3$ and T_4 , B_j = the effect of time rumen liquor and milk sampling, $(TB)_{ij}$ = interaction between time and treatments and E_{ijk} = the errors related to individual observation. Significant differences were determined by Duncan's Multiple Range test (Duncan, 1995).

3- Results and Discussion

3-1- Feed intake

Results of feed intake are presented in two different stages (Table 2). The first one is the last two months of the pregnant period (the fourth and fifth months) at which feed intake increased significantly ($P < 0.05$) in onion, garlic and fenugreek groups as compared with control one. In the fourth month of pregnant the increase in feed intake was 7.63, 6.25 and 5.55 % for onion, garlic and fenugreek respectively while, the corresponding values for fifth month were 8.74, 7.11 and 7.79%. While, after parturition (the second period) feed intake did not show any change due to treatments except for the first month in which feed intake was significantly ($P < 0.05$) increased in onion and garlic as compared with control but the differences among treated groups (onion, garlic and

fenugreek) were not significant. In the first month the rate of increase was 5.57%, 4.93 % and 2.75% in onion, garlic and fenugreek respectively.

These results are in harmony with the results obtained by Abo El-Nor *et al.* (2007) who found that fenugreek seeds and lepidium sativum increase ($P < 0.05$) feed intake in pregnant buffaloes. Also, Lin *et al.* (2013) who found that dry matter intake of roughage increase significantly ($P < 0.05$) by adding essential oils to sheep ration. As well as, Kholif *et al.* (2012) who studied the effect of garlic, cinnamon and ginger oils on the performance of dairy goats and found that dry matter intake was increased in treated groups. The increase of feed intake in onion and garlic groups may be due to that aromatic plants (onion and garlic) contain various chemical substances which improve the nutrients palatability (Kholif *et al.*, 2012 and Hassan and Abdel-Raheem, 2013) While, the increase in feed intake in fenugreek might be partially due to the presence of saponins in fenugreek seeds which increase food consumption and also, fenugreek seeds had an effect on hypothalamus to stimulate hunger center in the brain and increase the desire for eating (Petit *et al.*, 1993).

In contrast to current results some authors found no effect of using garlic on sheep feed intake Klevenhusen *et al.* (2011) and lactating goats Mirzaei *et al.* (2011). This disagreement may be due to differences in type of diets or to the different in dose of garlic.

Table 2. Effect of onion, garlic, fenugreek seeds as feed additives on feed intake by ewes (kg/day)

Physiological stage	Periods	Treatments*			
	(month)	Control (T1)	Onion (T2)	Garlic (T3)	Fenugreek (T4)
Pregnant	4 th	1.440 ± 0.006 ^b	1.550 ± 0.021 ^a	1.530 ± 0.012 ^a	1.520 ± 0.017 ^a
	5 th	1.475 ± 0.003 ^b	1.600 ± 0.029 ^a	1.580 ± 0.003 ^a	1.590 ± 0.009 ^b
Lactation	1 st	1.560 ± 0.023 ^b	1.647 ± 0.026 ^a	1.637 ± 0.035 ^a	1.603 ± 0.020 ^{ab}
	2 nd	1.503 ± 0.089	1.567 ± 0.044	1.537 ± 0.015	1.550 ± 0.029
	3 rd	1.473 ± 0.068	1.510 ± 0.038	1.460 ± 0.006	1.490 ± 0.023
	4 th	1.488 ± 0.009	1.520 ± 0.055	1.475 ± 0.044	1.510 ± 0.03

^{a,b and c} The same letter within a row means no significant difference.

*Control=control ration, consisted of 60% and 40 % roughages ; Onion = control ration supplemented with 3% onion powder, Garlic =control ration supplemented with 3% Garlic powder and Fenugreek = control ration supplemented with 3% fenugreek seeds powder.

3-2 Blood parameters

Plasma total protein and albumin level increased significantly ($P < 0.05$) in treated groups (onion, garlic and fenugreek) as compared with control one with no significant differences among treated groups (Table 3).

The highest value of plasma total protein was recorded in ewes fed onion (7.185 ± 0.123) followed by those fed garlic (7.107 ± 0.066) then those fed fenugreek (6.992 ± 0.076). Plasma albumin concentration increased by 11.6 , 9.3 and 7.7% due to diets supplemented with onion, garlic and fenugreek seeds, respectively. Similarly, Khattab *et al.*(2010) reported that serum total protein and albumin concentrations were increased ($P < 0.05$) in lactating buffaloes fed ration supplemented with garlic and fenugreek seeds. Also, Khattab *et al.*(2011) found that pregnant buffaloes fed rations supplemented with black seed oil had higher ($P < 0.05$) plasma total protein and albumin than those fed control diet. The increase in plasma total protein in treated groups (onion, garlic and fenugreek) in our study may be due to

the increase of crud protein digestibility.

Plasma globulin and albumin: globulin ratio was not significant differ between treated groups and control one (Table 3). These results are in agreement with the results obtained by Abo EI-Nor *et al.* (2007) found that fenugreek seeds and lepidium sativum had no effect on globulin or albumin: globulin ratio in lactating buffaloes. Also, Biricik *et al.*(2016) found no effect of adding carvacrol or thymol essential oils to Merino ewes ration on globulin or albumin: globulin ratio. Also, no significant effect due to treatments on blood plasma triglycerides and glucose concentration (Table 3). Similarly, EL-Ghousein. (2010) found no effect of chamomile flowers and Nigella sativa seeds on glucose, and triglycerides in lactating sheep. Also, Khattab *et al.* (2011) showed that black seed oil had no significant effect on triglycerides and glucose concentrations in pregnant buffaloes.

Plasma cholesterol concentration decreased ($P < 0.05$) in ewes fed garlic compared with those fed control, onion and fenugreek diets. Also,

plasma cholesterol concentration decreased significantly ($P < 0.05$) in ewes fed onion as compared with those fed control diets however there was no significant difference between onion and fenugreek or between fenugreek and control group. These results are in agreement with the results obtained by EL-Ghousein. (2010) who found that cholesterol concentration decreased significantly ($P < 0.05$) in lactating sheep fed ration

supplemented with chamomile flowers and Nigella sativa seeds Also, Kholif *et al.*(2012) reported that cholesterol concentration decreased significantly ($P < 0.05$) in dairy goats fed garlic or ginger essential oils. Similarly, Pirmohammadi *et al.*(2014) indicated that garlic supplemented-diets resulted in a significant ($P < 0.05$) decrease of serum cholesterol concentration in pre-partum goats.

Table 3. Effect of onion, garlic, fenugreek seeds as feed additives on blood plasma parameters of ewes

Items	Treatments*			
	Control (T1)	Onion (T2)	Garlic (T3)	Fenugreek (T4)
Total protein (g/dL)	6.786 ± 0.093 ^b	7.185 ± 0.123 ^a	7.107 ± 0.066 ^a	6.992 ± 0.076 ^a
Albumin (g/dL)	3.394 ± 0.056 ^b	3.788 ± 0.087 ^a	3.710 ± 0.063 ^a	3.657 ± 0.088 ^a
Globulin (g/dL)	3.392 ± 0.100	3.413 ± 0.096	3.397 ± 0.064	3.335 ± 0.107
Albumin: Globulin (A:G) ratio	1.048 ± 0.051	1.128 ± 0.056	1.109 ± 0.031	1.126 ± 0.071
Cholesterol (mg/dL)	73.86 ± 1.205 ^a	68.97 ± 1.022 ^b	65.28 ± 1.271 ^c	71.39 ± 1.227 ^{ab}
Triglycerides (mg/dL)	53.05 ± 1.273	49.86 ± 1.362	50.45 ± 1.087	52.59 ± 1.135
Glucose (mg/dL)	84.10 ± 2.105	84.21 ± 3.721	88.91 ± 1.904	84.53 ± 2.075

^{a,b and c} The same letter within a row means no significant difference.

*Control=control ration, consisted of 60% and 40 % roughages ; Onion = control ration supplemented with 3% onion powder, Garlic =control ration supplemented with 3% Garlic powder and Fenugreek = control ration supplemented with 3% fenugreek seeds powder.

3-3- Rumen fermentation

Results in Table (4) indicated that rumen liquor pH values did not affected by either treatments or sampling time. These results are in agreement with the results obtained by Kongmun *et al.* (2010) they found no effect of adding garlic on pH values in sheep. Also, Kholif *et al.* (2012) found no effect of adding garlic or ginger essential oils on pH values in dairy goats.

Ammonia-N concentrations of rumen liquor are presented in Table (4). Results showed that ammonia-N concentration decreased significantly ($P < 0.05$) in groups fed onion, garlic and fenugreek as compared with that

fed control diet, with no significant differences among treated groups in the first, second and third month. In the first month at 0 h of feeding ammonia-N reduced by 14.8, 14.15 and 17.8% due to diets supplemented with onion, garlic and fenugreek seed respectively while, at 6 hrs after feeding the reduction was 10.9 10.18 and 16.9% due to diets supplemented with onion, garlic and fenugreek seed respectively. In the second month the corresponding values at 0 h of feeding were 11.4 , 6.88 and 13.6% while they were 10.3 8.05 and 8.9% at 6 hrs after feeding.

Table 4. Effect of onion, garlic, fenugreek seeds as feed additives on Ruminant pH values, Ammonia-N, total volatile fatty acids concentration of ewes

parameters	Month	Hours	Treatments*			
			Control (T1)	Onion (T2)	Garlic (T3)	Fenugreek (T4)
pH values	1 st	0	6.200 ± 0.086	6.320 ± 0.166	6.420 ± 0.086	6.370 ± 0.075
		6	6.040 ± 0.081	6.100 ± 0.170	6.240 ± 0.075	6.160 ± 0.098
	2 nd	0	6.180 ± 0.139	6.280 ± 0.128	6.380 ± 0.116	6.400 ± 0.071
		6	5.940 ± 0.129	6.020 ± 0.124	6.140 ± 0.081	6.260 ± 0.060
	3 rd	0	6.220 ± 0.162	6.360 ± 0.172	6.440 ± 0.160	6.340 ± 0.157
		6	6.060 ± 0.129	6.080 ± 0.159	6.300 ± 0.155	6.100 ± 0.152
Ammonia-N (mg/dl)	1 st	0	21.83 ± 0.691 ^a	18.59 ± 0.458 ^b	18.74 ± 0.517 ^b	17.93 ± 0.296 ^b
		6	22.68 ± 0.711	20.19 ± 0.431	20.37 ± 0.306	18.83 ± 0.431
	2 nd	0	21.57 ± 0.318 ^a	19.11 ± 0.502 ^b	20.09 ± 0.593 ^b	18.62 ± 0.699 ^b
		6	22.33 ± 0.304 ^a	20.09 ± 0.593 ^b	20.43 ± 0.756 ^b	20.34 ± 0.734 ^b
	3 rd	0	21.78 ± 0.696 ^a	19.02 ± 0.950 ^b	19.02 ± 0.855 ^b	18.94 ± 0.612 ^b
		6	23.18 ± 0.786 ^a	21.11 ± 0.866 ^b	20.07 ± 0.795 ^b	20.21 ± 0.660 ^b
Total volatile fatty acids (meq/100ml)	1 st	0	9.77 ± 0.354 ^b	11.20 ± 0.464 ^a	10.80 ± 0.539 ^a	11.70 ± 0.374 ^a
		6	10.86 ± 0.424 ^b	12.20 ± 0.515 ^a	12.30 ± 0.332 ^a	13.00 ± 0.224 ^a
	2 nd	0	9.50 ± 0.224 ^b	12.00 ± 0.524 ^a	11.30 ± 0.700 ^a	11.40 ± 0.579 ^a
		6	10.50 ± 0.232 ^b	12.90 ± 0.430 ^a	12.70 ± 0.632 ^a	12.50 ± 0.447 ^a
	3 rd	0	9.900 ± 0.367 ^b	11.90 ± 0.510 ^a	11.80 ± 0.600 ^a	11.70 ± 0.644
		6	11.10 ± 0.292 ^b	13.20 ± 0.490 ^a	13.00 ± 0.447 ^a	12.80 ± 0.594 ^a

^{a,b and c} The same letter within a row means no significant difference.

*Control=control ration, consisted of 60% and 40 % roughages ; Onion = control ration supplemented with 3% onion powder, Garlic =control ration supplemented with 3% Garlic powder and Fenugreek = control ration supplemented with 3% fenugreek seeds powder.

In the third month at 0 h of feeding the reduction in ammonia-N was 12.67, 11.84 and 13.03% due to diets supplemented with onion, garlic and fenugreek seed respectively while at 6 hrs after feeding the reduction values were 8.93, 13.41 and 12.81 % due to diets supplemented with onion, garlic and fenugreek seed respectively. These results are in agreement with the results obtained by Hassan and Abdel-Raheem (2013) they found that ammonia-N reduced ($P<0.05$) in growing buffalo calves fed rations supplemented with caraway and garlic also, Wang *et al.* (2009) and Kholif *et al.* (2012) found that garlic oils reduced ($P<0.05$) of ruminal ammonia-N in sheep and dairy goats respectively. The reduc-

tion in ammonia-N concentration in treated groups may be due to inhibit protein hydrolyzing microorganism in the rumen (Patra, 2011).

As shown in Table (4) total volatile fatty acids concentration increased ($P<0.05$) in treated groups (T2, T3 and T4) as compared with control one with no significant differences among treatments groups. TVFA'S increase by 17.8 %, 13.68% and 23.1% due to diets supplemented with onion, garlic and fenugreek seed respectively in the first month at 0 h of feeding while at 6 hrs after feeding the increases were 10.9% 10.18% and 16.9% due to diets supplemented with onion, garlic and fenugreek seed respectively. In the second month the corresponding values at 0 h of feed-

ing were about 26.3 , 18.9 and 20% and at 6 hrs after feeding were 22.8 , 20.9 and 19%. In the third month at 0 h of feeding the highest value of TVFA was recorded in onion followed by garlic then fenugreek also, the same was observed at 6 hrs after feeding. These results are in agreement with the results obtained by Kholif *et al.*(2012) they found that concentration of VFAs was higher in dairy goats fed rations supplemented with garlic and ginger oils. Also, Hassan and Abdel-Raheem (2013) reported that total volatile fatty acids concentration increased ($P<0.05$) in growing buffalo calves fed rations supplemented with caraway and garlic as a natural feed additives. In this field, Biricik *et al.* (2016) found that total volatile fatty acids concentrations were increased ($P<0.05$) at 3 hrs after feeding in growing sheep by using carvacrol or thymol oils as feed additives. Total volatile fatty acids are the end products of rumen microbial fermentation and represent the main supply of metabolizable energy for ruminants (Van Soest, 1982). Therefore, using onion, garlic and fenugreek as feed additives may be responsible for the improvement of energy production and carbohydrate metabolism in treated groups.

Conclusion

It could be concluded that onion, garlic or fenugreek seeds as feed additives may have a beneficial effect on feed intake, blood metabolites and rumen fermentation parameters of osimi ewes.

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تأثير إضافة مسحوق البصل و الثوم وطحين بذور الحلبه المجفف علي الغذاء المأكول وبعض مكونات الدم وتخمرات الكرش في الأغنام الأوسيمي

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الملخص

اجريت هذه الدراسة لتقييم تأثير مسحوق البصل المجفف ومسحوق الثوم المجفف وطحين بذور الحلبه كإضافات اعلاف علي الغذاء المأكول ومكونات الدم وتخمرات الكرش في الأغنام. تم اختيار ٢٠ نعجه عشر في اليوم 7 ± 90 من الحمل بمتوسط وزن جسم $52 \pm 2,5$ كجم وعمر من ١٤-١٨ شهر وزعت عشوائيا الي اربع مجموعات (٥ حيوانات لكل مجموعه). المجموعه الاولى (م١) قدمت لها العليقه الاساسيه والتي تتكون من ٦٠% مخلوط مركز و ٤٠% مواد خشنه. يتكون المخلوط المركز من (٤٤% ذره صفراء و ٢٠% كسب فول صويا و ٢٠% ردة قمح و ١٣% كسب قطن غير مقشور و ٢% حجر جيرى و ١% ملح طعام) وتتكون المواد الخشنه من (٢٠% تين قمح و ٢٠% دريس برسيم مجروش) في حين ان المجموعات المختبره الاخرى غذيت علي العليقه الأساسية مضافا اليها ٣% مسحوق البصل المجفف (م٢) او ٣% ومسحوق الثوم المجفف (م٣) او ٣% وطحين بذور الحلبه (م٤). تم تسجيل الغذاء المأكول يوميا وأخذت عينات الدم من كل النعاج شهريا وكذلك عينات الكرش تم تجميعها باستخدام انبوب المعده لتقدير رقم الحموضه وتركيز الامونيا والاحماض الدهنيه بالكرش.

اظهرت النتائج ان الغذاء المأكول زاد معنويا في الشهرين الاخيرين من الحمل في المجموعات المختبره مقارنة مع مجموعه الكنترول في حين بعد الولاده لم يكن هناك اي تأثير للمعاملات علي الغذاء المأكول ما عدا الشهر الاول والذي زاد فيه الغذاء المأكول في (م٢) و (م٣) مقارنة مع الكنترول. اظهرت النتائج ان البروتين الكلي والاليومين في بلازما الدم زادا زياده معنويه في المجموعات المختبره مقارنة مع الكنترول في حين لم يكن هناك فروق معنويه في كلا من الجلوبيولين و نسبة الاليومين الي الجلوبيولين او التراي جلسريد او الجلوكوز. الكولسترول انخفض معنويا في (م٣) مقارنة مع مجموعه الكنترول والمجموعات الاخرى وكذلك انخفض في (م٢) مقارنة مع مجموعه الكنترول. لم يكن هناك فروق معنويه بين المجموعات في رقم الحموضه في الكرش وانخفضت الامونيا معنويا في المجموعات المختبره مقارنة مع مجموعه الكنترول. اما الأحماض الدهنيه الطياره زادت معنويا في المجموعات المختبره مقارنة مع مجموعه الكنترول.