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Effect of Pediococcus spp. Supplementation on Growth Performance, Nutrient Digestibility and Some Blood Serum Biochemical Changes of Fattening Lambs

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ABSTRACT

Key words:

Fattening lambs, Probiotics, Growth performance, Nutrient digestibility.

Twenty growing lambs, which were apparently healthy, of nearly the same body weight (approx. 21.45 kg) were used in this study to investigate the effect of pediococcus spp. supplementation on growth performance, nutrient digestibility and some blood serum parameters of growing lambs. Lambs were allotted into two equal groups, first group fed on the basal diet without any supplement while 2nd group fed on the basal diet and pediococcus supplementation in drinking water for continuous 10 weeks. It was noticed that Pediococcus supplementation improved final body weight, total body gain and feed conversion efficiency (FCE) of dry matter, total digestible protein and digestible protein throughout the whole experimental period by about 15.5%, 49.9%, 30.1%, 31.4% and 29.1% respectively when compared with the control> Moreover, probiotic supplementation improved nutrient digestibility and feed values of the used ration. It was observed that bacterial probiotic supplementation non significantly increased blood serum total protein and globulin concentrations, while had no clear effect of blood serum calcium, phosphorus, kidney and liver function units concentrations when compared with untreated one. Also, Pediococuus supplementation non significantly decreased blood serum lipids concentration. Moreover, it was observed that probiotic supplementation increased benefit/cost ratio% and net income/total cost % from 110% and 10.0% of the control to 123.12% and 23.12% of the treated group respectively. Finally bacterial probiotic supplementation in the drinking water for growing lambs improve economic efficiency of production. Generally, bacterial probiotic supplementation improve lamb growth and maximize economic efficiency of production.

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1. INTRODUCTION

Recent studies on ruminant nutrition have mostly focused on increasing the feed conversion rate. A variety of feed additives have been developed to achieve this objective. Antimicrobial feed additives, which are one of the additives that have been used widely in the world; have been prohibited or restricted in most countries due to the increased concern of causing resistance to antibiotics in bacterial pathogens. Therefore, the interest to potential alternatives to antibiotic feed additives such as direct-feed microbials (DFM), which is known as biological products composed of cultures of useful microorganisms (Alp and Kahraman, 1996; Krehbiel *et al.*, 2003; Elam *et al.*, 2003).

In ruminants, direct-feed microbials are mainly used for lowering the effects of stress conditions and decreasing the use of antibiotics in calves. These microbials both increase milk yield in dairy cows and the body weight gain and feed conversion rate in beef cattle (Krehbiel*et al.*, 2003). Lema *et al.* (2001) it has been reported thatthe addition of direct-feed microbials to the ration of growing lambs resulted in decreased numbers of harmful microorganisms in the intestines improved fattening performance, and feed conversion rate.

The nutrient utilization can further be improved by accelerating the rumen function through the use of feed additives like probiotics (Ding *et al.*, 2008). Probiotics have also been reported to increase daily weight gains in lambs by improving nutrient utilization in the rumen due to their positive effects on rumen microflora(Abd El-Ghani, 2004). Most evidences for such effects come from results of intensive studies of microbial activities in the rumen of cattle and sheep, however very rare studies dealing with fermentation product consisting of a bacterial cocktail of specific lactic acid producing bacteria (pediococcus spp.) on growth performance and nutrient digestibility of growing lambs. On the other hand, few studies have been carried out on the action of DFM on blood parameters and published results have been conflicted. Jouany et al. (1998), reported that DFM did not have any effect on ruminal metabolism such as protein decomposition or microbial protein synthesis and did not cause any changes in some of the blood parameters including serum urea, total protein and albumin.

These experiment was conducted to investigate the effect of bacterial probiotics (Pediococuus spp. containing probioti) water supplementation on growth performance, nutrient digestibility and some blood serum biochemical alterations of fattening lambs under field or traditional conditions.

2. MATERIAL AND METHODS

2.1. Animal used and housing: Twenty growing lambs, which were apparently healthy, of nearly the same body weight (approx. 21.45 kg) and within the same age (average 8 months) were used in this study. Each group was housed in a separate open yard (10m^2 meter), with sandy ground and provided with suitable umbrella of iron sheets, one basin for fresh water and one stilts for feeding. Mineral salt blocks were distributed equally inside each yard (Fe, 3850 mg/kg, Mg 970 mg/kg, Mn 860 mg/kg, ZnO 800 mg/kg, Cu 150 mg/Kg, I 50 mg/kg. Co, 40 mg/kg, Se 30 mg/kg and NaCl up to 100 g).

2.2. Experimental diets and feeding plain

Lambs fed on different mentioned feedstuffs (Corn grain, berseem hay and wheat straw were the basal feeds offered to lambs throughout this experiment. The ingredient proximate chemical analysis are shown in table 1), during the experimental period (lasted for continuous 10 weeks) as in the following table (2). Corn grain was offered in two meal (In the morning and at evening), while berseem hay and wheat straw was offered afternoon.

2.3. Experimental design: After an observation period of 3 days, the used lambs were allotted on body basis into two equal groups. the first group served as control while the second was the experimental group, which fed on the basal diet with supplementation of Max Boost Powder Plus (Probiotic based on pediococcus spp.) in drinking water and named latter, (treated group).Max Boost Powder Plus used at 0.5 g per Kg of offered feed and the total quantity used soaked in 2 liter of water for 6 hours and then mixed in the drinking water for lambs with through mixing from time to time during the day.

Table (1): Proximate chemical analysis of feedstuffs used in the experiment (as fed basis).

Items	Corn	Berseem hay	Wheat straw
DM%	87.6	88.1	89.6
CP%	7.8	16.9	3.8
EE%	3.1	2.70	0.9
Ash%	2.3	12.5	18.6
CF%	2.1	30.9	36.9
NFE%*	72.3	25.1	29.4
Ca%	0.03	1.4	0.23
P%	0.29	0.12	0.07
TDN**	85	54	36

*NFE (calculated by difference) = 100 – (Moisture% + CP% + EE% + Ash% + CF%).

**TDN: calculated according to NRC for sheep (1985).

Table (2): Quantity of different feedstuffs (g/lamb/day) during different experimental period.

Experimental period	Quantity (g/lamb/day)		
	Corn	Green Berseem	Wheat straw
0 – 2 weeks	250	400	200
2 – 4 weeks	375	500	200
4 – 10 weeks	500	500	200

2.4. Growth performance and feed efficiency measurements:

Blood samples: At 6th weeks of the experiment and at the end (10th weeks) of the experimental period, blood samples were taken from 5 lambs of each groups. Each blood sample was left to coagulate at roomtemp. Separation of serum was carried out bycentrifugation of coagulated blood at 3000 rpm for 10 min. The clear serum was transferred carefully to clean and dry vials and kept in deep freezer until analysis for determination of serum glucose, total serum protein, albumin, globulin, calcium, phosphorus, creatnine, uric acid, urea, triglycerides, cholesterol, HDL. LDL, GOT and GPT according to Trinder (1969), Doumas *et al.* (1981), Reinhold (1953) and Coles (1974) respectively.

2.5. Digestibility coefficient: Digestibility of nutrients is one of the most important parameters in feed evaluation studies. At 10 weeks old of the experimental period, digestibility trials were carried out to determine the apparent digestibility coefficients of different nutrients. Five animals from each group of both experiments were used. Fecal samples were collected by hand from each lamb at 12:am for five successive days then dried in a hot air oven at 105°C for 5 hours. After complete drying, the average dry matter content was calculated and the dried fecal samples were mixed for each animal and saved for chemical analysis and nutrient digestibility was calculated according to the following formula: Nutrient digestibility = 100 – (100x % acid insoluble ash in feed/% acid insoluble ash in feces) x %nutrient in feces/ % nutrient in feed)**.**

2.6. Chemical analysis:

Dry matter and crude nutrients: Analytical DM contents of feed and fecal samples were determined by oven-drying at 105°C for 48 h (AOAC, 1990; method 930.15). Ash contents of feed and feces samples were determined by incineration at 550°C overnight, and the OM content was calculated as the difference between 100 and the percentage of ash (AOAC, 1990; method 942.05). Crude fiber were determined by digestion of the sample for 30 min. by using 1.25% H_2SO_4 after hot water washing, digested for 30 min. by using 1.25% NaOH, washing and filtration into the crucible, dried and ignition. Crude protein in feed and fecal samples were determined by using Kjeldahl method according to Randhir and Pradhan (1981) and ether extract was determined according to Bligh and Dyer (1959) technique as modified by Hanson and Olly (1963).

2.7. Statistical analysis: The analysis of variance for the obtained data was performed using Statistical Analysis System (SAS, 1996) to assess significant differences.

3. RESULTS AND DISCUSSION

3.1. Body weight development: Effect of water supplementation of pediococcus probiotic on body weight development of growing fattening lambs are in presented in table 3. Statistical analysis of the obtained data revealed that there no significant ($P \geq 0.05$) difference between lambs weight at the start of the experiment while, lambs loss body weight at 2 week of the experiment by about 1.3% and 0.2% for control and probiotic treated groups respectively when compared with their initial body weight. Moreover, it was observed that pediococcus supplementation non significantly ($P \geq 0.05$) improved body weight of growing lambs at 4th, 6th, and 8th weeks of the experiment by about 9.5%, 14.2% and 14.8% respectively when compared with control group which fed on the basal diet without any supplement.

Pediococcus supplementation non significantly improved final body weight by about 15.5% when compared with control one. Moreover, it was observed that Pediococcus supplementation was more effective during the 2nd half of the experimental period. The obtained data are in harmony with those obtained by Lackowski *et. al.* (2001) , Liotta *et. al.* (2003) and Kochewad et al. (2009) opined that the kids during active growth are more benefited by probiotic supplementation as compared to kids of preweaning age. Adequate data on lamb production support that, supplementation of probiotics to the basal diet is effective and may be helpful to improve growth performance of the ruminants. Efficiency of feed utilization improved in growing lambs fed diets supplemented with probiotics (pioneer PDFM) which indicated the biological changes in rumen (Antunovic et al., 2005). Antunovic et al. (2006) also reported better efficiency of feed utilization in lambs fed diets with probiotics compared to the diets without probiotics but the differences were statistically non-significant.

Table (3) :Effect of pediococcus probiotic supplementation on body weight development (kg/lamb) of growing fattening lambs.

Weeks	Experimental Groups	
	Control	Treated
0	21.11±1.38[a]	21.88±1.43[a]
2	20.83±2.43[a]	21.83±1.94[a]
4	22.67±3.23[a]	24.83±2.99[a]
6	24.89±2.77[a]	28.42±3.83[a]
8	27.22±3.19[a]	31.25±3.29[a]
10	28.39±3.04[a]	32.79±2.98[a]
Relative to control	100	115.5

Values are means ± standard error. Mean values with different letters at the same raw differ significantly at (P≤.05).

3.2. Growth performance parameters:Effect of pediococcus probiotic supplementation on final body weight, weight gain and feed conversion ratio values of growing lambs are presented in table 4. It was observed that probiotic improved final body weight, total body gain and feed conversion efficiency (FCE) of dry matter (DM) or TDN or DCP throughout the whole experimental period by about 15.5%, 49.9%, 30.1%, 31.4% and 29.1% respectively when compared with the control.

Results showed increase in lie body weight (LBW), daily body gain (DBG) due to probiotic containing pediococcus supplementation)probably due to enhance in rumen activity and digestibility. Bacterial probiotic supplementation has positive effects in young ruminant's performancethrough increased daily gain, Thus, The performance promoting effects of probiotic additives could be correlated to an improvement in rumen development parameterssuch as papillae length and width, and rumen thickness (Lesmeister*et al.* 2004), early establishment and stabilization of rumen microbial communities and reduced number of days of diarrhea. Similarly, Abdel-Salam et al. (2014) reported that Najdi male Lambs shown high level of synbiotic association and the highest growth gain (13.74 kg) and had the heaviest weight (35.76 kg) followed by lambs given low level (8.75 and 30.87 kg, respectively) and then by the control lambs (7.33 and 29.36 kg, respectively). Similarly, Sarwar et al. (2011) found that weight gain by growing lambs was higher in the lambs fed on probiotic supplementation.

3.3. Nutrient digestibility and feeding values: Effect of pedoicoccus probiotic supplementation on nutrient digestibility of growing fattening lambs are presented in table5. It was observed that probiotic supplementation for growing lambs improved dry matter, organic matter, crude protein, ether extract, crude fiber and NFE by about 5.5%, 3.9%, 4.4%, 1.9% and 10.5% respectively when compared with untreated group. Moreover, probiotic improved calcium and phosphorus digestibility when compared with control. On the other hand, it was observed that pediococcus supplementation improved TDN and DCP values (table, 6) buy about 3.8% and 4.1%respectively when compared with the control. Also, probiotic treated group showed slight narrower nutritive ratio (NR) values, compared with either the control.

The improvement in nutrients digestibility is possibly explained on the basis that bacterial probiotic enhanced microbial activity and also due to that some beneficial activities of lactic acid bacteria in the gastrointestinal tract, i.e., its anti-diarrhea activities, anti-tumor activities and its ability to alter enzyme activities**.** The main effect of Pediococcus supplementation on ruminants include improvement of gut health and ecology through rumen maturity by favoring microbial establishment, stabilization of rumen pH and interaction with lactate utilizing bacteria (Yang et al. 2004).The establishment of complex rumen microbial ecosystem subsequently improve rumen function that promotes absorption ability and feed digestion (Hopper et al. 2001), thus bacterial probiotics additives improve gut health.

These results are in agreement with those reported by Bohm & Srour (1995) who reported that supplementing the diet of crossbred calves with 5 g Pronifer/(kg concentrate.d)improved the digestibility of most feed nutrients. El-Ashry et al. (2003) with sheep and goats, Nagah (2002) and Khattab et al. (2003) with crossbred lambs and Ragheb et al. (2003) with Friesian calves indicated that the digestibility of most feed nutrients improved by yeastculture (YC), yea-sac (YS) or lacto-sac (LS) supplementation. Feeding values have improved with supplementations due to positive effect on digestible tract. Nagah (2002) and Khattab et al. (2003) reported that the use of either 3 g YS or 3 g LS/h/d improved SV and TDN values of crossbred lambs. Also, Gado et al. (1998), Salem et al. (2000) and El-Ashry et al. (2003) found that yeast culture supplementations had positive effect on TDN and DCP values of growing lambs.

3.4. Blood serum parameters: Effect of pediococcus probiotic supplementation on blood serum total protein, albumin, globulin and glucose concentrations of growing lambs are presented in table 7.Statistical analysis of the obtained data revealed that probiotic supplementation non significantly increased blood serum protein and globulin concentrations at 6th weeks and at the end of the experimental period by about (1.7% and 4.3%) and (8.6% and 17.7) respectively when compared with the untreated group. The present results are in agreement with Abdel-Salam et al. (2014) who found that, Najdi male lambs has given high level of symbiosis and showed the highest concentration of total protein, albumin and globulin (7.93, 4.20 and 3.73 g dl-1, respectively) which was followed by the lambs fed on low level of probiotics (6.72, 3.70 and 3.02 g dl-1, respectively) and the least effective treatment was the control group (6.43, 3.63 and 2.8 g dl-1, respectively).

The present results may be related to the beneficial effect of probiotics supplementation on increasing protein digestibility through the enzymatic effect of protease and alteration amino acid profile of digesta due to increasing microbial protein synthesis (Williams, 1989 & Abdel-Khalek et al., 2000). It was reported that pediococus(bacterial probiotics) showed higher values of serum albumin which is about 2.2%, 3.6% and 2.7% at 6th week or at the end or throughout the whole experimental period respectively when compared with control. The increase in blood albumin suggested normal status of liver function, since liver is the main organ of albumin synthesis. The obtained results are in accordance with those reported by El-Shaer (2003) and Mahrous & Abou-Ammou (2005) for sheep and Kholif (2001) for goats. The increase of albumin in response to YC supplementation may be associated with improved nitrogen absorption (Talha et al., 2009).

Moreover, it was observed that probiotic supplementation had no effect on blood serum glucose concentration when compared with control. These data are in harmony with Antunovic et al. (2006) reported no change of blood glucose levels in the diets of lambs containing probiotics. In addition, Ding et al. (2008) reported that no differences were noticed in blood glucose concentration in lambs fed diets with or without probiotics.

Table (5): Effect of pedoicoccus probiotic supplementation on nutrient digestibility of growing fattening lambs.

Items	Experimental groups	
	Control	Treated
Dry matter	80.44±4.53	84.9±5.09
Organic matter	82.7±2.59	85.994.89
Crude protein	77.9±4.11	81.3±3.91
Ether extract	88.2±2.99	89.9±4.55
Crude fiber	49.43±3.17	54.6±6.03
NFE	84.7±4.30	86.9±7.08
Calcium	52,1±2.93	54.8±3.92
Phosphorus	63.9±4.03	69.8±3.68

Values are means ± standard error. Mean values with different letters at the same raw differ significantly at (P≤.05).

Table (6): Effect of probiotic supplementation on feeding values(%DM) of growing fattening lambs.

Items	Experimental groups	
	Control	Treated
TDN	69.4	72.02
DCP	7.4	7.7
Nutritive ratio	8.37	8.35

Table (7): Effect of pediococcus probiotic supplementation on some blood serum parameters of growing fattening lambs.

Parameters	Experimental group	
	Control group	Treated group
	6th weeks of the experiment	
Total protein (g/dl)	5.77±0.03[a]	5.87±0.41[a]
Albumin (g/dl)	4.08±0.10[a]	4.17±0.25[a]
Globulin (g/dl)	1.63±0.04[a]	1.7±0.04[a]
A/G ratio*	2.43±0.02[a]	2.46±0.18[a]
Glucose (g/dl)	50.4±2.56[a]	50.1±1.99[a]
	At the end of the experiment	
Total protein (g/dl)	6.37±0.43[a]	6.92±0.76[a]
Albumin (g/dl)	3.93±0.41[a]	4.07±0.13[a]
Globulin (g/dl)	2.43±0.09[a]	2.86±0.06[a]
A/G ratio*	1.61±0.08[a]	1.42±0.03[a]
Glucose (g/dl)	50.37±3.50[a]	49.93±432[a]
	Average values	
Total protein (g/dl)	6.07	6.4
Albumin (g/dl)	4.01	4.12
Globulin (g/dl)	2.03	2.28
A/G ratio*	1.98	1.81
Glucose (g/dl)	50.39	50.02

Values are means ± standard error. Mean values with different letters at the same raw differ significantly at ($P \leq .05$). *A/G ratio = Albumin/Globulin ratio.

Table (8): Effect of Pediococcus probiotic supplementation on some blood serum mineral concentration of growing fattening lambs.

Items	Experimental groups	
	Control	Treated
	6th weeks of the experiment	
Calcium)mg/dl)	11.17±1.89[a]	11.17±2.03[a]
Phosphorus (mg/dl)	4.97±0.59[a]	4.80±0.43[a]
	At the end of the experiment	
Calcium)mg/dl)	9.77±0.99[a]	9.80±1.48[a]
Phosphorus (mg/dl)	3.87±0.32[a]	3.53±0.45[a]
	Average values	
Calcium)mg/dl)	10.47	10.49
Phosphorus (mg/dl)	4.42	4.17

Values are means ± standard error. Mean values with different letters at the same raw differ significantly at ($P \leq .05$).

3.5. Blood serum minerals: Effect of Pediococcus probiotic supplementation on some blood serum mineral concentration of growing fattening lambs is presented in table 8. It was observed that bacterial probiotic supplementation for growing lambs had no significant effect on blood serum calcium and phosphorus concentrations level during different experimental period or throughout the whole experimental period when compared with control.

The factors affecting mineral needs of animals, inorganic composition of the body and tissues are determined by species of the animal, race, age, gender, growth rate, health condition, nutritional condition, endocrinological condition, season, and physiological condition (lactation, pregnancy, dry period). In addition, the mineral composition of the body and tissues depend on levels of mineral and protein of the diet (i.e., amount, chemical form, interaction between minerals) **(**Alp et al., 2001; Kahraman et al., 2002). Abu-Damir et al., 1991,vreported that diet-induced change in blood acid-base status was an important factor for mineral retention in lambs and the rates of mineral retention were lowered by acid diets in lambs. Further investigation required to determine the effect of probiotic on different blood serum mineral concentration of growing lambs.

3.6. Kidney function parameters: Effect of pediococcus probiotics supplementation on blood serum parameters concentration for kidney function of growing fattening lambs are presented in table, 9.

Urea in the blood is an indicator of renal function (Oltner & Wiktorson, 1983).It was observed that probiotic supplementation non significantly (P≥0.05) reduced blood serum urea concentration at 6th weeks and at the end of the experimental period by about 4.4% and 7.2% respectively when compared with untreated group (control). Results are disagreement with, Abo El-Nor & Kholif (1998) those who reported higher PUN values in response to probiotics supplementation. While the result in agreement with those obtained by Dimova et al. (2013) found that significant decrease (P<0.05) in PUN of lambs received 5 g.kg–1 probiotic Zoovit" along with concentrate feed; Antunovic et al. (2005) in weaned lambs received 0.1% probiotic and Antunovic et al. (2006).On the other hand, Dolezal et al. (2011) found lower concentration in serum urea nitrogen of cows in response to yeast culture supplementation which suggested as an indicator of better nitrogen metabolism and utilization of protein.

Generally, serum creatinine level is a useful indicator of glomerular filtration in the kidney and normal concentration of creatinine indicates the optimal physical activity. The obtained data indicated that probiotic supplementation had no significant difference in blood serum uric acid and creatinine concentration when compared with control. These data are in harmony with those obtained by Antunovic et al. (2006) have not reported any change in creatinine in growing lambs with probiotics. Dimova et al. (2013) found that no significant differences (P>0.05) in plasma creatinine concentration between control lambs and group received 5 g.kg–1 probiotic "Zoovit" along with concentrate feed. Also Hussein (2014) reported that probiotic supplementation had no significant effect on blood plasma creatinine concentration of Najdi ram lamb.

7. Liver function parameters: Effect of Pediococcus probiotics supplementation on blood serum parameters concentration for liver function of growing fattening lambs is presented in table 10. Statistical analysis of the obtained data indicated that probiotic supplementation increased blood serum GOT and GPT concentrations at 6th weeks of the experimental period by about 0.7% and 91.7% respectively when compared with control, however, pediococcus supplementation significantly (P≤0.05) reduced blood serum GOT and GPT concentrations at the end of the experimental period by about 57.6% and 13.0% respectively when compared with control.

Moreover, it was observed that probiotic supplementation reduced blood serum GOT throughout the whole experimental period by about 32.7% when compared with the control while increased blood serum GPT concentration by about 22.5%. In general blood serum GOT and GPT concentrations estimated in the present study arewithin the normal ranges for ruminants published by several workers in the literatures (Owen *et al.* 1954, Mahmoud 1993, Nagah 2002, EL-Ashry *et al.* 2003 and Ragheb *et al.* 2003) suggested that the experimental growth promoters are safe for physiological and healthystatus of all experimental lambs.

Table (9). Effect of pediococcus probiotics supplementation on blood serum parameters concentration for kidney function of growing fattening lambs.

Items	Experimental groups	
	Control	Treated
6th weeks of the experiment		
Uric acid (µg/dl)	5.93±0.42[a]	5.93±0.64[a]
Creatinine (µg/dl)	0.73±0.02[a]	0.98±0.01[a]
Urea (µg/dl)	60.54±6.09[a]	57.88±6.11[a]
At the end of the experiment		
Uric acid (µg/dl)	5.96±0.91[a]	6.09±0.85[a]
Creatinine (µg/dl)	1.33±0.01[a]	1.00±0.02[a]
Urea (µg/dl)	64.93±4.87[a]	60.27±4.75[a]
Average values		
Uric acid (µg/dl)	5.95	6.01
Creatinine (µg/dl)	1,03	0.99
Urea (µg/dl)	62.74	59.08

Values are means ± standard error. Mean values with different letters at the same raw differ significantly at (P≤.05).

Table (10): Effect of Pediococcus probiotics supplementation on blood serum parameters concentration for liver function of growing fattening lambs.

Items	Experimental groups	
	Control	Treated
6th weeks of the experiment		
GOT	49.0±3.77[a]	49.33±6.04[a]
GPT	12.0±1.09[b]	23.0±1.76[a]
At the end of the experiment		
GOT	66.0±5.65[a]	28.0±0.86[b]
GPT	23.0±2.12[a]	20.0±2.09[b]
Average values		
GOT	57.5	38.67
GPT	17.5	`21.5

Values are means ± standard error. Mean values with different letters at the same raw differ significantly at (P≤.05).

Table (11): Effect of pediococcus probiotics supplementation on blood serum lipids concentration of growing fattening lambs.

Items	Experimental groups	
	Control	Treated
6th weeks of the experiment		
Triglyceride (mg/dl)	212.03±11.43[a]	210.67±14.32[a]
Total cholesterol (mg/dl)	198.77±12.49[a]	198.27±10.93[a]
HDL	31.0±2.44[a]	31.90±1.93[a]
LDL	124.76±8.79[a]	125.11±9.83[a]
At the end of the experiment		
Triglyceride (mg/dl)	200.23±11.67[a]	198.83±13.56[a]
Total cholesterol (mg/dl)	196.13±15.42[a]	194.13±10.93[a]
HDL	28.67±2.09[a]	28.20±1.98[a]
LDL	133.14±11.44[a]	131.81±12.42[a]
Average values		
Triglyceride (mg/dl)	206.13	204.75
Total cholesterol (mg/dl)	195.13	196.2
HDL	29.84	30.09
LDL	128.95	128.46

Values are means ± standard error. Mean values with different letters at the same raw differ significantly at (P≤.05).

3.8. Blood serum lipids concentrations: Effect of pediococcus probiotic supplementation on blood serum lipids concentrations are presented in table 11. Statistical analysis of the obtained data indicated that probiotic (pediococcus) supplementation non significantly deceased blood serum triglyceride and total cholesterol concentrations at 6th weeks of the experiment or at the end of the experimental period by about (0.8% and 0.3) and (0.7% and 1.4%) respectively when compared with control group.Moreover, probiotic supplementation had no significant effect on blood serum HDL and LDL concentrations when compared with control.

Although there are number of studies indicating that direct-feed microbials lower the blood cholesterol level(Alp and Kahraman 1996; Lubbadeh *et al.*, 1999), brought up a possible explanation why the direct-feed microbials decrease the level of cholesterol. Microbial feed additives reduce the absorption of lipid from the intestines by deconjugation; consequently it may decrease blood cholesterol. on the other hand, Abas et al. (2007) revealed that organic acids decreased significantly the cholesterol level more than direct-feed microbials did.

3.8. Economic efficiency: Effect of pediococcus probiotic supplementation on economic efficiency of lamb production is presented in table 12. The obtained data revealed that pediococcus probiotic supplementation improved total return from 990 LE per lamb of the control group to 1145 LE. This improvement may be related to the higher final body weight of the treated group. Moreover, it was observed that probiotic supplementation increased benefit/cost ratio% and net income/total cost % from 110% and 10.0% of the control to 123.12% and 23.12% of the treated group respectively. Finally bacterial probiotic supplementation in the drinking water for growing lambs improve economic efficiency of production.

Table (12): Effect of pediococcus probiotic supplementation on economic efficiency of lamb production.

Items	Control group	Treated group
No. of lamb used	10	10
Animal price (LE per lamb)	750	760
Total feed cost (LE/lamb)	100	100
Additives cost (LE/lamb)	0.0	12
Other cost (LE)*	50	50
Total cost (LE/Lamb)	900	930
Total return (LE/lamb)	990	1145
Net income (LE)	90	215
Benefit/cost ratio %	110.0	123.12
Net income/T. cost %	10.00	23.12

*Managemental cost including veterinary care, drug used, workers and housing.

4. CONCLUSION The obtained data concluded that Pediococcus spp. supplementation in drinking water for growing lambs improve final body weight, weight gain and feed conversion of lambs. Also, probiotic supplementation improve nutrient digestibility and feeding values of animal feed and had no significant effect on blood serum parameters. Moreover, bacterial probiotics improve economic efficiency of lamb production.

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