EFFECTS OF REDUCED DIETARY PROTEIN CONCENTRATIONS WITH PROTEXIN PROBIOTIC SUPPLEMENTATION ON GROWTH PERFORMANCE AND CARCASS COMPONENTS IN RABBITS.

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(Received 5/4/2012, Accepted 7/6/2012)

SUMMARY

The effects of a multi-strain probiotic (protexin) on rabbit growth performance, carcass parameters and economic efficiency were studied. Live body weight and daily gain significantly (P<0.001) increased with the increasing crude protein level in rabbit diets. Rabbits fed diets with normal crude protein (16%) recorded higher body weight, daily weight gain, feed intake, feed cost, return from body weight gain and final margin by 12.91, 18.90, 7.46, 10.24, 19.04 and 30.04%, respectively than those fed diets containing low (14%) crude protein. On the other hand, the increasing the crude protein in rabbit diets improved the feed conversion ratio. The improving value in feed conversion was 9.71% than those fed low protein diet. Serum total protein, albumin, globulin, urea-N, createnine, glucose, triglycerides and AST increased significantly (P<0.001) with increasing dietary protein, while ALT significantly (P<0.01) decreased. Analysis of variance indicated that the dietary protein level significantly (P<0.001) pre-slaughter live body weight. However, analysis of covariance indicated that adjusted carcass and non-carcass components were insignificantly affected. Final body weight increased with 10.85, 19.45 and 18.68%, respectively in rabbit groups fed diets supplemented with 0.05, 0.10 and 0.15 g protexin/kg diet when compared with the control group. The same figures for the daily gain at 0-8 weeks were 14.52, 29.84 and 27.75%, respectively. Daily feed intake increased in rabbit groups fed diets supplemented with 0.05, 0.10 and 0.15 g protexin/kg diet with 9.45, 15.66 and 17.31%, respectively. Feed cost, return from body gain and final margin increased with dietary supplementation with protexin. Return from body gain increased with 14.52, 29.84 and 27.75%, respectively in rabbit fed diets supplemented with 0.05, 0.10 and 0.15 g protexin/kg diet, also the same figure for final margin were 21.22, 48.60 and 41.55%, respectively.

Rabbit fed low protein diet and supplemented with 0.10 or 0.015 g protexin/kg diet recorded higher growth rate than the rabbit group fed normal protein diet and without protexin supplementation. Rabbit groups fed low protein diet and supplemented with 0.10 or 0.015 g protexin recorded higher final margin with 7.02 and 7.86%, respectively than rabbit group fed normal protein diet without protexin supplementation. Protexin effect was apparent with the low protein level than with the normal level.

Keywords: *protexin probiotic; growth performance; feed conversion blood components; slaughter traits.*

INTRODUCTION

Use of feed additives as growth promoters is going to be popular in animal and poultry diets to improve nutrients digestion, absorption, metabolism, performance and health (Beheshti Moghadam *et al.*, 2009).

The role of different probiotic additives is to sustain digestion processes, to enable better digestibility and food conversion and to improve the health of the animal. Probiotics include viable microbial and microbial fermentation products which are beneficial to decrease the undesirable microflora population in the gastrointestinal tract of animals (Chiang and Hsich, 1995), to sustain digestion processes, to enable better digestibility and food conversion and to improve the health of the animal (Kermauner and Strulec, 1996 and 1999), has a particularly favourable effect on microbial balance in the caecum of rabbit (Kermauner and Strulec, 1996) and build-up resistance against diseases by stimulating the immune system (Cheeke, 1991; Patterson and Burkholder, 2003). Majority of the probiotic products are based mainly on *Lactobacillus acidophilus*, although other organisms such as *Streptococcus faecium*, *Bacillus subtilis* and yeast are also used (Cheeke, 1991).

Protexin is a multi-strain probiotic used in poultry and rabbit production (Ghafoor *et al.*, 2005). It contains naturally occurring nine different species of beneficial microflora which are generally regarded as safe by the American Food and Drug Administration (Fuller, 1989 and Anjum *et al.*, 2005).

Protexin is one of the commercial preparations of probiotics available in Egypt marketed by Protexin International limited, UK. It contains *Lactobacillus plantarum, Lactobacillus rhamnosus, Bifidobacterium bifidum, Enterococcus faecium, Candida pintolepesii, Aspergillus oryzae* in isolated forms. However, information on the use of protexin, their levels in rabbit diets and its effect on growth performance is scanty in Egypt.

The objective of the present study was to investigate the effect of dietary supplementation of probiotic (Protexin) on body weight gain, feed consumption, feed conversion ratio, carcass evaluation characteristics, blood components and economic efficiency in rabbit under Egyptian conditions.

MATERIALS AND METHODS

The present study was conducted during November – January at privet farm at Zagazig city, Sharqia Governorate. A total of 80 weaned New Zealand White (NZW) male rabbits of 28 days of age with nearly equal initial live body weight were used for 8 weeks. The rabbits were randomly allotted to 8 experimental groups (10 rabbits in each); four groups were fed on low protein diet (14% CP) and the others four groups were fed on normal protein diet (16% CP). Within each protein level, a control group (no probiotic supplement was added) and three groups were dietary supplemented with protexin (0.05, 0.1 and 1.5 g/kg diet, respectively). All animals were fed a pelleted diet and watered *ad libitum*. The basal diets were shown in Table 1.

Table (1): Composition and chemical analysis of the experimental diets.

	Low protein diet (14%)	Normal protein diet (14%)
Ingredients:		
Alfalfa hay %	30.0	30.0
Barley %	12.0	7.0
Soybean meal %	7.0	12.0
Wheat bran %	32.0	32.0
Yellow corn %	14.0	14.0
Molasses %	3.0	3.0
Limestone %	1.4	1.4
Sodium chloride salt %	0.3	0.3
Vitamin and mineral premix %	0.3	0.3
Chemical composition:		
Crude protein %[1]	14.40	16.86
Crude fibre %[1]	13.22	13.67
Ether extract %[1]	2.83	2.69
Digestible energy (kcal/kg)[2]	2516.00	2525.00

[1] *Analyzed according to A.O.A.C. (1980)*

[2] *Calculated according to NRC (1977).*

All animals were kept under similar managerial and hygienic conditions, during the experimental period. The rabbits were raised in cages provided with feeders and automatic nipple drinkers. The building was naturally ventilated and provided with electric fans. Rabbits were individually weighed at the beginning and the end of the experimental period. Weighing was carried out before offering the morning meal at 8.00 h. Feed consumption was recorded during the experimental period and feed conversion was calculated.

At the end of the experimental period, four rabbits chosen randomly from each group were slaughtered. The rabbits were fasted 12 h before slaughtering. After complete bleeding, pelt, viscera and tail were removed and the carcass and some carcass components (fore, intermediate and hind parts, liver and head), were weighed. Blood samples of rabbits were collected during slaughter. Serum samples were obtained by centrifugation of blood at 3000 rpm for 20 minutes and kept at -20°C for analysis. Serum total protein, albumin, creatinine, urea-N and tranaminase enzymes were determined by using commercial kits.

Economic evaluation was calculated as the following equation (Ayyat, 1991b), Margin = Return from body gain weight - Feed cost. Other overhead costs were assumed constant. Price of one kg of 14% protein diet and 16% protein diet were 2.125 and 2.180 LE, respectively and price of selling of one kg live body weight of rabbits was 18.0 LE.

The data of body weight, daily body gain and blood components of rabbits were statistically analyzed by factorial experiment (SAS, 2002) according to the following Model 1: $Y_{ijk} = \mu + P_i + A_j + PA_{ij} + e_{ijk}$, where Yijk = an observation, μ = the overall mean, P_i = the fixed effect of i^{th} dietary protein level (i= 1,2), A_j = the fixed effect of j^{th} protexin probiotic (j=1..., 4) , PA_{ij} = the interaction between the i^{th} dietary protein level and protexin probiotic and e_{ijk} = random error. The data of slaughter traits were statistically analyzed by analysis of covariance (factorial experiment) according to the following Model 2: $Y_{ijk} = \mu + P_i + A_j + PA_{ij} + b(X-x) + e_{ijk}$, where, Yijk,μ, S_i, A_j, SA_{ij} and eijk were as defined in the Model 1, b = partial linear regression coefficients of Y_{ij} on slaughter weight, X = value of slaughter weight and x = overall average of slaughter weight. Significant differences were determined by Duncan's Multiple Range test (Duncan, 1955).

RESULTS AND DISCUSSION

Growth performance:

Live body weight and daily gain significantly (P<0.001) increased with the increasing crude protein level in rabbit diets (Table 2). Rabbits fed diets with normal crude protein (16%) recorded higher body weight by 9.25 and 12.91% at 4 and 8 weeks of the experimental period, respectively than those fed diets containing low (14%) crude protein. Daily body gain at the whole experimental period (0-8 weeks) increased by 18.90% rabbits fed normal protein diet. The results obtained are in agreement with those obtained by Omole (1977 and 1982), Ayyat (1991a, 1994) and Ayyat *et al.* (1995).

Table (2): Live body weight and gain of Zealand White male rabbits as affected by dietary protein level, protexin probiotic and their interactions.

Item	Live body weight			Daily gain (g/day)		
	0 W	4 W	8 W	0-4 W	4-8 W	0-8 W
Effect of dietary protein level						
Low	577.00±7.77	1206.88±16.56	1844.63±25.15	22.50±0.61	22.78±0.90	22.64±0.44
Normal	573.38±7.11	1318.50±19.76	2082.75±24.69	26.61±0.77	27.29±0.93	26.95±0.44
P value	0.9334	0.0001	0.0001	0.0001	0.0001	0.0001
Effect of protexin probiotic (g/kg diet)						
0.00 g	573.25±10.93	1227.75±27.98^{b}	1749.50±32.89^{c}	23.37±0.99^{b}	18.63±0.95^{c}	21.01±0.59^{c}
0.05 g	592.00±10.33	1227.00±22.18^{b}	1939.25±30.32^{b}	22.68±0.92^{b}	25.44±1.30^{b}	24.06±0.50^{b}
0.10 g	562.25±8.89	1259.75±25.24^{b}	2089.75±35.90^{a}	24.91±1.01^{ab}	29.64±1.02^{a}	27.28±0.64^{a}
0.15 g	573.25±11.25	1336.25±32.49^{a}	2076.25±29.05^{a}	27.25±1.15^{a}	26.43±0.93^{b}	26.84±0.47^{a}
P value	0.2628	0.0060	0.0001	0.0037	0.0001	0.0001
Interaction effect between dietary protein level and protexin						
Low protein level						
0.00 g	579.50±15.66	1165.00±32.98^{d}	1619.50±21.48^{e}	20.91±0.91^{d}	16.23±0.77^{e}	18.57±0.27^{g}
0.05 g	538.00±17.80	1202.00±33.52^{cd}	1823.00±19.57^{d}	21.93±1.55^{cd}	22.18±1.72^{cd}	22.06±0.23^{f}
0.10 g	569.50±12.42	1205.00±27.19^{cd}	1959.50±18.70^{c}	22.70±0.98^{cd}	26.95±0.91^{b}	24.82±0.17^{d}
0.15 g	571.00±17.49	1255.50±36.64^{bcd}	1976.50±26.27^{c}	24.45±1.23^{bcd}	25.75±1.34^{bc}	25.10±0.32^{cd}
High protein level						
0.00 g	567.00±15.83	1290.50±36.63^{bc}	1879.50±18.73^{d}	25.84±1.41^{bc}	21.04±1.38^{d}	23.44±0.25^{e}
0.05 g	596.00±11.42	1252.00±28.54^{bcd}	2055.50±22.27^{b}	23.43±1.02^{bcd}	28.70±1.36^{ab}	26.06±0.33^{c}
0.10 g	555.00±12.95	1314.50±35.83^{b}	2220.00±36.37^{a}	27.12±1.50^{ab}	32.34±1.41^{a}	29.73±0.60^{a}
0.15 g	575.50±15.06	1417.00±40.83^{a}	2176.00±25.73^{a}	30.05±1.54^{a}	27.11±1.33^{b}	28.58±0.41^{b}
P value	0.8287	0.4359	0.5506	0.4065	0.2371	0.1195

Means in the same column within each classification with different letters differ significantly (P<0.05).

Omole (1977) reported that the rabbits fed diets contained 18% crude protein recorded high body weight than those fed lower levels. Also, Ayyat (1991a) obtained lower body weight in New Zealand White rabbits fed diet containing 14.4% crude protein than those given diet with 16.4% crude protein, under Egyptian conditions. Ayyat (1994) found that the body weight increased significantly (P<0.001) with increasing the level of dietary protein in rabbit diets. On the other hand, Carregal and Nikum (1980) and Zaragoza and Vallelo (1982) did not found any significantly differences among groups fed different protein diets.

Live body weight, daily gain weight increased significantly (P<0.01 or 0.001) with dietary supplementation with protexin probiotics. Final body weight increased with 10.85, 19.45 and 18.68%, respectively in rabbit groups fed diets supplemented with 0.05, 0.10 and 0.15 g protexin/kg diet when compared with the control group. The same figures for the daily gain at 0-8 weeks were 14.52, 29.84 and 27.75%, respectively (Table 2). Rabbit groups fed diets supplemented with 0.10 or 0.15 g protexin recorded higher final body weight and daily gain than the other groups. *Lacto-Sacc* (probiotic) addition showed significant (P<0.05) effects on final body weight at 12 weeks and daily gain at 4-12 weeks of age in rabbits (Ayyat *et al.*, 1996). Also, Anjum *et al.* (2005) suggests that protexin supplementation is beneficial for better weight gains in broiler chicks.

Dietary supplementation with 0.10 g protexin recorded higher final live body weight, total gain weight than the other concentrations of protexin (0.05 and 0.15 g/kg diet) under sub-tropical conditions of Egypt.

Interactions between dietary protein level and protexin were insignificant on live body weight and body gain weight (Table 2). Rabbit fed low protein diet and supplemented with 0.10 or 0.015 g protexin/kg diet recorded higher growth rate than the rabbit group fed normal protein diet and without protexin supplementation. Kamrad *et al.* (1996) Crude protein digestibility was significantly improved (P<0.05) in the animals given Lacto-Sacc (mixed culture of lactic acid bacteria). Within each dietary protein level, protexin supplementation increased final body weight and gain. Particularly, within low protein diet, it was observed that dietary protexin supplementation improved the final live body weight and gain weight.

Feed efficiency:

Rabbits fed diet containing normal crude protein recorded higher feed intake with 7.46% at 0-8 weeks of the experimental period than those fed low protein diet (Table 3). On the other hand, the increasing the crude protein in rabbit diets improved the feed conversion ratio. The improving value in feed conversion was 9.71% than those fed low protein diet. Ayyat (1991a) and Omole (1977) have obtained similar results.

Table (3): Feed intake, feed conversion and profit analysis of Zealand White male rabbits as affected by dietary protein level, protexin probiotic and their interactions.

	Feed intake (g/day)	Feed conversion (g food/g gain)	Feed cost (LE/rabbit)	Return from gain (LE/rabbit)	Final margin (LE/rabbit)
Effect of dietary protein level					
Low	106.58	4.707	12.682	22.821	10.139
Normal	114.53	4.250	13.981	27.166	13.185
Effect of protexin probiotic (g/kg diet)					
0.00 g	99.95	4.757	12.054	21.178	9.124
0.05 g	109.40	4.547	13.193	24.252	11.060
0.10 g	115.60	4.238	13.941	27.498	13.558
0.15 g	117.25	4.368	14.140	27.055	12.915
Interaction effect between dietary protein level and protexin					
Low protein level					
0.00 g	96.20	5.180	11.448	18.719	7.271
0.05 g	105.30	4.773	12.531	22.236	9.706
0.10 g	111.60	4.496	13.280	25.019	11.738
0.15 g	113.20	4.510	13.471	25.301	11.830
High protein level					
0.00 g	103.70	4.424	12.660	23.628	10.968
0.05 g	113.50	4.355	13.856	26.268	12.412
0.10 g	119.60	4.023	14.601	29.968	15.367
0.15 g	121.30	4.244	14.808	28.809	14.000

Daily feed intake increased in rabbit groups fed diets supplemented with 0.05, 0.10 and 0.15 g protexin/kg diet with 9.45, 15.66 and 17.31%, respectively when compared with the control group, also the fed cost showed the same trend. On the other hand, feed conversion improved with 4.41, 10.91 and 8.18%, respectively (Table 3). Hollister *et al.* (1989) and Rosell (1990) found that addition of probiotic in rabbit diets improved feed conversion. Dietary supplementation with 0.10 g protexin improved the feed conversion than the other concentrations of protexin (0.05 and 0.15 g/kg diet) under sub-tropical conditions of Egypt.

Within low protein diet, it was observed that dietary protexin supplementation improved the feed conversion (Table 3).

Economic efficiency:

Feed cost slightly increased by increasing crude protein levels in rabbit diets. On the other hand the return from body weight gain increased. Feed cost, return from body weight gain and final margin increased by 10.24, 19.04 and 30.04%, respectively, in rabbits fed normal protein diet than those fed low protein diet (Table 3). Ayyat (1994) reported that feed cost, return from body gain and final margin increased by 7.52, 22.58 and 29.67%, respectively, in rabbits fed normal protein diet (16.8%) than those fed low protein diet (13.2%).

Feed cost, return from body gain and final margin increased with dietary supplementation with protexin. Return from body gain increased with 14.52, 29.84 and 27.75%, respectively in rabbit fed diets supplemented with 0.05, 0.10 and 0.15 g protexin/kg diet, also the same figure for final margin were 21.22, 48.60 and 41.55%, respectively (Table 3). The present results are in accordance with the findings of Chiang and Hsieh (1995), Ayyat *et al.* (1996), Santoso *et al.* (2001) and Fuller (2001). Therefore, when both body weight gain and feed conversion ratio are considered for gaining maximum profit, the inclusion of protexin at 0.10g/kg in diets may be recommended. Dietary supplementation with 0.10 g protexin recorded higher return from body gain and final margin than the other concentrations of protexin (0.05 and 0.15 g/kg diet) under sub-tropical conditions of Egypt.

Rabbit groups fed low protein diet and supplemented with 0.10 or 0.015 g protexin recorded higher final margin with 7.02 and 7.86%, respectively than rabbit group fed normal protein diet without protexin supplementation (Table 3).

Blood components:

Serum total protein, albumin, globulin, urea-N, createnine, glucose, triglycerides and AST increased significantly ($P<0.001$) with increasing dietary protein, while ALT significantly ($P<0.01$) decreased (Tables 4 and 5). The obtained results may be indicated that the increasing dietary protein level improved the liver activity and increase the protein synthesis in the liver. The increasing in serum total protein concentration was related with the increasing serum albumin level. These results may be indicated that the protein synthesis increased in rabbits fed normal dietary protein level. Omole (1982) reported that the increasing dietary protein increased the concentrations of serum total protein and globulin at the end of growing period. He also reported that the blood urea concentration positively related to protein level in rabbit diets. Ayyat (1991) reported that serum total protein insignificantly increased as result of the increased levels of crude protein. However, Ayyat (1994) found that the concentrations of serum total protein and albumin increased significantly ($P<0.001$), while the level of serum globulin did not affect with dietary protein.

All studied blood components affected significantly ($P<0.001$, 0.01 or 0.05) with protexin supplementation in rabbit diets, except urea-N concentration (Tables 4 and 5). Serum total protein, albumin, globulin, urea-N, createnine, glucose and AST increased with dietary protexin supplementation, while the concentrations of triglycerides and ALT decreased. Fuller (2001) and Patterson and Burkholder (2003) had explained the mechanism of probitics to pathogen inhibition by competition for nutrients, production of toxic condition and compounds (volatile fatty acids, low pH, and bacteriocins), competition for binding sites on the intestinal epithelium and stimulation of the immune system.

Interaction between dietary protein and protexin addition showed significant effects ($P<0.01$ or 0.05) on serum total protein, globulin, glucose and triglycerides (Tables 4 and 5).

Slaughter traits:

Analysis of variance indicated that the dietary protein level significantly ($P<0.001$) pre-slaughter live body weight. However, analysis of covariance indicated that adjusted carcass and non-carcass components were insignificantly affected (Tables 6 and 7).

Omole (1977) reported that the carcass yield and kidney fat weight did not seem to be significantly influence by protein level in rabbit diets. Also, Carregal (1993) reported that dietary crude protein level insignificantly affected carcass yield.

Pre-slaughter live body weight affected significantly with protexin. On the other hand, carcass weight and carcass components insignificantly affected with the protexin supplementation (Tables 6 and 5). The present results are in accordance with the findings of Ayyat *et al.* (1996).

Table (4): Serum total protein, albumin, globulin, urea-N and createnine of New Zealand White male rabbits as affected by dietary protein level, protexin probiotic and their interactions.

Item	Total Protein (g/100ml)	Albumin (g/100ml)	Globulin (g/100ml)	Urea-N (mg/100ml)	Createnine (mg/100ml)
Effect of dietary protein level					
Low	6.99±0.08	4.07±0.08	2.92±0.072	22.60±0.70	1.241±0.030
Normal	8.39±0.13	4.84±0.09	3.55±0.065	26.81±0.49	1.390±0.033
P value	0.0001	0.0001	0.0001	0.0001	0.0006
Effect of protexin probiotic (g/kg diet)					
0.00 g	$7.12±0.21^{d}$	$4.08±0.12^{c}$	$3.04±0.16^{b}$	$22.98±1.23^{b}$	$1.197±0.043^{b}$
0.05 g	$7.51±0.22^{c}$	$4.29±0.17^{c}$	$3.22±0.07^{ab}$	$24.75±1.06^{ab}$	$1.303±0.049^{ab}$
0.10 g	$8.27±0.31^{a}$	$4.86±0.15^{a}$	$3.41±0.18^{a}$	$26.08±0.82^{a}$	$1.407±0.040^{a}$
0.15 g	$7.85±0.21^{b}$	$4.59±0.16^{b}$	$3.26±0.11^{ab}$	$24.99±1.09^{ab}$	$1.355±0.049^{a}$
P value	0.0001	0.0001	0.0293	0.0839	0.0046
Interaction effect between dietary protein level and protexin					
Low protein level					
0.00 g	$6.52±0.12^{g}$	$3.84±0.10^{d}$	$2.68±0.21^{e}$	$21.06±1.62^{c}$	$1.180±0.052^{c}$
0.05 g	$6.86±0.02^{f}$	$3.80±0.08^{d}$	$3.06±0.06^{cd}$	$21.86±0.69^{bc}$	$1.196±0.049^{c}$
0.10 g	$7.36±0.08^{e}$	$4.46±0.12^{c}$	$2.90±0.10^{de}$	$24.56±1.26^{abc}$	$1.328±0.060^{abc}$
0.15 g	$7.22±0.06^{e}$	$4.18±0.15^{c}$	$3.04±0.13^{cd}$	$22.90±1.69^{bc}$	$1.260±0.076^{bc}$
High protein level					
0.00 g	$7.72±0.10^{d}$	$4.32±0.16^{c}$	$3.40±0.10^{bc}$	$24.90±1.51^{ab}$	$1.214±0.075^{c}$
0.05 g	$8.16±0.07^{c}$	$4.78±0.06^{b}$	$3.38±0.06^{bc}$	$27.64±0.65^{a}$	$1.410±0.056^{ab}$
0.10 g	$9.18±0.07^{a}$	$5.26±0.07^{a}$	$3.92±0.07^{a}$	$27.60±0.53^{a}$	$1.486±0.026^{a}$
0.15 g	$8.48±0.06^{b}$	$5.00±0.09^{ab}$	$3.48±0.11^{b}$	$27.08±0.55^{a}$	$1.450±0.023^{a}$
P value	0.0012	0.1517	0.0244	0.6929	0.3851

Means in the same column within each classification with different letters differ significantly ($P<0.05$).

Table (5): Serum glucose, triglycerides, aspartate amino transferase (AST) and alanine transferase (ALT) of New Zealand White male rabbits as affected by dietary protein level, protexin probiotic and their interactions.

Item	Glucose (mg/100ml)	Triglycerides (mg/100ml)	AST (U/L)	ALT (U/L)
Effect of dietary protein level				
Low	132.46±1.70	127.17±1.06	38.72±0.83	23.48±0.36
Normal	146.36±2.58	140.01±1.03	44.41±0.72	21.67±0.44
P value	0.001	0.0001	0.0001	0.0013
Effect of protexin probiotic (g/kg diet)				
0.00 g	$127.65±1.71^{c}$	$137.31±2.75^{a}$	$38.72±1.27^{b}$	$23.39±0.74^{a}$
0.05 g	$134.18±2.14^{b}$	$133.11±2.16^{b}$	$41.57±1.20^{ab}$	$23.49±0.28^{a}$
0.10 g	$148.15±3.08^{a}$	$127.47±2.54^{c}$	$42.86±1.33^{a}$	$21.27±0.55^{b}$
0.15 g	$147.65±3.22^{a}$	$136.47±1.52^{a}$	$42.10±1.60^{a}$	$22.13±0.64^{ab}$
P value	0.0001	0.0001	0.0179	0.0116
Interaction effect between dietary protein level and protexin				
Low protein level				
0.00 g	$122.68±0.68^{d}$	$129.36±0.61^{de}$	$36.40±0.73^{d}$	$24.36±0.62^{a}$
0.05 g	$128.70±0.67^{c}$	$127.02±0.48^{e}$	$38.34±0.64^{cd}$	$24.04±0.44^{ab}$
0.10 g	$140.04±1.57^{b}$	$120.12±0.65^{f}$	$40.32±2.08^{cd}$	$21.94±0.82^{bcd}$
0.15 g	$138.40±1.03^{b}$	$132.18±0.76^{a}$	$39.80±2.36^{cd}$	$23.56±0.59^{ab}$
High protein level				
0.00 g	$132.62±0.63^{c}$	$145.26±1.41^{a}$	$41.04±2.02^{bc}$	$22.42±1.27^{abcd}$
0.05 g	$139.66±2.27^{b}$	$139.20±1.49^{b}$	$44.80±0.92^{ab}$	$22.94±0.12^{abc}$
0.10 g	$156.26±2.73^{a}$	$134.82±1.23^{c}$	$45.40±0.60^{ab}$	$20.60±0.70^{d}$
0.15 g	$156.90±1.66^{a}$	$140.76±0.83^{b}$	$46.40±0.75^{a}$	$20.70±0.70^{cd}$
P value	0.0308	0.0048	0.8736	0.6301

Means in the same column within each classification with different letters differ significantly ($P<0.05$).

Table (6): Actual pre-slaughter live weight and adjusted carcass, liver and kidney fate weight of New Zealand White male rabbits as affected by dietary protein level, protexin probiotic and their interactions.

Item	Pre-slaughter weight (g)	Carcass weight (g)	Liver weight (g)	Kidney fat weight (g)
Effect of dietary protein level				
Low	1734.25±30.25	1109.75±17.03	70.06±5.47	17.90±1.33
Normal	1977.30±35.27	1046.95±17.03	64.29±5.47	19.55±1.33
P value	0.0001	0.0604	0.5808	0.5195
Effect of protexin probiotic (g/kg diet)				
0.00 g	1635.60±35.86[c]	1136.35±29.56	69.52±9.49	17.90±2.31
0.05 g	1859.00±52.70[b]	1079.43±11.04	69.47±3.55	19.34±0.86
0.10 g	1976.00±45.28[a]	1054.60±18.60	64.60±5.97	18.77±1.45
0.15 g	1952.50±39.17[a]	1043.02±16.34	65.11±5.25	18.88±1.28
P value	0.0001	0.1693	0.8737	0.8578
Interaction effect between dietary protein level and protexin				
Low protein level				
0.00 g	1544.00±25.61[e]	1161.21±41.85	74.85±13.44	18.93±3.27
0.05 g	1708.00±29.44[d]	1118.34±24.13	78.35±7.75	17.82±1.89
0.10 g	1846.00±22.66[c]	1084.39±15.66	63.49±5.03	17.17±1.22
0.15 g	1839.00±16.16[c]	1075.03±15.75	63.55±5.06	17.70±1.23
High protein level				
0.00 g	1727.20±30.58[d]	1111.48±22.36	64.18±7.18	16.88±1.75
0.05 g	2010.00±15.17[b]	1040.52±24.75	60.59±7.95	20.87±1.93
0.10 g	2106.00±16.23[a]	1024.81±34.86	65.71±11.19	20.36±2.72
0.15 g	2066.00±14.18[ab]	1011.01±30.48	66.68±9.79	20.07±2.38
P value	0.0706	0.8715	0.1299	0.1705
LW-P value	-----	0.0001	0.8024	0.0781

LW-P value = Regression on slaughter weight. Means in the same column within each classification with different letters differ significantly (P<0.05).

Table (7): Adjusted carcass components of New Zealand White male rabbits as affected by dietary protein level, protexin probiotic and their interactions.

Item	Head Weight (g)	Fore part Weight (g)	Intermediate Weight (g)	Hind part Weight (g)	Prime cuts Weight (g)
Effect of dietary protein level					
Low	113.80±3.06	245.34±6.48	286.27±9.89	362.84±12.32	649.11±15.07
Normal	115.60±3.06	230.06±6.48	270.68±9.89	332.16±12.32	602.84±15.07
P value	0.7571	0.2217	0.4111	0.1978	0.1147
Effect of protexin probiotic (g/kg diet)					
0.00 g	111.17±5.31	254.58±11.24	286.48±17.16	382.81±21.38	669.29±26.15
0.05 g	113.37±1.98	236.78± 4.20	271.22±6.41	354.25±7.99	625.47±9.77
0.10 g	117.66±3.34	235.20±7.07	270.80±10.80	333.61±13.46	604.41±16.46
0.15 g	116.60±2.94	224.24±6.21	285.41±9.48	319.32±11.82	604.73±14.45
P value	0.7315	0.1002	0.2626	0.0977	0.4120
Interaction effect between dietary protein level and protexin					
Low protein level					
0.00 g	113.16±7.52	257.50±15.91	294.73±24.29	387.81±30.28	682.54±37.02
0.05 g	108.95±4.34	245.94±9.18	275.89±14.01	377.26±17.46	653.15±21.35
0.10 g	115.39±2.81	244.18±5.95	281.37±9.09	350.19±11.33	631.56±13.85
0.15 g	117.68±2.83	233.74±5.99	293.07±9.14	336.10±11.39	629.17±13.93
High protein level					
0.00 g	109.18±4.02	251.66±8.50	278.23±12.98	377.82±16.18	656.05±19.78
0.05 g	117.79±4.45	227.62±9.41	266.54±14.37	331.24±17.90	597.78±21.90
0.10 g	119.92±6.26	226.22±13.25	260.22±20.23	317.04±25.21	577.26±30.84
0.15 g	115.53±5.48	214.74±11.59	277.74±17.70	302.54±22.05	580.28±26.97
P value	0.1620	0.6848	0.9365	0.5403	0.7517
LW-P value	0.0816	0.0001	0.0021	0.0002	0.0001

Means in the same column within each classification with different letters differ significantly (P<0.05).

Pre-slaughter live body weight, carcass weight and carcass components insignificantly affected with the interaction between dietary protein level and protexin supplementation (Tables 6 and 5). Analysis of covariance of carcass and non-carcass components relatively to live body weight at slaughter did not show any significantt effects for the interaction between dietary protein level and probiotic supplementation in rabbit diets (Ayyat *et al.*, 1996).

CONCLUSION

In conclusion, it is summarized that supplementation of rabbit diets with protexin 0.10g/kg diet was beneficial in terms of weight gain, feed efficiency and economic viability. Protexin effect was apparent with the low protein level than with the normal level.

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تأثير خفض تركيزات البروتين مع إضافة بروبايوتيك البروتوكسين علي النمو ومكونات الذبيحة فى الأرانب

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اجريت هذة الدراسة خلال الفترة من نوفمبر 2010 حتى يناير 2011 فى مزرعة خاصة بمدينة الزقازيق – محافظة الشرقية. أستخدم 80 ذكر أرنب نيوزيلاندى أبيض مفطوم عمر 28 يوم بوزن بداية متساوى تقريباً لمدة 8 أسابيع. قسمت الارانب عشوائيا إلى 8 مجاميع تجريبية (10 أرانب لكل مجموعة)، غذيت 4 مجاميع على علائق منخفضة البروتين (14% بروتين خام) والاربع مجموعات الاخرى غذيت على علائق معتدلة فى البروتين (16% بروتين خام). تم التقسيم داخل كل مستوى بروتين إلى مجموعة ضابطة (بدون إضافة البروبايوتيك) و 3 مجموعات بإضافة 0.05 ، 0.1 و1.5 جم بروتكسين/كجم عليقة على التوالى.

أظهرت النتائج زيادة معنوية في الوزن الحي ومعدل الزيادة اليومية مع زيادة مستوي البروتين الخام في علائق الأرانب. سجلت الأرانب التي تم تغذيتها علي علائق محتوية علي نسبة معتدلة من البروتين الخام (16%) أعلى مستوي من وزن الجسم، النمو اليومى للجسم، تناول الغذاء، تكلفة الغذاء، العائد من الزيادة في الوزن وهامش الربح النهائي بمعدل 12.91، 18.90، 7.46، 10.24، 19.04 و 30.04% علي التوالي مقارنة بالمجموعة المغذاة علي علائق منخفضة فى البروتين الخام (14%). ومن ناحية أخرى فإن زيادة مستوي البروتين الخام في علائق الأرانب أدى إلي تحسن معدل التحويل الغذائي بنسبة 9,71% عن تلك العلائق المنخفضة في البروتين. كما لوحظ أن زيادة مستوي البروتين في العلائق أدي إلي زيادة معنوية في مستوي البروتين الكلي ، الألبيومين ، يوريا النيتروجين ، الكيرياتنين ، الجلوكوز ، الجليسريدات الثلاثية وانزيم الأسبرتات ترانسفيريز في مصل الدم بينما سجل أنزيم الألانين ترانسفيريز نقص معنوي ملحوظ. وقد أوضح تحليل التباين إلي أن مستوي البروتين في العلائق قد أحدث زيادة معنوية في الوزن الحي قبل الذبح. وعلي الرغم من هذا فإن تحليل التغاير أوضح أن كلا من مكونات الذبيحة وغير الذبيحة لم تظهر أي تأثير معنوي.

أكدت النتائج زيادة الوزن النهائي بنسبة 10.85، 19.45 و 18.68% علي التوالي في الأرانب المغذاة علي علائق تحتوي علي 0.05، 0.10 و0.15% جرام بروتكسين / كجم علف بالمقارنة بالمجموعة الضابطة. وأيضا لوحظ نفس الاتجاه للنمو اليومى عند عمر 0-8 أسابيع حيث كانت النسب 14.52 ، 29.84 و 27.75% علي التوالي. وقد زاد تناول الغذاء اليومى في الارانب المغذاة علي علائق تحتوي علي 0.10،0.05 و0.15 جرام بروتكسين / كجم علف بنسبة 9.45، 15.66 و 17.31 % علي التوالي. كما أكدت النتائج زيادة تكلفة العليقة والعائد من نمو الجسم وهامش الربح النهائي مع إضافة البروتوكسين في العلائق حيث زاد العائد من نمو الجسم بنسبة 14.52 ، 29.84و 27.75% علي التوالي في الأرانب المغذاة علي علائق تحتوي علي 0.10،0.05 و0.15 جرام بروتكسين / كجم علف ونفس الإتجاه لهامش الربح النهائي حيث كانت النسب 21.22 ، 48.60 و 41.55 % علي التوالي.

سجلت الأرانب التي تم تغذيتها علي علائق منخفضة المستوي من البروتين ومضاف إليها 0.10 أو 0.015 جم بروتكسين / كجم علف معدلات نمو أعلي من تلك المغذاة علي علائق معتدلة المحتوي البروتيني وخالية من البروتكسين . بينما سجلت الأرانب التي تم تغذيتها علي علائق منخفضة المستوي البروتيني ومضاف إليها 0.10 أو 0.015 جم بروتكسين / كجم علف مستويات عالية من هامش الربح بنسب 7.02 و7.86 % علي التوالي عن تلك المغذاة علي علائق معتدلة المحتوي من البروتين وخالية من البروتكسين. ولقد أظهرت النتائج أن تأثير إضافة البروتوكسين كان أفضل مع المحتوي البروتيني المنخفض عن المستوي المعتدل.