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Effect of L-Carnitine and Coenzyme Q10 treatments on immune response, productive and reproductive performance of Damascus goats and their offspring. 1- Effect on quality and chemical composition of milk and Labneh.

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SUMMARY

Thirty healthy Damascus does were selected in the last third of pregnancy period and assigned to three groups (10 each) considering their body weight. The first group fed on basal ration (according to NRC, 1981) composed of 60% concentrated feed mixture (CFM), 20% clover hay and 20% rice straw that served as control. The second group (A) fed on basal ration supplemented with 3mg/kg live body weight/day of Coenzyme Q10. The third group (B) fed on basal ration fortified with 40 mg/kg live body weight/day of L-Carnitine. Milk samples collected weekly up to 60 days to study the effect of these additives on milk physicochemical properties and its products, eg. yoghurt and labneh. Results showed significant improvement in the modified lactometer reading and total solids of treatments A and B compared to control and this was reflected on the time required for coagulation, being longer in A & B treatments than control one. Results revealed also an increase in coagulation time during manufacturing of Labneh which noticed on samples of A & B treatments. Labneh samples of treatment A showed a slight improvement in yield, curd tension, curd synersis, total solids, fat, protein, lactose and ash, followed by samples of treatmen B then control. Conversely, the rate of proteolysis and lipolysis, counts of total viable, lactic acid bacteria and yeast & moulds were found fewer in treatments A & B than control, along the storage period. Organoleptic evaluation cleared that Labneh of treatment A (Co- Q10) recoded slightly higher score points than the others, along the storage period. The resultant Labneh of all treatments were characterized, generally, by clean acid flavour, firm body, good texture and acceptable appearance. Finally, it could be concluded that supplementation of dairy goats ration by Co-Q10 or L-Carnitine led to enhance the quality and chemical composition of the resultant milk as well as the products manufactured from it .

INTRODUCTION

Many researchers interest in applications for goats' milk, had been increased internationally in recent years. Goats' milk has been used since long time, throughout the world, for the manufacture of different products ***(Loewenstein et al., 1980; Robinson & Vlahopoulou, 1988*** and ***Abrahamsen & Rysstad, 1991).***

Labneh or concentrated yoghurt, which is the product obtained from the ordinary yoghurt after removing part of its water, are a popular food in various parts of the world especially in the middle east region. It's nutritional benefits and storage characteristics led to increase its economic importance ***(Benezech & Maingonnat, 1994*** and ***Nsbimana et al., 2005).***

Coenzyme Q10 is a fat – soluble substance, which resembles a vitamin presents in most eukaryotic cells, primarily in the metachondria. It is a component of the electron transport chain and participate in aerobic cellular respiration, which generates energy in the form of ATP. Nienty–five percent of the human body energy is generated by this way ***(Emster & Dallner, 1995; Dutton et al., 2000)***. Also, Coenzyme Q10 is an antioxidant that has great importance against free radicals ***(Bentinger et al., 2007)***, protects the stability of cell membrane and DNA from free radicals induce oxidative damage, helps

recycling of vitamin E and maintain healthy energy levels **(*El-Tohamy et al., 2012)***.

L- Carnitine is a quaternary ammonium compound involved in metabolism in most mammals, plants and some bacteria. Carnitine is involved in the oxidation of fatty acids, and involved in systemic primary carnitine deficiency. It has been studied for preventing and treating other conditions, and used as purported performance for enhancing drugs ***(Karlic et al., 2004; Bremer, 1983)***. It is a switterionic compound synthesized in vivo from lysine and methionine, essential for the transport of long-chain fatty acid across the inner metachondria membrane for B-oxidation and remove toxic accumulation of fatty acid from metachondriaand generally keeping these organelles healthy and functioning at their best. It is also important as antioxidant for protection of the cell membranes against oxidative damage ***(Kalaiselvi and Panneerselvam, 1998)*.**

These additives play an important role in the immune response, productive and reptoductive performance of cow, buffalo and goats, therefore it was of concern and well studied.

MATERIALS & METHODS

Experimental plan :

A total number of 30 healthy Damascus does aged 1.5 – 2 years, 45±1.64 kg body weigh were used in the experiment. The does were assigned to three groups (10 each) according to body weight and were fed on basal ration according to NRC (1981). The first group was fed basal ration composed of 60% concentrate feed mixture (CFM) plus 20% clover hay and 20% rice straw and served as control. The other two groups were fed the same basal ration supplemented with Coenzyme Q10 or L-Carnitine at levels of 3 mg and 40 mg/kg live body weight/day, respectively .

Physicochemical and bacteriological analysis:

Milk: Samples of fresh milk were collected every 7 days up to 1 month for the first suckling period and 2 months for the second one. All samples were analysed chemically and physically and the mean of the resultant data for each period was tabulated.Titratable acidity, total solids, fat, total protein and ash contents were analysed according to ***(AOAC, 2000)***. Lactose content ***(Barnett and Abd El-Tawab, 1957)***. pH values were determined using pH meter (model JENWAY 3020, ENGLAND). Rennet coagulation time (***Fahmi and Amer, 1962)***. Corrected lactometer reading by lactometer.

Yoghurt: manufactured from the resultant milk of each period was analysed for pH values , curd tension ***(Chandrasekhara et al., 1957)*** and curd synersis ***(Mehanna and Mehanna, 1989)***.

Labneh was manufactured according to ***El-Sayed et al. (1993)***. Three treatments were done: the first used as a control, the second (A) belonged to Co- Q10 and the third (B) for L-carnitine, using yoghurt starter culture (a mixed strains of ***Streptococcus thermophilus and Lactobacillus delbrueckii sub sp. Bulgaricus***) obtained from Chr. Hansen's laboratories, Copenhagen, Denmark**. Labneh** was made from the milk of 60 days (at the end of the second period) and analysed chemically, bacteriologically and organoleptically when fresh and after 7 and 14 days of storage at 5 ± 2 ºC. Samples were analysed chemically for total solids, total protein, total nitrogen, non protein nitrogen, fat, ash, pH value and acidity (***AOAC, 2000)*.** Total volatile fatty acids ***(Kowsikowski, 1978)***, saltcontent (***Richardson, 1985)***, acetaldehyde **(Lees and Jago, 1969)** and Lactose content (***Barnett and Abd El-Tawab, 1957***). Curd tension (***Chandrasekhara et al., 1957)*** and curd synersis ***(Mehanna and Mehanna ,1989)***. Labneh yield was calculated as weight percentage of labneh/weight of milk.

Counts of Total viable bacteria (TBC), Lactic acid bacteria (LAB) and Yeast & Moulds (Y&M) were determined as described by ***(APHA 1992)***.

Labneh were scored for flavour (60 points), body & texture (30 points) and appearance (10 points) by 10 panelists of the staff members of the Department of Dairy Technology, Al-Gemmiza station.

Statistical analysis: Analysis of variance and Duncan's test as well as average and standard error (SE) were carried out using computer program ***(SPSS, 1999).***

RESULTS AND DISCUSSION

The chemical composition of all goats' milk were tabulated in Table (1). Data in the first suckling period revealed that pH values and acidity were similar in all samples. On the other hand, corrected lactometer reading (CLR), fat, protein , ash and lactose were found slightiy higher in treated samples than control, owing to the action of Co-Q10 or L-carnitine on the composition and quality of the resultant milk. Rennet coagulation time (RCT/sec.) were low in treated milk (202 & 195 sec.) than control one (213 sec.). Table (1) shows, also , that the chemical composition during the second suckling period for all milk samples had the same trend of the first period with the exception of a slight increase in CLR, TS, fat and protein, in treated milk.

Analysis of variance revealed minor differences among the threegroups though some constituents showed significancy, either in the first or second period. These results are in agreement with those given by ***Ramanau et al. (2004)*** who studied the effect of L-carnitine supplementation in sows' feed on milk production and milk constituents.

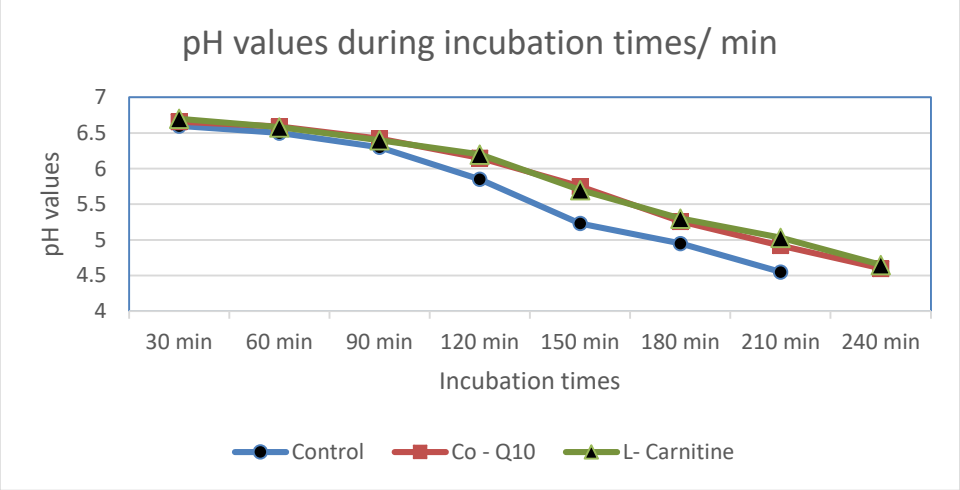
Figure (1) shows the progress of yoghurt acidity as indicated in the term of pH values. pH had the same decreasing trend by advance of incubation time for all groups. The control group had relatively less pH values especially after 90 min of incubation until last measured time (210 min).

Table (1): Physicochemical properties of goats milk , during two suckling periods, as affected by supplementing the feeding rations by Co-Q10 or L- Carnitine.

Property	*Treatments*		
	Control	*Co - Q 10*	*L- Carnitine*
	First Period (1-30days)		
PH	6.63^{a} ± 0.03	6.70^{a} ± 0.05	6.68^{a} ± 0.07
Acidity, %	0.16^{a} ± 0.03	0.16^{a} ± 0.04	0.16^{a} ± 0.03
CLR	29.00^{b} ± 0.12	29.75^{a} ± 0.11	29.50^{a} ± 0.09
RCT, sec.	213^{a} ± 0.62	202^{b} ± 0.73	195^{b} ± 0.78
TS, %	11.35^{b} ± 0.21	11.59^{a} ± 0.15	11.50^{a} ± 0.22
Fat, %	3.30^{b} ± 0.12	3.50^{a} ± 0.11	3.50^{a} ± 0.08
Protein, %	2.95^{b} ± 0.09	3.02^{ab} ± 0.12	3.18^{a} ± 0.15
Ash, %	0.70^{a} ± 0.03	0.75^{a} ± 0.05	0.75^{a} ± 0.03
Lactose, %	4.50^{bc} ± 0.12	4.75^{a} ± 0.15	4.63^{ab} ± 0.08
	Second Period (31-60 days)		
PH	6.65^{a} ± 0.02	6.68^{a} ± 0.03	6.70^{a} ± 0.02
Acidity, %	0.16^{a} ± 0.01	0.16^{a} ± 0.03	0.16^{a} ± 0.03
CLR	29.50^{a} ± 0.13	30.00^{a} ± 0.13	30.00^{a} ± 0.15
RCT, sec.	220^{a} ± 0.78	208^{b} ± 0.82	196^{c} ± 0.65
TS, %	11.43^{b} ± 0.21	11.66^{a} ± 0.25	11.60^{a} ± 0.19
Fat, %	3.35^{b} ± 0.15	3.60^{a} ± 0.14	3.50^{ab} ± 0.20
Protein, %	3.03^{bc} ± 0.08	3.18^{b} ± 0.07	3.28^{a} ± 0.09
Ash, %	0.70^{ab} ± 0.03	0.75^{a} ± 0.02	0.75^{a} ± 0.02
Lactose, %	4.60^{b} ± 0.13	4.75^{a} ± 0.15	4.65^{ab} ± 0.18

In control treatment, the values of pH were rapidly decreased throught the incubation periods, comparing to the treated ones, and reached the end of incubation time after 210 min. and to 240 min. in both Co-Q10 and L-carentine treatments , in order . pH values were decreased in all treatments as the incubation period advanced. Although the analysis of varience was not detected between control treatment and the other ones up to 60 min. of incubation , it was noticed thereafter. In addition no significant differences was observed between the two treated milks along the incubation periods. These results are coincided with that reported by ***El-Ghandour et al., (2009).***

Fig (1): Activity of yoghurt starter culture (pH values) during the fermentation period of yoghurt used to produce Labneh.



Results in Table (2) indicate that, yoghurt samples of Co-Q10 and L-carentine had dlightly higher values of curd tension (25.21 and 24.7 gm in order) than the control one (23.18 gm) . Regarding the curd syneresis after 30, 60 and 120 min., control samples drained the high amounts of whey than the treated samples. The total amounts of whey exuded were 28.07, 26.13 and 26.26 gm. for control, Co-Q10 and L-Carnitine, respectively. This might be due to the higher percent of Ts, protein and fat noticed in Co-Q10 and L-Carnitine treatments and to the action of these substances on the chemical composition of the resultant milk. Results revealed, also, significant differences between control and the two treatments. These observations are in agreement with those given by ***Mann, (1984), Hefnawy et al., (1992)*** and ***El-Ghandour (2008).***

Table (2)*: Curd Tension* and *Curd Syneresis of yoghurt, as* affected by using *Co - Q10* and *L- Carnitine in feeding to* produce Labneh.

Treatments	*Curd Tension (gm)*	*Curd Syneresis after*			
		30 min	*60 min*	*120 min*	*Total*
Control	**$23.18^{b} \pm 0.82$**	**$8.55^{a} \pm 0.31$**	**$9.57^{a} \pm 0.27$**	**$9.95^{a} \pm 0.29$**	**$28.07^{a} \pm 0.41$**
Co - Q10	**$25.21^{a} \pm 0.73$**	**$7.82^{b} \pm 0.25$**	**$8.95^{ab} \pm 0.22$**	**$9.36^{ab} \pm 0.20$**	**$26.13^{b} \pm 0.32$**
L- Carnitine	**$24.70^{ab} \pm 0.65$**	**$7.90^{b} \pm 0.33$**	**$8.88^{b} \pm 0.31$**	**$9.48^{a} \pm 0.18$**	**$26.26^{b} \pm 0.42$**

Labneh :

Yield and chemical composition :

Labneh from Co-Q10 milk (A) recorded the highest yield, along the storage period, followed by L-carnitine treatment (B), compared to control one, Table (3). These differences between control and A & B treatments were significant ($P < 0.05$) and may be due to the differences observed in the chemical composition among the treatments. The same table shows, also, that the acidity in control labneh was higher than the other ones, owing to its activity of starter culture. pH values had a reverse trend to acidity during the storage period. Co-Q10 Labneh (A) recorded the highest values of TS, fat/DM, ash/DM and Lactose followed by L- Carnitine Labneh and control Labneh in order, with the exception of L-carentine labneh which was high in (TP/DM) than the others.

As the storage period advanced, yield and lactose contents of all Labneh treatments were decreased gradually up to the end, while the other components increased. The loss of moisture, the activity of microorganisms and the biochemical interactions occurred during storage as well as the action of Co- Q10 and L- Carnitine, played important role in that.

Statistical analysis showed that, the differences between the control and other treatments at fresh and during storage period were significant ($P < 0.05$), whereas a slight differences noticed between Co-Q10 and L-carnitine treatments. Generally, these results are in agreement with those reported by ***Omar, (1995), Ragab, (2000), Mehanna et al., (2004)*** and ***Ibrahim et al., (2013).***

Table (3): Yield and chemical composition of Labneh processed from goats' milk yoghurt, as affected by the presense of Co-Q10 or L- Carnitine in the goat rations.

Treatments	*Storage Period (days)*	*Yield %*	*Acidity %*	*PH*	*TS %*	*Fat/DM %*	*TP/DM %*	*Ash/DM %*	*Salt/DM %*	*Lactose %*
Control	Fresh	26.53^{b} ± 0.19	0.82^{a} ±0.03	4.42^{b} ±0.05	22.72^{b} ±0.12	33.01^{c} ±0.61	25.31^{c} ±0.31	9.02^{c} ±0.13	5.59^{a} ±0.11	2.98^{a} ±0.05
Co - Q10	Fresh	27.75^{a} ± 0.21	0.74^{b} ±0.05	4.58^{a} ±0.07	23.15^{a} ±0.11	36.72^{a} ±0.52	28.42^{b} ±0.25	9.72^{a} ±0.15	5.97^{b} ±0.08	3.20^{a} ±0.12
L- Carentine	Fresh	27.15^{a} ± 0.16	0.75^{b} ±0.02	4.55^{a} ±0.03	23.20^{a} ±0.09	34.48^{b} ±0.73	29.96^{a} ±0.38	9.53^{ab} ±0.09	5.59^{a} ±0.11	3.15^{a} ±0.08
Control	7	26.40^{b} ± 0.12	0.99^{a} ±0.06	3.80^{b} ±0.07	22.88^{b} ±0.11	33.87^{c} ±0.58	25.87^{c} ±0.41	9.14^{b} ±0.18	5.77^{a} ±0.07	2.70^{b} ±0.09
Co - Q10	7	27.45^{a} ± 0.16	0.87^{b} ±0.05	3.96^{a} ±0.08	23.29^{a} ±0.15	36.93^{a} ±0.71	28.73^{b} ±0.25	9.79^{a} ±0.10	5.07^{b} ±0.09	3.07^{a} ±0.07
L- Carentine	7	27.00^{a} ± 0.17	0.89^{b} ±0.07	3.95^{a} ±0.04	23.42^{a} ±0.13	35.23^{b} ±0.52	30.53^{a} ±0.37	9.62^{a} ±0.13	5.18^{ab} ±0.10	2.95^{a} ±0.09
Control	14	26.27^{b} ± 0.11	1.25^{a} ±0.08	3.14^{b} ±0.03	22.95^{b} ±0.05	35.95^{c} ±0.36	26.01^{c} ±0.22	9.24^{c} ±0.16	5.98^{a} ±0.11	2.42^{b} ±0.11
Co - Q10	14	27.25^{a} ± 0.20	1.18^{ab} ±0.11	3.30^{a} ±0.08	23.37^{a} ±0.07	37.05^{a} ±0.51	29.10^{b} ±0.15	9.85^{a} ±0.19	5.22^{b} ±0.10	2.86^{a} ±0.09
L- Carentine	14	26.90^{a} ± 0.19	1.15^{b} ±0.07	3.32^{a} ±0.07	23.55^{a} ±0.09	36.09^{b} ±0.48	30.87^{a} ±0.31	9.68^{b} ±0.12	5.25^{b} ±0.15	2.76^{a} ±0.08

Proteolysis (NPN/ DM) recorded the highest values in control treatment followed by Co-Q10 and L- Carnitine treatments in order, along the storage period, Table (4). These values reached, after 14 days of storage, to 9.57, 8.41 and 7.9, respectively.

Similar trend in librated TVFA in fresh and stored samples were noticed also, Table 4. The highest values of TVFA gained at the end of the storage period was for control treatment (11.99), while the lowest one (7.90) was for L-Carnitine treatment. The highest values of proteolysis and TVFA noticed on control treatment were probably due to the higher values of acidity, total viable and lactic acid bacterial counts and SN/TN content. These results are similar with those recorded by ***Omar, (1995), Ragab, (2000)*** and ***Mehanna et al., (2004).*** Acetaldehyde values of all treatments behaved different trend, so it increased in all treatments up to day-7 then decreased gradually thereafter. It were high in control treatment followed by Co- Q10 and L-Carnitine, respectively**.**

Table (4): NPN/TN, TVFA and acetaldehyde contents of Labneh manufactured from milk of dairy goats' fed Co-Q10 or L-Carnitine in their rations.

Treatments	*Storage Period (days)*	*NPN/TN,%*	*TVFA**	*Acetaldehyde***
Control		**$6.67^{a}\pm0.09$**	**$9.32^{b}\pm0.11$**	**$295^{a}\pm0.78$**
Co - Q10	**Fresh**	**$4.85^{b}\pm0.08$**	**$8.79^{a}\pm0.08$**	**$282^{b}\pm0.69$**
L- Carentine		**$4.57^{bc}\pm0.05$**	**$8.80^{b}\pm0.15$**	**$278^{bc}\pm0.82$**
Control		**$8.60^{a}\pm0.07$**	**$10.15^{b}\pm0.07$**	**$318^{a}\pm0.93$**
Co - Q10	**7**	**$4.85^{b}\pm0.09$**	**$9.63^{a}\pm0.09$**	**$297^{b}\pm0.57$**
L- Carentine		**$6.40^{b}\pm0.08$**	**$9.57^{b}\pm0.12$**	**$289^{c}\pm0.68$**
Control		**$9.57^{a}\pm0.12$**	**$11.99^{a}\pm0.15$**	**$301^{a}\pm0.75$**
Co - Q10	**14**	**$8.41^{b}\pm0.09$**	**$10.25^{b}\pm0.07$**	**$287^{b}\pm0.82$**
L- Carentine		**$7.90^{c}\pm0.15$**	**$10.13^{b}\pm0.08$**	**$272^{bc}\pm0.79$**

* Expressed as ml 0.1 N NaOH/100g sample.
** Expressed as µ mol /100g sample.

Bacteriologicl examination :

Counts of TBC and LAB were found higher in control, followed by Co-Q10 and L-Carnitine in order, along the storage period, Table (5). This may be due to the presence of some residues of Co-Q10 and L-Carnitine in milk used in manufacturing labneh, which may cause a partial inhibition to the former microorganisms ***(Kalaiselvi and Panneerselvam, 1998).*** The counts of TBC and LAB were gradually decreased throughout the storage period, as a result of increasing the acidity and S/DM. These results are coincided with that obtained by ***Sharaf et al. (1996), Salem et al., (2007)***and ***El-Ghandour et al. (2008)***.

YMC counts were absent in fresh labneh, and appeared after 7 and 14 days of storage period. These results are in agreement with those obtained by ***Hamad et al., (2014)*** and ***Basiony et al., (2015).***

Table (5): Microbiological analysis of Labneh manufactured from milk of dairy goats' fed Co-Q10 or L-Carnitine in their rations.

Treatments	*Storage Period (days)*	*Total bacterial count*	*Lactic acid bacterial count*	*Yeast & Moulds count*
Control	**Fresh**	**$5.2 \times 10^7 \pm 0.63$**	**$4.3 \times 10^5 \pm 0.73$**	**Nil**
Co - Q10		**$0.48 \times 10^7 \pm 0.57$**	**$0.62 \times 10^5 \pm 0.80$**	**Nil**
L- Carentine		**$0.25 \times 10^7 \pm 0.65$**	**$0.31 \times 10^5 \pm 0.75$**	**Nil**
Control	**7**	**$2.5 \times 10^6 \pm 0.48$**	**$5.6 \times 10^4 \pm 0.30$**	**$0.06 \times 10^2 \pm 0.10$**
Co - Q10		**$0.12 \times 10^6 \pm 0.39$**	**$0.32 \times 10^4 \pm 0.25$**	**$0.03 \times 10^2 \pm 0.08$**
L- Carnitine		**$0.10 \times 10^6 \pm 0.52$**	**$0.26 \times 10^4 \pm 0.33$**	**$0.02 \times 10^2 \pm 0.05$**
Control	**14**	**$3.3 \times 10^5 \pm 0.36$**	**$4.20 \times 10^3 \pm 0.51$**	**$0.29 \times 10^2 \pm 0.03$**
Co - Q10		**$0.55 \times 10^5 \pm 0.79$**	**$0.50 \times 10^3 \pm 0.21$**	**$0.15 \times 10^2 \pm 0.06$**
L- Carentine		**$0.21 \times 10^5 \pm 0.88$**	**$0.45 \times 10^3 \pm 0.72$**	**$0.11 \times 10^2 \pm 0.03$**

Organoleptic evaluation :

It's clear that, labneh manufactured from treatments A & B gained slightly higher score points than from control, all over the storage period, Table (6). No obvious differences were noticed between Co-Q10 and L-Carentine labneh treatments. With progress of storage period, the organoleptic properties of all treatments were gradually decreased with slight superiority to Co-Q10 and L-Carnitine treatments. Increasing the acidity and the changes occurred in the flora community were the main reasons for that. Generally, Co-Q10 labneh recorded slightly higher score points than the others along the storage period. The resultant Labneh of all treatments were characterized generally by clean acid flavor, firm body, good texture and acceptable appearance. These results are coincided with that given by ***Salem et al. (2007), El-Ghandour et al. (2008), Ibrahim et al. (2013), Hamad et al. (2014)*** and ***Basiony et al. (2015).***

CONCLUSION

It could conclude that supplementation of dairy goats ration, during the suckling period, by Co-Q10 or L-Carnitine, will improve its productive efficiency, led to enhancement the quality and chemical composion of the resultant goat milk as well as the products manufactured from it .

Table (6): Organoleptic properties of Labneh manufactured from milk of dairy goats' fed on rations fortified with Co-Q10 or L-Carnitine

Treatments	*Storage Period (days)*	*Appearance (10)*	*Body & Texture (30)*	*Flavour (60)*	*Total (100)*
Control		**8**	**28**	**55**	**91**
Co - Q10	**Fresh**	**8**	**29**	**55**	**92**
L- Carentine		**8**	**29**	**55**	**92**
Control		**7**	**27**	**53**	**87**
Co - Q10	**7**	**7**	**28**	**53**	**88**
L- Carentine		**7**	**28**	**52**	**87**
Control		**5**	**26**	**50**	**81**
Co - Q10	**14**	**5**	**28**	**51**	**84**
L- Carentine		**5**	**28**	**50**	**83**

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Effect of L-Carnitine and Coenzyme Q10 treatments on immune response, productive and reproductive performance of Damascus goats and their offspring.
1- Effect on quality and chemical composition of milk and Labneh.

تأثير المعاملة بـ ل-كارنتين وكوانزيم كيو 10 على الاستجابة المناعية والأداء الإنتاجى والتناسلى للماعز الدمشقى ومواليدها
1- التأثير على الجودة والخواص الكيماوية للبن واللبنة المصنعة
-2

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الملخص العربى

أجريت التجربة على الأمهات حيث تم اختيار عدد 30 عنزة دمشقى فى الثلث الأخير من الحمل، وقسمت إلى ثلاثة مجاميع (كل مجموعة 10 أفراد).
المجموعة الأولى: كنترول وتتغذى على عليقة المحطة على حسب مقررات NRC لعام 1981.
المجموعة الثانية: تتغذى على عليقة المحطة + 3 مليجرام / كجم وزن حى/ للرأس مرة واحدة يومياً من Coenzyme Q10 حتى نهاية الحليب وتتم الإضافة باستخدام كبسولات جيلاتينية لتلافى تكسيره فى الكرش.
المجموعة الثالثة: تتغذى على عليقة المحطة + 40 مليجرام / كجم وزن حى/ للرأس مرة واحدة يومياً من L-Carnitine حتى نهاية الحليب وتتم الإضافة بصورة سائلة (تجريع).

حيث أظهرت النتائج حدوث تحسن ملموس فى قراءة اللاكتوميتر المعدلة والجوامد الصلبة الكلية فى عينات المجموعة الثانية والثالثة مقارنة بالكنترول وانعكس ذلك على الوقت اللازم لعملية التجبن حيث انخفض فيهما عن الكنترول، ودلت النتائج المتحصل عليها أثناء تصنيع اللبنة على زيادة الوقت اللازم للتجبن أثناء التحضين وذلك فى عينات المجموعتين الثانية والثالثة مقارنة بالكنترول.

وفى اللبنة أظهرت عينات المجموعة الثانية تحسناً واضحاً من حيث الجذب الخثرى ومعدل طرد الشرش وكذا الريع ومحتواها من الجوامد الكلية التى تتمثل فى الدهن والبروتين واللاكتوز والرماد.

تلاها فى ذلك عينات المجموعة الثالثة وكان أقلهم مجموعة الكنترول، وعلى العكس من ذلك انخفض معدل التحلل فى البروتين والدهن، وكذا معدل النمو البكتيرى وذلك فى لبنة المجموعات المعاملة عن الكنترول، ومن حيث التحكيم الحسى فقد حظيت لبنة المجموعة الثانية على درجات أفضل نسبياً، تليها عينات المجموعة الثالثة ثم الكنترول.

نستخلص من هذه النتائج أن استخدام Coenzyme Q10 و L-Carnitine كان لهما أثراً جيداً فى تحسن خواص اللبن الناتج، وكذا اللبنة المصنعة منه وقد كانت عينات المجموعة الثانية أفضلهم نسبياً بما يدعم استخدامها على النطاق التطبيقى.