

Effect of Probiotic or Prebiotic Supplementation on the Productive Performance of Barki Lambs.

Soliman, S. M. ; A. M. El-Shinnawy and A. M. El-Morsy.
Regional Center for Food & Feed, Agric. Res. Center, Giza, Egypt.



ABSTRACT

This study was carried out to evaluate the impact of dietary supplementation of probiotic (Diamond XP™) T1 or prebiotic (BioBoost™) T2 on nutrient digestibility, rumen fermentation characteristics, productive performance and economic efficiency of Barki lambs. Lambs in control group offered a concentrate feed mixture (CFM) and clover hay without supplementation while, lambs in treatment (T1) and treatment (T2) were fed CFM supplemented with probiotic or prebiotic at rate of 10 g/ head/ day, respectively. Nine barki male sheep (47kg ± 2.5) were used for running metabolism trail. The animals were allocated into three equal groups. Three ruminally cannulated ewes (45 kg ± 3.2) were used to study the rumen liquor parameter, while growth performance trails were carried out with twenty four growing male Barki lambs (27.5 kg ± 0.75) used to determine the growth performance, feed conversion and economic efficiency. The obtained results could be summarized as follow: Animals given ration supplemented with probiotic recorded the highest values of ($p < 0.05$) digestibility and nitrogen utilization followed by animals given ration supplemented with prebiotic, however those fed control ration had the lowest values. The same trend was observed with TDN and DCP values. No significant ($p < 0.05$) differences among rations in ruminal pH values, were recorded while total volatile fatty acids (VFA's) concentration and microbial protein synthesis had significantly ($p < 0.05$) increased with probiotic supplement. The control ration recorded the highest ruminal NH₃-N concentration. A positive impact of probiotics (DFM) and prebiotic supplementation on nutrient intake, feed conversion ratio and economic efficiency have been recorded. It could be concluded that feeding lambs on rations supplemented with either probiotic (DFM) or prebiotic at 10 g/h/d has beneficial effects on rumen parameters, digestibility coefficients, growth performance and economic efficiency of growing Barki lambs.

Keywords: Prebiotic, Probiotic, Growth Performance, Barki lambs.

INTRODUCTION

The application of direct-fed probiotic (DFM) or prebiotic on animal production has improved the animal performance. FAO/WHO (2002) defined Probiotics (DFM) as "live microorganisms that may beneficially affect the host upon ingestion by improving the balance of the rumen microflora". According to American Association of Feed Control Officials (AAFCO) which recognizes a list of microorganisms appropriate for use in animal feeds, reported that direct-fed microbial products are normally listed on the product label under probiotics. The terms probiotics and (DFM) are synonymous with each other (Heyman and Ménard, 2001), and are used as umbrella terms to refer to any type of single-cell microbial (bacterial-based and or yeast) feed additive. Inclusion probiotic in animal diets improved lamb performance (Ali, 2005, Abbas, 2005 and Hassan and Hassan 2008) and increased live weight gain (Orr *et al.*, 1988 and Galyean *et al.*, 2000) and digestibility (El-Shaer, 2003) and enhanced feed conversion ratio. The promotion and marketing of direct-fed microbial products (probiotic products) have increased greatly during the past few years, aiming at improving animal productivity. DFM (Probiotics) are being feed additives that improve promote rumen metabolic development by modulating rumen functions and fermentation activity of its microflora, which improves ruminant production performance (Tripathi and Karim 2011). Dawson (1993) reported a decrease in ruminal pH and an increase in cellulolytic ruminal bacterial numbers in steers fed hay supplemented with lactic acid bacteria (*L.acidophilus*). It also, improved health, performance, and increased growth rates (Bohm and Srour 1995).

Prebiotics are defined by FAO/WHO (2002) as "a nondigestible but fermentable food ingredient that beneficially affects the host by selectively stimulating the growth and/or activity of a number of bacteria in the host". According to the FAO/WHO (2002), prebiotics are non-digestible substances that provide a beneficial physiological effect on the host by selectively stimulating the favorable growth or activity of a number of indigenous bacteria. In ruminants there are evidence that prebiotics increase the population of ciliated protozoa in the rumen (Cendrowska *et al.*, 2006), decrease ammonia nitrogen (NH₃-N) concentration (Shibata, 1985; Biggs and Hancock, 1998), increase volatile fatty acid (VFA) and microbial protein concentrations, and stabilize the rumen pH (Li *et al.*, 2007). It is possible that, due to the fact that some prebiotics might not be degraded in the rumen, these functional carbohydrates could reach the large intestine intact where they could have beneficial effects. (Baines Antonio *et al.* 2011). However, other studies do not support these results; probably because the prebiotics are rapidly fermented by ruminal microorganisms.

Presently ruminant nutrition research draws more attention on feed safety and animal products. It seems that prebiotics and probiotic (DFM) have effects on animal performances, rumen microflora activities and immunity. The addition of probiotics/prebiotics in the diets of animals is a relatively recent endeavor and preliminary studies are very encouraging. Few researches on the use of probiotics and prebiotics to improve ruminant performance was discussed the possible impacts of the applications of probiotics and prebiotics on the ruminant growth performance and lactating dairy cattle. Therefore, the present study was carried out as attempt to test the impact of adding probiotic (DFM) or prebiotic to the ration of Barki

lambs on nutrient digestibility, rumen parameters, growth performance and economic efficiency.

MATERIALS AND METHODS

Metabolism trial

This study was carried out at Noubaria Station, Animal Production Research Institute. Three metabolism trials were conducted to evaluate three experimental rations, using three mature barki rams, aged 24 months (average live body weight $47\text{kg}\pm 2.5$) for each ration. The animals in each trial were fed individually in metabolic cages on one of the three rations to provide animals with their maintenance requirements according to (NRC, 2007). The control group received a basal ration composed of 60% concentrate feed mixture (CFM) and 40% clover hay without supplement, while group two and group three were received the same control basal rations plus either 10g probiotics (DFM) from *Diamond XP™ /head / day or 10 g prebiotics from **BioBoost™/ head /day respectively with mixed with the concentrate mixture. Chemical composition of feed ingredients and basal ration are shown in Table (1).

*Diamond XP™, contains eight species of live bacteria and one fungi. Microorganisms include (*Propionibacterium freudenreichii*, *Lactobacillus acidophilus*, *Lactobacillus casei*, *Enterococcus faecium*, *Lactobacillus lactis*, *Pediococcus cerevisiae*, *Megasphaera elsdenii*, *Bacillus licheniformis*, and *Aspergillus oryzae*). Total microbial activity, min: 1.6 billion (1.6×10^9) CFU/oz.

**BioBoost™, each one kg contains 100g inactive yeast product (50% mannan + 50% b-glucan), manganese sulphate monohydrate 2g, vitamin A 0.12g and vitamin E 0.13. Carrier bentonit 500g.}

Table 1. Chemical composition of feed ingredients and basal ration (on dry matter basis, %).

Item (%)	CFM	Clover Hay	Basal ration
DM	91.10	91.20	91.13
OM	92.86	89.48	91.61
CP	17.05	12.82	15.36
CF	12.87	27.20	18.60
EE	3.55	4.80	4.18
NFE	59.39	44.66	53.47
Ash	7.14	10.52	8.39

*Composition CFM asDM: corn45%, soybean meal 15%, cotton seed meal 12%, wheat bran 20%, molasses5%, salts1%, limestone1.5% and premix0.5%(One kilogram of premix contain: Vit. A 12000 000 IU, Vit.D3 2200 00 IU, Vit.E 1000 mg, Vit.B1 1000 mg, Vit. B2 4000 mg, Vit b6 100 mg, Vit b12 10 mg, Pantothenic acid 3.33 g, Biotin 33 mg, folic acid 0.83 g, Zn 11.79g, Mn 5 g, Fe 12.5 g, Cu 0.5 g, Se 16.6 mg and Mg 66.7g).

The animals were fed twice daily at 8.00 and 17.00. Water was available all time. Each metabolism trial lasted for three weeks as preliminary period followed by one week as a collection period. Feces and urine were collected quantitatively once a day before the morning meal at 8.00. One seventh of daily faces and extracts urine were taken. Faces samples were stored at -10 °C while urine samples were stored in tight bottles

containing sulphuric acid (1:1) to capture NH₃ nitrogen. The collected feces (7 days collection) for each animal was well mixed and then dried at 60 °C for 48 hours. Samples were taken for determination of dry matter. The remaining was ground through a one mm screen on a Wiley mill grinder for analyses. Digestibilities were determined and expressed on dry matter basis. Approximate analyses were carried out according to AOAC (1995), crude protein (CP) by Kjeldahl, while nitrogen free extract (NFE) was calculated by difference.

Rumen liquor parameters

Three female sheep fitted with permanent rumen fistula (with an average of 45 kg live body weight), were used for rumen fermentation. Samples were collected from the fistula. Collected rumen liquor samples were directly tested for pH using Orain 680 digital pH meter. Samples were strained through four layers cheesecloth for each sampling time to get clear liquid. Ammonia nitrogen (NH₃-N) was determined using magnesium oxide (MgO) as described by Al-Rabbat, *et al* (1971). Total volatile fatty acid (VFA` S) were estimated, using steam distillation as described by Warner (1964).

Microbial protein

The microbial protein (MP) synthesized in the rumen of sheep fed the experimental rations were calculated using the following equation: microbial nitrogen (MN) = $(70 \times \text{AP}) / (0.83 \times 0.116 \times 1000)$, where 70 represents the amount of N in the purines (mg N/mmol), 0.83 is the digestibility of the microbial purines, and 0.116 is the purine N: total N ratio in ruminal microorganisms (Chen and Gomes, 1992). The absorbed microbial purines (AP, mmol/day) are calculated from the total excretion of purine derivatives (DP, mmol/day), using the equation: $\text{AP} = (\text{DP} - 0.385 \times \text{BW}^{0.75}) / 0.85$, where 0.85 is the recovery of absorbed purines as urinary purine derivatives, and $0.385 \times \text{BW}^{0.75}$ is the endogenous contribution in the urinary excretion of PD (Verbic *et al.*, 1990).

Growth experiment:-

Twenty four male Barki lambs with average initial live body weight of 27.5 kg (± 0.75) and about 5 months of age were distributed into three similar groups in live body weight and age (eight animals each). Lambs body weights were recorded at the beginning of experimental period and morning before feeding on biweekly intervals till the end of experimental which lasted for 90 day. Animals were fed in groups. Control was fed the basal ration containing approximately 60 % concentrate mixture and 40 % clover hay. Group 2 and 3 were given the basal rations supplemented with 10g / head / day of probiotic (DFM) or prebiotic, respectively. Nutrient requirements of lambs were calculated according to (NRC, 1985) to meet the nutrient requirements of the finishing lambs. Feed intake was recorded daily, mean daily gain and feed conversion was calculated to evaluate lambs performance on experimental rations.

Data were statistically analyzed using the method of least squares analysis of variance using General Linear Models (GLM) procedure (SAS, 2000). The

following model was used: $Y_{ij} = \mu + T_i + E_{ij}$ were: μ = mean, T_i = effect of treatment and E_{ij} = stander error. Duncan's Multiple Range Test (Duncan, 1955) was used to compare among means of each trait.

RESULTS AND DISCUSSION

The effect of dietary supplementation of probiotics (DFM) or prebiotic on the digestion coefficients and the nutritive values of tested rations are presented in Table (2). The results revealed that there was significant improvement in OM digestibility value for animal fed basal the ration supplemented with either probiotic (DFM) or prebiotic compared with those given the control ration. On the other hand, animals fed ration supplemented with probiotic (DFM) recorded the highest ($P < 0.05$) digestibility values for DM, CP, CF and EE followed by those fed the ration supplemented with prebiotic, However animals fed the control ration had the lowest values ($P < 0.05$). Little evidence exists in the literature regarding the effect of feeding probiotic (DFM) or prebiotic supplementation on nutrient digestibility. However, previous studies have demonstrated that the addition of probiotic (DFM) increased the *in vitro* dry matter digestibility (IVDMD) and *in vitro* organic matter digestibility values (IVOMD) cited by Hutjens (2005). Gomez-Basauri *et al.* (2001) evaluated the effect of a supplement DFM containing *L. acidophilus*, *L. casei*, *Enterococcus (Streptococcus) faecium* (total lactic bacteria = 10^9 cfu/g) or mannan oligosaccharide on DMI and apparent total tract digestibility. They found that cows fed ration supplemented with DFM increased digestibility of OM, DM, CP and CF compared with those fed control ration or supplemented with mannan oligosaccharide. Also, other researchers found that Probiotics improved nutrient digestibility (Abd El-Ghani, 2004) and degradation of fiber (El-Waziry and Ibrahim, 2007). In addition, Dawson *et al.* (1990) reported an increase in

cellulolytic ruminal bacterial numbers in steers fed hay supplemented with probiotics and significantly increased ($P < 0.05$) of OM,CF and CP digestibilities. Krehbiel *et al.* (2003) reported that feed additives of probiotic (DFM) improved the CP and CF digestibilities of the diets. Also, Ismaiel *et al.* (2010) showed that CP and CF digestibility significantly improved in lambs fed rations supplemented with probiotic (Tonilissat or Roemin). The positive effect of the DFM additive on CF digestibility in this study might be related to stimulation of growth of cellulolytic bacteria (Michael *et al.*, 2011). This result in agreement with Sallam *et al.* (2014) who reported that adding DFM Ru-max to a diet may increase enzymatic activity within the rumen, which enhances digestibility of the feed. Also Galip (2006) reported that addition of probiotic (DFM) at 5 or 10 g/ day has significantly modified the proportions of the different protozoa types and improved ruminal cellulolytic activity. Whitley *et al.* (2009) also reported improved apparent DM, OM, CP, NDF and ADF digestibility in meat goats fed diet supplemented with commercial probiotics compared with the control group. In contrast, Titi *et al.* (2008) reported that the addition of probiotics had no effect on DM, CP and NDF digestibility.

The nutritive values of the experimental rations expressed as total digestible nutrient (TDN%) and digestible crude protein (DCP%) are presented in Table (2). The results indicated that, (TDN%) and (DCP%) values were higher ($P < 0.05$) for animals fed ration supplemented with DFM followed by that supplemented with prebiotic compared with control ration. These results are in agreement with Sallam *et al.* (2014) who found that probiotics (Ru-Max) had positive responses on the mean values of TDN and DCP%. Also, Ismaiel *et al.* (2010) reported that the highest value of DCP% was recorded with DFM (Tonilissat) group compared with the other groups.

Table 2. Digestibility coefficients and nutritive values of the experimental rations fed to sheep. (\pm SE).

	Control	probiotic(DFM)	Prebiotic
Total intake (gm) DM	1100 \pm SE 25.15	1112 \pm SE 18.33	1105 \pm SE 23.17
Digestibility coefficients (%):			
DM	70.02 \pm 0.31 ^b	73.89 \pm 0.33 ^a	72.23 \pm 0.21 ^{ab}
OM	71.62 \pm 0.42 ^b	74.87 \pm 0.35 ^a	73.06 \pm 0.22 ^a
CP	69.86 \pm 0.86 ^b	73.89 \pm 0.71 ^a	71.06 \pm 0.82 ^b
CF	63.04 \pm 0.64 ^b	67.58 \pm 0.75 ^a	64.47 \pm 0.69 ^b
EE	77.32 \pm 0.91 ^b	79.33 \pm 0.78 ^a	79.04 \pm 0.82 ^a
NFE	71.12 \pm 0.91 ^a	74.72 \pm 0.73 ^a	73.07 \pm 0.93 ^b
Nutritive values (%):			
TDN	67.79 \pm 0.22 ^b	71.34 \pm 0.28 ^a	69.40 \pm 0.25 ^{ab}
DCP	10.73 \pm 0.11 ^b	11.34 \pm 0.14 ^a	10.91 \pm 0.16 ^{ab}

^{ab} means in the same row with different superscripts are significantly differ ($P < 0.05$).

Nitrogen intakes and nitrogen balance for sheep fed the experimental rations are presented in Table (3). The results showed that nitrogen intakes for sheep given experimental rations ranged from 27.00 to 27.33 g/h/day with no significant differences. Also, these results indicated that all animals were in positive nitrogen balance (NB). However, the highest value of nitrogen balance was recorded for the lambs supplemented with probiotics (DFM) in their ration.

This increase in NB appeared to be related to an improved N digestion as opposed to a reduction in urinary N excretion as reported by Mc Allister *et al.* (1998). Nitrogen balance as % from nitrogen intake (NI) and nitrogen digested (ND) was higher ($P < 0.05$) for lambs supplemented probiotics (DFM) in their ration as compared with supplemented with prebiotic or the control. These results are in agreement with those obtained by Nocck and kautz, (2006) who found that the

metabolism of protein is the combination of microbial crude protein and protein escapes in the rumen degradation is available for enzymatic digestion in the small intestine, which enhanced by the probiotic supplement. Pronounced effect of probiotics (DFM) in improving nitrogen utilization could be attributed to reduction of nitrogen excretion in fecal and urine. Similar results were obtained by Ahmed and Salah (2006) and El- Ashry *et al.*, (2000).

Table 3. Nitrogen utilization of lambs fed different experimental rations.

ITEM	Experimental rations		
	Control	Probiotic (DFM)	Probiotic
Nitrogen intake (NI)	27.00 ±SE 0.85	27.33±SE 0.45	27.16±SE 0.56
Nitrogen digested (ND)	18.86±0.21 ^b	20.19±0.21 ^a	19.30±0.19 ^{ab}
Urinary N	14.29±0.23 ^b	13.56±0.25 ^b	13.91±0.31 ^{ab}
Nitrogen balance (NB)	4.57±0.27 ^c	6.63±0.32 ^a	5.39±0.29 ^b
NB/NI	16.93	24.26	19.85
NB/ND	24.23	32.84	27.98

^{abc}means in the same row with different superscripts are significantly differ (P< 0.05).

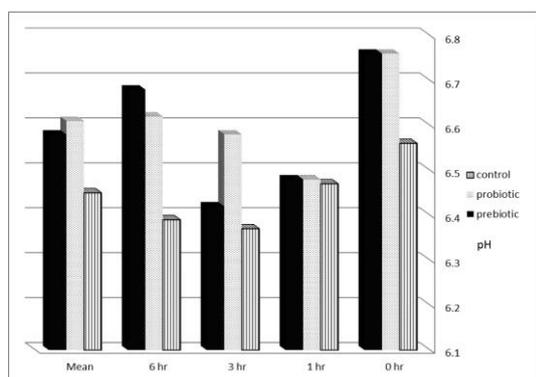


Figure 1. Effect of probiotic and prebiotic supplementation on ruminal pH of barki sheep at different times of sampling.

Rumen parameters:

Results of rumen fluid fermentation parameters are illustrated in Table (4) and figures 1-3. As reported by El-Shinnawy *et al.* (2015) that ruminal pH value is one of the most important factors, which affect microbial fermentation in the rumen and influence its functions. The results indicated that the rumen pH was not affected by the supplement with either probiotic (DFM) or prebiotic and showed no significant differences when compared with control ration. The obtained values were within the normal ranges (6.45-6.61) as reported by Hungate (1966), who indicated that cellulytic bacteria need a rumen pH of about 6.2 and 7.0 in order to multiply rapidly and colonize the epidermal surfaces of plant fragments within 5 minutes.

Regarding the effect of sampling time, the results indicated the highest pH value was recorded at zero time and tended to decrease at 1 and 3 hrs. then returned to increase at 6 hrs. post feeding.

This data may be related to fermentation process of both non structural and structural carbohydrates and

producing of volatile fatty acids which were increased with proceeding time and cause a reduction in ruminal pH until they were proportionally more absorbed from the rumen wall resulting an increase in pH again. This result agreed with the finding of El-Shinnawy (2010) and El-Shinnawy *et al.* (2011)

As for ammonia nitrogen concentrations the values were low in pre-feeding samples (Figure 2 and Table 4). However, at three hours after feeding the values for different rations were increased, and then decreased after 6 hours. The data also indicated that ruminal ammonia nitrogen values were significantly (p<0.05) lower in both rations containing probiotic and prebiotic. The greatest mean value of ruminal ammonia (14.40) was recorded for lambs fed control ration. The results obtained in this study are consistent with the results obtained by Shibata, (1985) and Biggs and Hancock, (1998). However, Sánchez *et al.* (2010) found that the concentrations of NH₃-N were not modified by supplemented prebiotic. On the other hand, the decrease in NH₃-N concentration with animal fed ration supplemented with probiotics (DFM) might have been the result of increased incorporation of ammonia into microbial protein. This result supported the results obtained from microbial protein synthesis. The ranges of NH₃-N concentration were 9.6: 13.75 at zero time and 11.38: 14.4 mg/100 ml at 6 hrs post feeding. These ranges could cover the required amounts for microbial protein synthesis, since the minimum value in this concern 3.3 to 8.5 mg/ 100 ml R. L. (kang- Meznarich and Broderick, 1981).

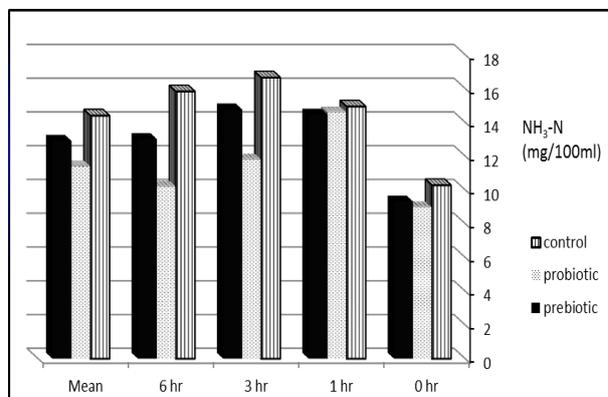


Figure 2. effect of probiotic and prebiotic supplementation on ruminal (NH₃-N) concentration of barki sheep at different time's sampling.

The values of rumen total volatile fatty acids (TVFA's) concentrations and their fractions (m.eq/ 100 ml R.L.) are presented in Figure (3) and Table (4). The data showed that the minimum values were recorded before morning feeding and increased after 3 hours to the maximum values, then again decreased after 6 hours. These results agree with EL- Ashry *et al.* (2000) who found that TVFA's concentration in the rumen was low before feeding and increased with time after feeding. Animals fed rations supplemented with prebiotic showed intermediate values between those fed control ration or rations supplemented with probiotic

which recorded higher values in TVF's concentrations. While, lower values TVF's concentrations obtained from control. These results in agreement with Li *et al.* (2007) and Sánchez *et al.* (2010) who provided evidence that probiotics increase volatile fatty acid (VFA), microbial protein concentrations, and stabilize the rumen pH. Similar results were reported by Al-Dabeeb and Ahmed (2002), Komonna (2007) in sheep and Shahin *et al.* (2005). They reported that increasing in VFA concentration match well with that reported by Mousa *et al.* (2012) in sheep. They also reported that higher total VFA concentrations were found for sheep fed rations supplemented with probiotics (DFM) as compared with control group. It is of interest to note that minimum pH values were observed at 3 hours post feeding and increased thereafter, which were the highest NH₃-N concentrations at that time as well. Contrarily, pH values noticed at 3 hrs post feeding were negatively interrelated with highest total VFA's concentrations.

The values of acetic acid concentrations (m.eq/100 ml R.L.) are presented in figure (3). The acetic acid values tend to increase by prolongation of time post feeding, reaching highest at 3 hrs post feeding then increased after 6 hrs post feeding. The data also showed that proportion of acetic acid was lower with probiotic group than control. Furthermore, the percentage of propionic acid was greater in rumen fluid of sheep fed ration supplemented with probiotics (DFM) than those fed ration supplemented with prebiotic and control. Increasing the proportions of glucogenic (propionate) at the expense of acetogenic VFA (acetate and butyrate) is perhaps the only case in which a distinction needs to goals of feedlot cattle (Nicolas, 2013). Probiotics (DFM) supplemented leads to a decrease in the acetate-to propionate ratio (A: P). the values of A:P ratio indicted an improvement of propionate production with probiotic supplemented than that of control improvement. Such increase in propionate production is favorable in growth promotion since it acts as a major precursor of hepatic gluconedgensis which is responsible for the improved performance observed in feedlot cattle. (Krehbiel *et al.* 2003). Moreover, JaK

yeomSeo *et al.* (2010) illustrated that decrease in the A: P ratio caused by probiotic (DFM) increases gross energy (GE) available. The mode of action of probiotic (DFM) is related to lactate-utilizing bacteria counts increase, the ability to metabolize lactate derived from carbohydrate fermentation and preventing or reducing the risk of acidosis in feedlot cattle (Henning *et al.* 2010).

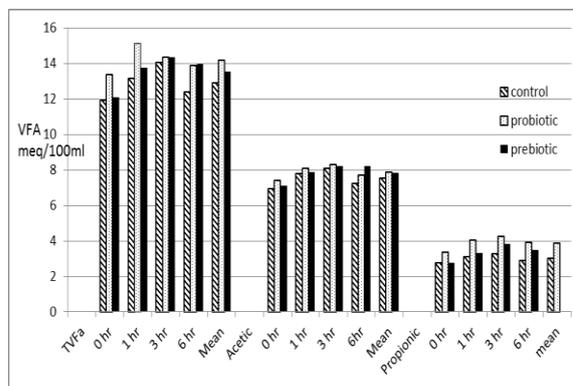


Figure 3. effect of probiotic and prebiotic supplementation on ruminal (VFA) concentration of barki sheep at different time's sampling.

Microbial protein syntheses in the rumen of lambs fed rations are presented in Table (4). The results showed that microbial protein synthesis was higher (P< 0.05) for sheep fed ration supplemented with probiotic (DFM) compare with prebiotic supplemented or control. Microbial protein synthesis dependent on the relationship between the amount of soluble and degradable nitrogen or protein, as well as its rate of degradation, and the amount of digestible organic matter fermented in rumen or carbon chains available to rumen microorganisms. Carro *et al.* (1992); Olson *et al.*(1994) and Vieira *et al.* (2014) reported that microbial protein was enhanced due to supplementation of probiotic (DFM) which was confirmed by greater microbial yield and microbial true protein reaching the duodenum.

Table 4. Overall mean of rumen parameters of sheep fed the experimental Rations (means ± SE).

Items	Experimental rations		
	Control	probiotic(DFM)	Prebiotic
PH	6.45 ± 0.23	6.61± 0.20	6.58 ± 0.14
Mean NH ₃ -N concentration (mg/1000ml R.L)	14.40 ± 0.21 ^a	11.38 ± 0.18 ^c	12.90 ± 0.15 ^b
Mean TVFA concentration (meq/1000ml R.L)	12.86 ± 0.21 ^b	14.17 ± 0.12 ^a	13.55 ± 0.11 ^{ab}
Acetic : propionic ratio	2.50 ± 0.02 ^a	2.03 ± 0.04 ^b	2.34 ± 0.05 ^{ab}
Microbial protein synthesis (gm/day)	81.56±2.05 ^c	105.24±2.24 ^a	88.53±1.95 ^b

^{abc}means in the same row with different superscripts are significantly differ (P< 0.05).

Growth performance:

The effect of dietary supplementation of probiotics (DFM) or prebiotic on feed intake, average daily gain (ADG) and feed conversion of Barki male lambs was shown in Table (5). The results of final BW revealed that probiotics (DFM) supplementation significantly improved (P<0.05) live body weight compared to prebiotics supplementation and control at the end of the experimental period. These results are

consistent with the result obtained by Khaled and Baraka (2011) who indicated that addition of probiotics (DFM) Tomoko® to the sheep rations resulted an increased body weight and ADG. In a similar study by Emanuelle *et al.* (1992), who stated that feeding lambs with probiotics (DFM) -added to dry forage improved the feed consumption, body weight gain and feed conversion rate of the animals. Krehbiel *et al.* (2003) reported that the positive effects of added probiotic

(DFM) on feed intake and feed conversion might be due to differences in bacteria strains used. The results of feed intake showed in Table (5) revealed a significant increase ($p < 0.05$) in feed intake of lambs fed ration supplemented with probiotic (DFM) than those fed rations supplemented with prebiotic or control ration. These results are in agreement with the results reported by Ismaiel *et al.* (2010) who found that addition of Tonilistat lead up to highest total dry matter intake, also a positive impact of probiotics supplementation on nutrient intake, weight gain and feed conversion ratio (FCR) in ruminants has been reported by Chiofalo *et al.* (2004); Antunovic *et al.* (2006) and Whitley *et al.* (2009).

Feed conversion expressed as (kg DMI/ kg gain) showed that the lambs fed rations supplemented with DFM showed the best value (5.52) followed by those feed rations supplemented with prebiotic (6.08) and the

final control rations was (6.50). These results are in agreement with Whitley *et al.*, (2009), who reported a positive impact of probiotic (DFM) supplementation on nutrient intake, weight gain and feed conversion ratio in ruminant. Generally, the DFM (probiotic) have positive effects in young ruminant's performance through increased DM intake and daily gain. Thus, the performance promoting effects of probiotic (DFM) additives could be correlated to an improvement in rumen development parameters such as increasing ratio of propionate: acetate molar may reduce hydrogen available for methane production in the rumen and leads to a reduction in methane. In addition, increments of propionate production in the rumen result in increases of hepatic glucose production (Stein *et al.*, 2006), providing more substrates for lactose synthesis, improving energetic efficiency (Weiss *et al.*, 2008).

Table 5: Growth performance and economic efficiency of lambs feeding experimental rations (Mean \pm SE).

Item	Groups		
	Control	Probiotic (DFM)	Prebiotic
Body weight (kg)			
Initial	28.03 \pm 4.06	27.72 \pm 3.24	27.58 \pm 3.91
Final	44.30 \pm 2.84 ^b	47.33 \pm 3.51 ^a	45.10 \pm 2.63 ^b
Daily gain (g)	181.10 \pm 13.77 ^b	217.08 \pm 18.66 ^a	194.03 \pm 17.22 ^b
Total daily feed intake	1177.10 \pm 92.87 ^c	1197.43 \pm 98.88 ^a	1180.10 \pm 104.42 ^b
Feed conversion			
DMI/ADG	6.50 \pm 0.47 ^a	5.52 \pm 0.21 ^c	6.08 \pm 0.43 ^b
TDN intake/ ADG	4.41 \pm 0.31 ^a	3.94 \pm 0.40 ^c	4.22 \pm 0.22 ^b
DCP intake/ ADG	0.70 \pm 0.02 ^a	0.63 \pm 0.05 ^c	0.66 \pm 0.01 ^b
Economic Efficiency			
Average daily feed cost (LE)	2.69	2.74	2.70
Total feed cost (LE)/ kg gain	14.86	12.63	13.92
Net revenue (LE)	13.14	15.37	14.08
Economic Efficiency	0.47	0.55	0.50
Relative economic efficiency	100	117	106

^{abc} means in the same row with different superscripts are significantly differ ($P < 0.05$).

Free market prices (LE/ton) for the CFM, clover hay, probiotics and prebiotics. Used in the experimental rations in the year (2015). CFM /ton (LE) = 2750, clover hay / ton (LE) = 1600, probiotics /kg (LE) = 25, prebiotics/kg (LE) = 20 & Price / kg live body (LE) = 28.

Economic efficiency:

Calculations were carried according to the prevailing prices of feed ingredients, additives and live body weight during year 2015 (the experiment time) as listed in Table (5). Economic efficiency % (EE) of growing lambs was higher for the lambs fed rations supplemented with probiotics (DFM) followed by those fed ration supplemented with prebiotic and lowest was recorded with lambs fed control ration. These results are in agreement with results by Hesham *et al.* (2013) who stated that probiotics supplemented group showed the highest return value compared with control group and the group supplemented with prebiotic.

CONCLUSION

On the basis of the foregoing results, it could be concluded that feeding growing lambs on rations supplemented with either of probiotics (DFM) or prebiotic at 10 g/h/ day has beneficial effects on growth performance, digestibility coefficients, rumen parameters and economic efficiency of growing Barki

lambs. However, such effects were more obvious with probiotics supplemented ration, compared with prebiotics or control ration. Further works are needed to clearly the mode of action of such additives and to determine the optimum levels of supplemented to be used with other kinds of farm animals and various types of production.

REFERENCES

- Abbas, M. R. (2005). Effect of adding Iraqi probiotic to the ration on the productive performance of caged laying hens. *Iraqi J. Agri.*, 36, (6): 97-104.
- A.O.A.C. (1995). *Multiresidue method* (16th Ed. 985.22) Association Official Analytical Chemists. Washington, Virginia, U.S.A.
- Abd El-Ghani AA (2004). Influence of diet supplementation with yeast (*Saccharomyces cerevisiae*) on performance of Zaraibi goats. *Small Rumin. Res.*, 52:223-229.
- Ahmed, B.M. and M.S. Salah (2006). Effect of yeast culture as an additive to sheep feed on performance, digestibility, nitrogen balance and rumen fermentation". *J. Agric, Sci.*, 1, (14):1-13.

- Al-Dabeeb, S. N. and B. M. Ahmed (2002). Effect of dry yeast (*Saccharomyces cerevisiae*) in sheep rations differing in their roughage to concentrate ratio on digestion, nitrogen balance and rumen fermentation. *Egyptian J. Nutr. and Feeds*, 5 (1) : 1 – 11.
- Ali, M. (2005). Effect of probiotic addition on growth performance of growing lambs fed different roughages. *Egyptian J. Nutr. and Feeds*, 8: 567-578.
- Al-Rabbat, M.F.;R.L. Baldwin and W.C. Weir (1971). *In vitro* nitrogen-treacer technique for some kinetic measures of rumen ammonia. *J. Dairy Sci.*, 54, 150.
- Antunovic Z; M. Speranda, D. Amidzic; V. Seric; Z. Steiner;N.Doma-Cinovic and F.Boli (2006). Probiotic application in lambs' nutrition. *Krmiva*, 4: 175-180.
- Baines Antonio A.T. Baines, D. Xu and C.J. Der(2011). Inhibition of Ras for cancer treatment: the search continues. *Future Med Chem*, pp. 1787–1808.
- Biggs, D.R. and K.R., Hancock, (1998). *In vitro* digestion of bacterial and plant fructans and effects on ammonia accumulation in cow and sheep rumen fluids. *J. Gen. Appl. Microbiol.* 44, 167-171.
- Bohm J. and A. Srour (1995). An Austrian probiotic feed additive for Egyptian buffalo and cattle production. 3rd Scientific Conference, Faculty of Veterinary Medicine, Assiut University (Egypt Society for Cattle Diseases), Dec 3-5, Assiut, Egypt.
- Carro, M. D; P. Lebzien, and K. Rohr, (1992). "Effects of yeast culture on rumen fermentation, digestibility and duodenal flow in dairy cows fed silage based diet" *Livest. Prod. Sci.* 32:219–229.
- Cendrowska, M.C., A. Kasproicz and T. Michalowski (2006). Preliminary assessment of the capability of the rumen bacterium, *Butyrivibrio fibrisolvens*, to utilize fructose polymers for growth. *J. Anim. Feed Sci.* 15, 11-14.
- Chen X. B. and M. J. Gomes (1992). Estimation of microbial protein supply to sheep and cattle based on urinary excretion of purine derivatives - an overview of the technical details. *International Feed Resources Unit*, 45, 445-449.
- Chiofalo, V., L. Liotta and B. Chiofalo. (2004). Effects of the administration of Lactobacilli on body growth and on the metabolic profile in growing goat kids. *Reprod. Nutr. Dev.*, 44: 449-457.
- Dawson, K. (1993). Current and future role of yeast culture in animal production: A review of research over the last seven years. *Biotechnology in the feed industry* 9: 1-21.
- Dawson, K. A., K. E. Newman, and J. A. Boling (1990). Effects of microbial supplements containing yeast and lactobacilli on roughage-fed ruminal microbial activities. *J. Anim. Sci.* 68: 3392.
- Duncan, D.B. (1955). Multiple ranges and multiple F- test. *Biometric*, 11: 1-42.
- El-Ashry, M. A., A. M., Fayed, K. M., Youssef, F. A., Salem, and H. A. Aziz (2000). Effect of feeding Flavomycin or yeast as feed supplement on lamb performance in Sinai. *Egy. J. Nutri Feeds.*, 6, 1009-1022.
- El-Shaer, E.K.H. (2003). Nutritional studies in ruminants (Effect of yeast culture supplementation and concentrate : roughage ratio on performance of growing lambs). Ph.D. Thesis Faculty of Agriculture , Mansoura University. Egypt.
- El-Shinnawy A.M. (2010). Banana plant wastes as unteraditonal feed source for Rahmany sheep. Ph. D. Thesis, Fac. Agric., Univ., Egypt.
- El-Shinnawy M.M.; M.F. Emara; H.F.A. Motawe; Fatma, M. Salman and A.M. El-Shinnawy (2011). Effect of two kinds of bacteria inoculants on preservation and nutritive values of vine broad bean silages, compared with clover hay. Pro. of the 4th Animal Welth Research Conf. in the Middle East & North Africa.
- El-Shinnawy M.M.; K.E.I. Etman; Gihan M. El- Moghazy and A.M. El-Shinnawy (2015). Efficacy of different levels of dried distiller's grains with solubles as a replacement for soybean meal and portion of the corn in a growing and finishing buffaloes calves diet. *Egyptian J. Nutrition and Feeds*, 18(2) Special Issue: 27- 37.
- El-waziry, A. and H. Ibrahim (2007). "Effect of *Saccharomyces cerevisiae* of yeast on fiber digestion in sheep fed berseem (*Trifolium alexandrinum*) hay and cellulose activity" *Australian J. Basic and Applied Sci.*, 1(4):379-385.
- FAO/WHO (2002) Report of a joint FAO/WHO expert consultation on guidelines for the evaluation of probiotics in food. London, Ontario, Canada: World Health Organization and Food Agriculture Organization of the United Nations
- Galip N (2006). Effect of supplemental yeast culture on ruminal protozoa and blood parameters in rams. *Revue de Médecine Vétérinaire* 157: 519- 524.
- Galyean, M. L., G. A. Nunnery, P. J. Defoor, G. B. Salyer, and C. H. Parsons. (2000). Effects of live cultures of *Lactobacillus acidophilus* (Strains 45 and 51) and *Propionibacterium freudenreichii* PF-24 on performance and carcass characteristics of finishing beef steers. Burnett Center Internet Prog. Rep. No. 8, Texas Tech Univ., http://www.depts.ttu.edu/afs/burnett_center/progress_reports/.
- Gomez-Basauri, J.; M. B. de Oндarza and J. Siciliano-Jones. (2001). Intake and milk production of dairy cows fed lactic acid bacteria and mannanoligosaccharide. *J. Dairy Sci.* 84(Suppl. 1):283..
- Hassan. S. A. and K. M. Hassan (2008). The effect of supplementation of medicinal plants and probiotic on growth rate and blood parameters of karadi lambs. *Egyptian J. of Nutr – and Feed.* 12 (1): 53-63.
- Henning, P.H.; C.H. Horn; D. G. Steyn; H. H. Meissner and F. M. Hagg. (2010a). The potential of *Mesasphearales denii* isolates to control ruminal acidosis. *Anim. Feed Sci. Technol.* 157:13-19.
- Heyman, M. and S. Ménard. (2001). Probiotic microorganisms: how they affect intestinal pathophysiology. *Cell. Mol. Life Sci.* 59:1151–1165.
- Hesham H; Mohammed M. Badawi; El-Sayed and MA. Ali (2013). Effects of Commercial Feed Additives on Performance, Economic Efficiency, Blood Metabolites and Some Maintenance Behaviour in Goats. *J Vet Sci Med Diagn* 2.(2):1-7.
- Hungate, R. E. (1966). The rumen and its microbes. Academic press. Inc., NY. USA. 533.
- Hutjens, M.F. (2005). Dairy Efficiency and Dry Matter Intake. University of Illinois 232 ASL, 1207 W. Gregory Drive, Urbana, IL 61801.
- Ismail, A. M.; A. H. El-Far and I. I. Abou-Ganema (2010). Effect of Tonilistat and Roemin Supplementations on the Performance of Lambs. *Intern. J. Biol. Life Sci.*, 6(4).
- Kang-Meznarich, J. H., and G. A. Broderick. (1981). Effects of incremental urea supplementation on ruminal ammonia concentration and bacterial protein formation. *J. Anim. Sci.* 51:422–431.
- Khaled, N. F. and T. A. Baraka. (2011). Influence of TOMOKO® (Direct-Fed Microbials) on Productive Performance, Selected Rumen and Blood Constituents in Barky Finishing Lambs. *Journal of American Science.*; 7(9). 564-570.
- Komonna, O.F.A. (2007). Physiological and nutritional responses of sheep to some feed additives. Ph.D. Thesis, Fac. Agric., Minufiya University.

- Krehbiel CR; SR. Rust; G. Zhang and SE. Gilliland (2003). Bacterial direct-fed Use of commercial Probiotics supplement in meat goat. J. Anim. Sci.,87: 723-728.
- Li, G.H.; B. Liu; M.R.Ou; X.F. Zhang; G.B. Liu; M. Gao. and A.Z. Zhang (2007). Effects of soybean oligosaccharides infusion in different parts of the gastrointestinal tract on several immune indices in sheep. Chin. J. Anim. Sci. 19, 1-7.
- McAllister, T.A.; R. Z. Feniuk; L.B. Mir, Selinger and K.J., Cheng, (1998). Inoculants for alfalfa silage: Effects on aerobic stability, digestibility and the growth performance of feedlot steers. Livest. Prod. Sci. 53, 171-181.
- Micheal, J. J.; K. A. Johnson; R. J. Treacher;C. T. Gaskins and O. Sears (2011). The impact of direct fed fibrolytic enzymes on the growth rate and feed efficiency of growing beef steers and heifers. *Journal of Animal Science* 74, Suppl. 1, 296.
- National Research Council.(1985). Nutrient Requirements of sheep, 9th Revised Edition, National Academy Press, Washington, DC.
- National Research Council.(2007). Nutrient Requirements of sheep, 9th Revised Edition, National Academy Press, Washington, DC.
- Nicolas K. (2013). Impact of direct-fed microbials on nutrient utilization in beef cattle. Thesis of Master of Science in the College of Agriculture at the University of Kentucky.
- Nocek, J. E. and W. P. Kautz.(2006). Direct-fed microbial supplementation on ruminal digestion, health, and performance of pre- and postpartum dairy cattle. *Journal of Dairy Science* 89: 260-266.
- Olson, K. C.; J. S. Caton; D. R. Kirby and P. L. Norton. (1994). Influence of yeast culture supplementation and advancing season on steers grazing mixed-grass prairie in the Northern Great plains : II-Ruminal fermentation , site of digestion and microbial efficiency. J. Anim. Sci., 72 : 2158 – 2170.
- Orr, C. L.; D. R. Ware;E. T. Manfi-edi and D. P. Hutheson(1988). The effect of continuous feeding of *Lactobacillus acidophilus* strain BT1386 on gain and feed efficiency of feeder calves. J. Anim. Sci. 66(Suppl. 1):460-461. (Abstr.)
- Sallam, S. M.;S.1, Abdallah Ali and A. N. Samir.(2014). Comparison of Two Products of Direct-Fed Microbial Supplementation on the Nutrient Utilization and Ruminal Fermentation in Sheep.*Journal of Agricultural Science*; Vol. 6, No. 3: 159-167.
- Sánchez,J.A. J.M.;S.S.Pinos-Rodríguez; J.R. González; J. Barceñal and J.C. García (2010). Influence of supplemental aminooligo-saccharides on *in vitro* disappearance of diets for dairy cattle and its effects on milk yield. *South African Journal of Animal Science* (40).294-300.
- SAS (2000). SAS users guide: Statistics, SAS Inst., Inc., Cary N.C., USA.
- Shahin, G. F.; A. E. M. Khiniza and A. M. Abd-EIKhabir. (2005). Effect of non-hormonal growth promoters on growth, nutrient digestibility and feed efficiency by growing buffalo calves. J. Agric. Sci. Mansoura Univ.. 30. (1) : 103 – 113.
- Shibata. T.H. (1985). Studies on the utilization of pasture herbage nitrogen by rumen microorganisms 2. Effects of carbohydrate and lipid material on the microbial utilization of rumen ammonia *in vitro*. *Grassl. Sci.* 31, 322-331.
- Stein, D. R.; D. T. Allen, E. B. Perry; J. C. Bruner; K. W. Gates; T.G. Rehberger; K. Mertz; D. Jones and L. J. Spicer (2006). Effects of feeding propionibacteria to dairy cows on milk yield, milk components, and reproduction. *J. Dairy Sci.* 89:111-125.
- Tití HH;RO, Dmour and A.Y. Abdullah (2008). Growth performance and carcass characteristics of Awassi lambs and Shami goat kid culture in their finishing diet. *Animal Feed Science and Technology* 142: 33-43.
- Verbic, J., X.B. Chen, N.A. MacLeod and E.R.Ørskov. (1990). Excretion of purine derivatives by ruminants: effect of microbial nucleic acid infusion on purine derivative excretion by steers. J. Agric. Sci., Camb., 114:243-248.
- Vieira, V. A. M. P. Sforcini, V. Endo, G. C. Magioni, M. D. S. Oliveira (2014). Influence of Probiotics on Dairy Cows Diet. *International Journal of Biological, Biomolecular, Agricultural, Food and Biotechnological Engineering* Vol:8, No:7.786-789.
- Warner, A.C.I. (1964). Production of volatile fatty acids in the rumen. *Methods of Measurements.Nutr.Abstr.and Rev.*, 34:339.
- Weiss, W. P., D. J. Wyatt and T. R. McKelvey.(2008). Effect of feeding propionibacteria on milk production by early lactation dairy cows. *J. Dairy Sci.* 91:646-652.
- Whitley NC, D. Cazac, BJ. Rude, D. Jackson-O'Brien and S. Parveen (2009). Use of commercial Probiotics supplement in meat goat. *Journal of Animal Science* 87: 723–728.

تأثير إضافة كل من البروبيوتيك أو البروبيوتيك علي الأداء الإنتاجي لحملان البرقي.

سليمان محمد سليمان , أحمد محمد الشناوي و أحمد محمد المرسي .
المركز الإقليمي للأغذية والأعلاف، مركز البحوث الزراعية . الدقي ، الجيزة، مصر.

أجريت هذه الدراسة لتقييم تأثير إضافة البروبيوتيك T1 (Diamond XP™) أو البروبيوتيك T2 (BioBoost™) على معاملات هضم المواد الغذائية وخصائص تخمرات الكرش و الأداء الإنتاجي والكفاءة الاقتصادية في الحملان البرقي. وقد تم تغذية الحملان في المجموعة المقارنة علي خليط من العلف المركز (CFM) ودريس الريسيم كمادة مائه بدون اي إضافات ، بينما تغذية الحملان في المجموعتين T1 و T2 بإضافة كل من بروبيوتيك أو البروبيوتيك بمعدل ١٠ جم / رأس / يوم علي التوالي وخلطها مع العلف المركز. استخدمت تسعة من ذكور أغنام البرقي لتقدير معاملات الهضم. وتم تقسيم الحيوانات إلى ثلاث مجموعات متساوية بمعدل ٣ حيوانات/ مجموعة. وتم تقدير تخمرات سائل الكرش باستخدام ثلاثة من إناث أغنام البرقي المزودة بفسطولات في الكرش. بينما تم تقدير تجربة النمو باستخدام أربعة وعشرين من ذكور حملان (البرقي) والتي استخدمت لتقييم أداء النمو و التحويل الغذائي والكفاءة الاقتصادية. النتائج المتحصل عليها يمكن تلخيصها علي النحو التالي: ١- الحيوانات التي تم تغذيتها علي عليقة مضاف إليها البروبيوتيك سجلت أعلى ($p < 0.05$) القيم من حيث معاملات الهضم تليها الحيوانات التي تم تغذيتها علي عليقة مضاف إليها البروبيوتيك، بينما الحيوانات التي تغذت علي العليقة المقارنة فقد أظهرت أقل قيم. كما لوحظ نفس الاتجاه أيضا عند تقدير قيم كل من مجموع المواد الغذائية المهضومه والمهضوم من البروتين (% TDN و % DCP). ٢- لم تكن هناك أي اختلافات معنويه ($P < 0.05$) بين المجاميع الغذائية الثلاثة سواء المضاف إليها البروبيوتيك أو البروبيوتيك أو المجموعة المقارنة عند تقدير قيم درجة الحموضة في الكرش، في حين أن (الأحماض الدهنية الطيارة) وتخليق البروتين الميكروبي سجلت زيادة معنويه ($P < 0.05$) مع المجموعة التي تم تغذيتها علي عليقة مضاف إليها البروبيوتيك. في حين سجلت المجموعة التي تم تغذيتها علي العليقة المقارنة أعلى تركيز في معدل قيم الأمونيا نيتروجين-NH3 وذلك عند مقارنتها بالمجموعتين التي تم تغذيتها علي عليقة مضاف إليها البروبيوتيك أو البروبيوتيك . ٣- أظهرت الحيوانات التي تم تغذيتها علي عليقة مضاف إليها البروبيوتيك و البروبيوتيك تأثيراً إيجابياً من حيث نسبة المأكول الكلي من العليقة ونسبة التحويل الغذائي والكفاءة الاقتصادية. وذلك عند مقارنتها بالحيوانات التي تغذت علي العليقة المقارنة . وتوصي الدراسة باستخدام البروبيوتيك و البروبيوتيك بمعدل ١٠ جم / رأس / يوم كإضافات غذائية لما لها من تأثير إيجابي علي الاداء الإنتاجي لحملان البرقي.

