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A STUDY ON THE EFFECT OF FEEDING DIETS CONTAINING PROBIOTICS (PRONIFER & BIOGEN) ON GROWTH PERFORMANCE, INTESTINAL FLORA AND HAEMATOLOGICAL PICTURE OF BROILER CHICKS

(With 7 Tables)

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دراسة مدي تأثير تغذية العلائق المحتوية علي البرونيفير والبيوجين علي الأداء والبكتريا المعوية والصورة الدموية لبداري التسمين

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في هذه التجربة تم دراسة مدي تأثير إضافة كل من البرونيفير والبيوجين إلى علائق بداري التسمين علي كفاءة الأداء والحالة البكتريولوجية والدموية لها. تم تقسيم عدد ١٥٠ كتكوت عمر يوم (نوع روس) عشوائيا إلي خمس مجموعات بكل منها عدد ٣٠ كتكوت. تم تغذية المجموعة الأولى والتي استخدمت كضابطة علي العليقة الأساسية بينما تم تغذية المجموعتين الثانية والثالثة علي العليقة الأساسية مضافا إليها مركب البرونيفير بنسبة ١ و ٢ جم/كجم عليقة والمجموعتين الرابعة والخامسة علي العليقة الأساسية مضافا إليها مركب البيوجين بنسبة ١ و ٢ جم/كجم عليقة علي التوالي. وقد أظهرت النتائج مايلي: نقص كمية العلف المستهلك مع زيادة كمية كل من البرونيفير والبيوجين في العليقة. ، إضافة مركب البرونيفير إلى عليقة الطيور أدى إلى زيادة في وزن الجسم بمعدل ٣,٤٢% و ٤,٨٨% في المجموعتين الثانية والثالثة بينما إضافة البيوجين أدى إلى الزيادة بمعدل ١,٤٠% و ٦,٨٣% في المجموعتين الرابعة والخامسة مقارنة المجموعة الضابطة. ، معدل التحويل الغذائي في الطيور تحسن مع إضافة البرونيفير من ٣,٠٢ في المجموعة الضابطة إلى ٢,٨٤ و ٢,٧٤ في المجموعتين الثانية والثالثة بينما بلغ هذا المعدل ٢,٧٩ و ٢,٥٦ في المجموعتين الرابعة والخامسة علي التوالي مع اضافة البيوجين. ، أضافة هذين المركبين إلى علائق بداري التسمين أدى إلى انخفاض العد الطبقي الكلي للميكروبات القولونية والميكروبات الموجبة الجرام في الأمعاء مع اختفاء ميكروب الكولستريديم كلية. ، بفحص صورة الدم لوحظ زيادة في العدد الكلي لخلايا الدم الحمراء والبيضاء مع وجود زيادة ملحوظة في نسبة الخلايا الليمفاوية في الطيور التي غذيت علي العلائق المحتوية علي هذين المركبين مقارنة بالمجموعة الضابطة. نستخلص من هذه الدراسة أن إضافة ٢جم بيوجين/كجم عليقة إلى

علائـــق بداري التسمين كان له أثر ايجابي وضح في الزيادة في وزن الجسم ومعدل التحويل الغذائـــي وانخفـــاض العد الطبقي للبكتريا مما أدي الي زيادة العائد الاقتصادي لتربية بداري التسمين .

SUMMARY

The effect of probiotic feed additives either bronifer or biogen on the growth performance, feed utilization, intestinal flora and haematological picture of broiler chickens have been investigated in this experiment. A total of 150, day old broiler chicks (Ross strain) were divided randomly into five groups (30 each). The first group was kept as a control group and given the basal diet, while the second and third groups were supplemented with pronifer at a rate of 1 and 2 g/kg diet and the diets of fourth and fifth groups were supplemented with biogen at the same rate of pronifer. The amount of the feed intake was decreased significantly ($P<0.05$) as the level of either pronifer or biogen increased in the diet. The addition of the pronifer to the broiler diet significantly ($P<0.05$) increase the weight gain by 3.42% and 4.88% in groups II & III, while in case of biogen supplementation, the level reached 1.40% and 6.83% in groups IV & V respectively compared to the control group. Feed conversion was improved by addition of either pronifer or biogen from 3.02 in control group to 2.84 & 2.74 in groups II & III and 2.79 & 2.56 in groups IV & V respectively. The level of probiotics to the chick diets has proportional effect in the reduction reduced the total viable count of E.coli beside the complete disappearance of clostridium. The total erythrocytic, leucocytic count and the percentage of lymphocyte and monocyte were increased in the supplemented group compared to the control one. The addition of 2g biogen/kg diet increases the economic efficiency (23.08%). It could be concluded that, the addition of biogen at a rate of 2g/kg diet of broilers as a probiotic is superior than pronifer in increasing weight gain and feed conversion in addition to reduction of the total bacterial count & E.coli, in addition it increases the economical efficiency of the broilers.

Key words: *Probiotics.*

INTRODUCTION

The use of probiotics as a substitute for antibiotics in poultry production has become an area of great interest. Continued use of subtherapeutic dose of antibiotics in animal feeds may result in the

presence of antibiotic residues in animal products and the development of drug-resistant microorganisms in humans. Several studies with broilers have indicated that probiotic preparations improve liveweight gain and feed conversion rate, and markedly reduce mortality (Tortuero, 1973, 1989; Watkins *et al.*, 1982; Han *et al.*, 1984; Meluzzi *et al.*, 1986; Owings *et al.*, 1990; Mohan *et al.*, 1996 and Jin *et al.*, 1996a, 1997a,b). The addition of Lactobacilli culture (pronifer®) in broiler diets increased weight gain and feed conversion (Han *et al.*, 1984; Meluzzi *et al.*, 1986; Kim *et al.*, 1988; Tortuero *et al.*, 1989; Owings *et al.*, 1990; Jin *et al.*, 1996a, 1997a,b; Mohan *et al.*, 1996; and Yeo and Kim, 1997). Several by-products of *Lactobacillus* metabolism inhibit the growth of many bacteria including pathogenic organisms (Sorrels and Speck, 1970; Herrick, 1972) and inhibit the growth of salmonella and E.coli (Fuller, 1977; Muralidhara *et al.*, 1977; Francis *et al.*, 1978; Watkins and Miller, 1983; Oyarzabal and Conner, 1995; Qin *et al.*, 1995; Jin *et al.*, 1996a). *Lactobacillus* species have been shown to produce digestive enzymes; amylase, protease and lipase which may enrich the concentration of intestinal digestive enzymes (Moon and Kim, 1989; Lee and Lee, 1990; Jin *et al.*, 1996_b). Oral inoculation of animal with lactobacilli led to elevated levels of total serum protein, globulin, and increased white blood cell counts (Pollmann *et al.*, 1980); enhanced T-cell function, and increased production of anti-salmonella IgM antibodies (Dunham *et al.*, 1993) and increased activities of macrophages and lymphocytes (Perdigon *et al.*, 1986).

Supplementation of biogen® to broiler diets stimulate appetite, promote secretion of digestive enzyme , thus improve growth and feed efficiency and it can help in elimination of environmental pollution (Yang and Yu, 1990; Nikitine *et al.*, 1995; El-Banna *et al.*, 2001). Many researches reported that addition of garlic powder or garlic extract to broiler diets results in growth stimulation (Galal *et al.*, 1997) and inhibit the growth of bacteria (Ellnima *et al.*, 1983; Black, 1985; Roy *et al.*, 1992; Ahlam and Omayma, 1996; Konjufea *et al.*, 1997; Abdel-Moghney, 1998; Maidment *et al.*, 1999) and fungi (Mohawed *et al.*, 1996) and have enhancing effect on antibody activity (Angelo *et al.*, 1998). The Allicin in biogen® can activate and coordinate the function of various endocrine glands in the body and thus enable them to secrete hormone normally (Lun *et al.*, 1994). Once Ginseng enters the bodies of poultry and domestic animals, it will increase the vitality of cells by supplying oxygen of whole body (Yang and Yu, 1990); increase the content of antibody producing cells (Nikitine *et al.*, 1995) and have a

protective effect against candida infection (Abe *et al.*, 1998). On the other hand, Yang and Yu (1990) reported that Allicin and Ginseng in biogen® promote the phygocytic activity, enhances the mitogenesis of T & B lymphocytes, improving blood circulation in the body and respiratory function of cell and thus improve their physiological function. The high unit dissociating enzyme group of biogen® can make the starch, fat and protein of feeds to be entirely dissociated and absorbed in the gastrointestinal tract of the poultry (Yang & Yu, 1990).

The aim of the present study was to evaluate the probiotic feed additives pronifer and biogen on the growth performance, feed utilization, intestinal flora and haematological picture of broiler chickens.

MATERIALS and METHODS

Two commercial probiotics feed additives were used in this study:

1- **Pronifer:** Feed additive made by specific lactic acid fermentation of heat-treated soybean meal and malt, using a multiple strain mixture of lactobacilli and pediococcus, selected from their natural habitat. It contains viable lactic acid (L.plantarum, L.brevis, L.fermentum, L.casei, pediococcus acidilacticii) bacteria (10^6 CFU/g), lactic acid fermentation metabolities and enzymes (organic acids, glucosidase and peptidase enzymes) and free amino acids and short chain peptides.

2- **Biogen:** The main ingredients of biogen are allicin + High unit hydrolytic enzymes (proteolytic, lipolytic, amylolytic and cell separating enzymes) + Bacillus subtilis (6×10^7 cells /g) + Ginseng extract.

Chicks and feeding:

A total of 150, day old broiler chicks (Ross strain) were divided randomly into five groups (30 each). The first group was kept as a control and given the basal diet (Table, 1), while the diets of second and third groups were supplemented with pronifer at a rate of 1 and 2 g/kg diet respectively and the diets of fourth and fifth group were supplemented with biogen at a rate of 1 and 2 g/kg diet respectively.

Chicks in the experiment were fed on the starter diet for the first three weeks and on the grower-finisher diet for the last three weeks. The basal diet was formulated so that to satisfy the requirement stated in the NRC (1994). The diets were fed ad libitum and a fresh clean water was continuously available throughout the experimental period which extended for 6 weeks.

The chicks were reared on the floor in an experimental room bedded by a layer of chaffed wheat straw and provided with clean feeders and waterers. All birds were kept under standard hygienic conditions and were subjected to a prophylactic vaccination and pharmacological program against viral and bacterial diseases.

During the term of the experiment, feed consumption and body weight were recorded weekly in the different groups and weight gain and feed conversion were calculated.

Samples:

The fecal matter samples were collected by sterile forceps in sterile polyethylene bags from different groups localities. The samples were delivered directly to the laboratory for bacterial count according to APHA (1985), E.coli count (Quinn *et al.*, 1994) and Cl. perfringens count (Toply & Wilson,1991).

Blood samples were collected from the slaughtered birds at the end of the experiment for detection of the total erythrocytic count/mm^3 blood, total white blood cells count/mm^3 blood and differential leucocytic count on blood film stained with wrights stain.

Economical production:

Economical efficiency of production was calculated from the total production cost and selling price as follows:

Total production cost = cost of feed/bird + cost of other various items of production

Net revenue = total cost of bird at market age – total production cost

Economical efficiency = net revenue / total production cost × 100

Statistical analysis: Data were analyzed by the one-way analysis of variance (ANOVA) technique and Duncan's multiple range test (Snedecor and Cochran, 1967).

RESULTS and DISCUSSION

The results obtained for broiler performance in the terms of feed intake, live body weight, weight gain and feed conversion are illustrated in Tables 2, 3 & 4, while for the bacteriological, haematological parameters and economical evaluation are presented in Tables 5, 6 & 7

Pronifer supplementation:

There was a significant differences ($P<0.05$) in the feed intake (g/chick) between the chicks in group fed on the basal diet (control) and those in groups fed on the basal diet supplemented with pronifer and the amount of the feed intake decreased significantly ($P<0.05$) with the increased level supplementation. The feed intake was decreased by 2.71 & 4.59% in groups II & III than control group (I). The addition of the pronifer to the broiler diet significantly ($P<0.05$) increase the weight gain by 3.42% and 4.88% in groups II & III respectively more than the control one. The addition of lactobacilli cultures in pronifer to broiler diets increased the weight gain as reported by Kim et al (1988) and Jin *et al.* (1996a, 1997a). On the other hand Yeo and Kim (1997) reported that feeding a diet containing probiotic (L.casei) significantly increased weight gain during the first 3 weeks but not after that age. There was a significant ($P<0.05$) difference in feed conversion between the groups fed on the pronifer and control group with the superiority of the group fed on 2 g pronifer/kg diet. Feed conversion was improved by addition of pronifer from 3.02 in control group to 2.84 & 2.74 in groups II & III respectively. These results agreed with that reported by Jin *et al.* (1996a, 1997a,b) who reported that addition of *Lactobacillus* culture to broiler feed a significantly improved weight gain and feed to gain ratio. Tortuero *et al.* (1989) and Mohan *et al.* (1996) reported that body weight gain and feed efficiency increased significantly when chicken were fed on diets containing a mixture of L.acidophilus, L.casei, Aspergillus oryzae. On contrary, Watkins and Kratzer (1984) and Maiolino *et al.* (1992) did not observed any significant difference in the body weight of chickens fed with feeds containing L.acidophilus and S.faecium. *Lactobacillus* species have been shown to produce digestive enzymes (amylolytic, lipolytic and proteolytic) which may enrich the concentration of intestinal digestive enzymes leads to increase in the digestion coefficient and weight gain as reported by the some authors (Szylit *et al.*, 1980; Moon and Kim, 1989; Collington et al, 1990; Lee and Lee, 1990 and Jin *et al.*, 1996b).

The level of supplementation of the pronifer to the chick diets has a great effect on the reduction of the total viable bacterial count and E.coli while clostridium were completely absent. This reduction was directly proportional with the level of the pronifer. The mean colony forming unit (CFU) in the fecal matter was 8.57×10^8 in the control group, while the counts were 6.54×10^7 and 8.48×10^6 in the groups II & III respectively. The E.coli count was reduced from 6.50×10^7 in control

group to 5.30×10^6 and 5.10×10^5 in the two groups supplemented with the two levels of pronifer. This result agreed with that found by Chateau *et al.* (1993); Oyarzabal and Conner (1995) and Jin *et al.* (1996a) who reported that *Lactobacillus* were able to inhibit the growth of some pathogens; salmonella and E.coli. The antagonistic activity of lactic acid bacteria towards pathogens can be attributed to the production of bactericidal substances (bacteriocins, organic acids and hydrogen peroxide) as reported by many authors (Shanhani *et al.*, 1976; Tagg *et al.*, 1976; Joerger and Klaenhammer, 1986). The metabolic by-products of *Lactobacillus*; acetic and lactic acids inhibit the growth of many bacteria including pathogenic gram negative organisms (Sorrels and Speck, 1970; Herrick, 1972; Mulder, 1991). The addition of *Lactobacillus* product decreased the E.coli count as found in many studies (Fuller, 1977; Muralidhara *et al.*, 1977; Watkins *et al.*, 1982; Watkins and Miller, 1983), they all concluded that, the antibacterial action produced by *Lactobacillus* was probably due to a combination of factors which include lactic acids, hydrogen peroxide and bacteriocins.

Biogen supplementation:

Feed intake (g/chick) was significantly differed ($P<0.05$) between the chicks group fed on the basal diet (control) and those in groups fed on the basal diet supplemented with biogen and the amount of the feed intake decreased significantly ($P<0.05$) as the level of biogen supplementation was increased. The feed intake was decreased by 6.14 & 9.47% in groups IV & V than control group (I). The addition of biogen to the broiler diet significantly ($P<0.05$) increase the weight gain by 1.40% and 6.83% in groups IV & V respectively compared to the control group. Feed conversion was significantly ($P<0.05$) differed between chicks of the groups supplemented with biogen and control one and it was better in the group fed on 2g biogen/kg diet. The addition of biogen improved feed conversion from 3.02 in control group to 2.79 & 2.56 in groups IV & V respectively. The growth promoting effects of biogen may be through the increase in digestibility and absorbability and utilizability of different nutrients in the gastrointestinal tract of the chickens due to the role of some biogen enzymes (lipolytic, proteolytic, amylolytic, hydrolytic and cell separating enzymes). Similar results were reported by Brander *et al.* (1982), Yang and Yu (1990) and Lun *et al.* (1994). In addition, Homma and Hamaoka (1998) reported that, the improvement in growth performance and feed conversion of the chicks due to biogen supplementation as a result of supplying the chicken

intestine by Bacillus subtilis, shifting pH of the intestine would increase the growth rate of these beneficial commensal bacterium which is also a component of biogen. Growth stimulating effect of biogen may be also attributed to the antimicrobial effect of allicin (product of garlic) and Ginseng which could have a growth promoting ability. The same results were observed by Sharma *et al.* (1980), Aziz (1981), Yung and Yu (1990), Khalid *et al.* (1995), Ahlam and Omayma (1996), Galal *et al.* (1997), and El-Banna *et al.* (2001). In addition, Yung-Chih (1990) reported that, biogen can enhance the metabolism and energy of animal body cells, raise the efficiency of feed utilization, induce and balance the secretion of various secretary gland.

The level of biogen supplementation proportionally affect the total viable count and E.coli as they were decreased, beside Cl.perfrenges were completely disappeared. The mean colony forming unit (CFU) in the fecal matter was 8.57×10^8 in the control group, while the counts were reduced to 1.20×10^7 and 3.16×10^6 in the groups II & III respectively, however, the E.coli count was reduced from 6.50×10^7 in control group to 5.30×10^6 and 5.10×10^6 in the same groups. The results that allicin as a component of garlic have antibacterial and antifungal activity for a long time as reported by many authors (Ellnima *et al.*, 1983; Black, 1985; Roy *et al.*, 1992; Lun *et al.*, 1994; Ahlam and Omayma, 1996; Mohawed *et al.*, 1996 ; Konjufea *et al.*, 1997; Abdel-Moghney, 1998; Maidment *et al.*, 1999). Previous works on garlic proved that its bulb extract inhibits the growth of certain gram-positive and gram-negative bacteria isolated from man and animals (Saxena & Vyas, 1986 and Roy *et al.*, 1992).

The inhibitory effect of probiotics are increased with increasing levels of probiotics, moreover, the results revealed also that, the inhibitory effect was strong against Cl.perfringens (gram +ve) than that recorded on the total bacterial count (gram +ve & gram –ve bacteria) and this could be attributed to the natural difference of the cell wall structure between two groups as reported by Hugo & Bloomfield (1971) and Bernheim (1972).

The haematological picture of the supplemented groups (Table 6) showed significant ($P<0.05$) increase in the total erythrocytic and leucocytic cells count in comparison with control. In addition a slightly increase in the percentages of lymphocytes and monocytes were observed. These results indicated that probiotics have an enhancement effect to the humoral immune response which agreed with that reported by Pollmann *et al.* (1980) and Miake *et al.* (1985).

Data for feeding costs, total production, net revenue (L.E/bird) and economic efficiencies of different broiler chicken groups are shown in Table (7). These results revealed that, addition of 2g biogen/kg diet have the possibility for increasing the economic efficiency (23.08%) than the other treatments including pronifer groups. These may be due to better feed utilization obtained by those broiler chickens group (group V) compared to control and other groups.

From the results, it could be concluded that, the addition of 2g biogen/kg diet of broiler chickens had a highly significant ($P<0.05$) effect on the total feed intake and decrease the amount of consumed feeds when compared with the other treated groups. Weight gain and feed conversion of the group chicks fed on the diet supplemented with 2g biogen/kg diet had significantly ($P<0.05$) higher values. The addition of 2g biogen to the diet of broiler chicks reduced the total bacterial count and E.coli more than other treated and control groups.

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Table 1: Composition of the basal diet used in the experiment

Composition	Starter diet	Grower-finisher diet
Physical composition:		
Yellow corn, ground	67.70	73.14
Soybean meal (44%)	21.00	18.30
Fish meal (72%)	4.00	3.00
Meat meal (60%)	5.84	4.00
Bone meal	0.08	0.45
Dicalcium phosphate	0.20	0.10
Limestone, ground	0.86	0.76
Salt	0.10	0.10
Methionine	0.07	----
Premix*	0.15	0.15
Chemical composition:		
Crude protein (%)	21.38	18.83
ME (Kcal/kg)	2992	3082
C/P ratio	139.94	163.67
Ether extract (%)	3.55	3.51
Methionine (%)	0.45	0.34
Meth. + Cystine (%)	0.78	0.64
Lysine (%)	1.14	0.97
Calcium (%)	1.07	0.93
Total phosphorus (%)	0.68	0.61

*Broiler premix furnishing the following ingredients per kg of feed:- Vit.A 12000 IU; vit.D3 2000 IU; vit.E 10 mg; folic acid 1 mg; niacin 20 mg; pantothenic acid 10 mg; vit.K 2 mg; vit.B1 1 mg; vit.B2 4 mg; vit.B6 1.5 mg; vit.B12 10µg; biotin 50 µg; iron 30 mg; copper 10 mg; zinc 55 mg; Mn 55 mg; iodine 1 mg; Se 0.1 mg; choline chloride 500 mg.

Table 2: Body weight development (g/chick) of the experimental groups

Age (weeks)	Group / levels of probiotics				
	Control	Pronifer		Biogen	
	I	II (1g /kg diet)	III (2g/kg diet)	IV (1g/kg diet)	V (2g/kg diet)
0	40.3±3.10	41.9±3.03	42.30±3.15	42.5±3.15	44.1±4.10
1	115.4±5.04	129.83±2.95	143.52±3.75	121.4±2.87	117.8±5.55
2	311.5±14.4	337.35±11.22	351.99±14.20	349.5±14.13	344.5±16.7
3	526.43±12.6	545.59±12.15	572.39±14.13	533.57±10.11	551.79±13.63
4	782.07±21.54	797.09±15.25	812.96±16.78	831.03±17.05	828.96±18.48
5	993.45±24.84	1002.99±16.15	1041.33±23.14	1067.24±18.65	1143.1±26.84
6	1363.45±26.74^{c*}	1410.35±30.11^{a}	1429.99±30.83^{a}	1384.14±28.81^{ab}	1457.59±33.73^{a*}

*Figures in the same row having the same superscripts are not significantly different ($P<0.05$).

Table 3: Feed intake (g/chick) of the experimental groups.

Age (weeks)	Group / levels of probiotics				
	Control	Pronifer		Biogen	
	I	II (1g /kg diet)	III (2g/kg diet)	IV (1g/kg diet)	V (2g/kg diet)
1	189±3.05	183±3.50	170±2.80	175±3.50	161±4.01
2	455±12.10	443±10.11	428±13.10	441±10.12	434±12.01
3	581±13.01	563±10.80	551±12.25	553±13.05	532±10.80
4	714±18.30	683±15.20	646±17.30	686±15.70	651±15.80
5	931±20.15	909±17.01	861±18.20	861±14.60	840±17.10
6	1120±22.03	1101±20.25	1151±24.10	1029±18.30	994±16.03

Table 4: Total feed intake, weight gain (g/chick) and feed conversion in the different experimental groups

Parameters	Group / levels of probiotics				
	Control	Pronifer		Biogen	
	I	II (1g /kg diet)	III (2g/kg diet)	IV (1g/kg diet)	V (2g/kg diet)
Total feed intake	3990±22.10^{a*}	3882±25.03^{b}	3807±23.12^{c}	3745±20.40^{d}	3612±16.40^{e}
Total weight gain	1323.15±20.15^{e}	1368.45±18.03^{b}	1387.69±18.07^{a}	1341.64±15.20^{b}	1413.49±18.46^{a}
Feed conversion	3.02±0.15^{a}	2.84±0.10^{b}	2.74±0.13^{c}	2.79±0.18^{b}	2.56±0.12^{d}

*Figures in the same row having the same superscripts are not significantly different ($P<0.05$).

Table 5: Bacterial count/g fecal matter of the five experimental groups

	Group / levels of probiotics				
	Control	Pronifer		Biogen	
	I	II (1g /kg diet)	III (2g/kg diet)	IV (1g/kg diet)	V (2g/kg diet)
Acrobic plate count	8.57×10^{8}	6.54×10^{7}	8.84×10^{6}	1.2×10^{7}	3.16×10^{6}
E.coli count	6.50×10^{7}	5.30×10^{6}	5.10×10^{6}	4.80×10^{6}	4.20×10^{6}
Cl.perfringenes count	1.2×10	0	0	0	0

Table 6: Haematological picture of the control and probiotics supplementated groups*

	Groups		
	Control	Pronifer (1g/kg diet)	Biogen (1g/kg diet)
Total erythrocyte ($\times 10^6$/µl)	3.09±0.01 [c]	3.2±0.009 [b]	3.39±0.01 [a]
Total leucocyte ($\times 10^3$/µl)	11.5±0.02 [b]	12.5±0.03 [a]	11.9±0.05 [b]
Heterophil (%)	30±0.12 [a]	23±0.09 [b]	26±0.02 [b]
Lymphocyte (%)	54±0.17 [a]	60±0.11 [a]	57±0.13 [a]
Monocyte (%)	12±0.03 [a]	13±0.02 [a]	12±0.008 [a]
Eosinophil (%)	4±0.05 [a]	3±0.005 [a]	4±0.004 [a]
Basophil (%)	Rare	1±0.02	1±0.009

* Mean value ±SE

Table 7: Economical evaluation of broiler performance as affected by probiotics supplementation*

	Group / levels of probiotics				
	Control	Pronifer		Biogen	
	I	II (1g /kg diet)	III (2g/kg diet)	IV (1g/kg diet)	V (2g/kg diet)
Feeding cost	3.99	3.94	3.92	3.86	3.83
Total production cost	5.49	5.44	5.42	5.36	5.33
Net revenue	0.65	0.91	1.02	0.87	1.23
Economic efficiency	11.84	16.73	18.82	16.23	23.08

*Calculated by LE.