Egyptian Journal of Rabbit Science, 19 (1) 7-22 (2009)

COMPARATIVE STUDY BETWEEN PROBIOTIC (BIOPLUS 2B) AND ANTIBIOTIC (LINCOFEED) ON THE PERFORMANCE OF GROWING RABBITS.

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The objective of this study was to evaluate the effect of Bioplus 2B (as a probiotic) and Lincofeed (as an antibiotic) as growth prometers in rabbit diets. A total number of 96, unsexed, New Zealand White (NZW) weaned rabbits, (5 weeks old) were randomly divided into four experimental groups (24 rabbits/group). Each group was subdivided into six replicates of 4 rabbits. Average of initial body weights of all groups were almost equal. The first experimental group represents the control and fed a basal diet, while the groups from 2nd to 4th received the basal diet supplemented with either 200 mg licnofeed, 200 mg Bioplus 2B or 400 mg Bioplus 2B/kg diet, respectively. The experiment was extended up to 13 weeks of age.The highest average final body weight and daily weight gain were recorded by supplementing Bioplus 2B at level of 200 or 400 mg/kg.The high values in average feed consumption were obtained with the control and Lincofeed groups. Values for feed conversion ratio, protein efficiency ratio (PER), efficiency of energy utilization (EEU) were recorded by adding Bioplus 2B at level 200 or 400 mg/kg were better than those fed the control or Lincofeed diets.The digestibility coefficient value of CP was increased significantly by supplementation of Bioplus 2B and Lincofeed when than in the un-supplemented basal diet. The highest digestibility coefficient values of CF and DCP were obtained for group fed high level of Bioplus 2B. Dressing percentage increased insiginficanty with rabbits fed 400 mg Bioplus 2B or 200 mg lincofeed/kg feed. Heart weight (%) increased siginficanty, while kidneys fat weight (%) decreased in general for rabbits receiving 200 mg Bioplus 2B diet.Total serum proteins and globulin levels of rabbits decreased, while A/G ratio and urea-N concentration were superior siginficanty in the group which received the diet supplemented with 200 mg Lincofeed/kg than in the Bioplus 2B and control groups. Cholesterol content and ALT in serum blood decreased significantly for rabbits fed a diet containing 400 mg Bioplus 2B/kg of feed than in the

other experimental groups. The greatest reduction in total bacterial count in caecum content of rabbits was noticed with the groups fed diets containing either Bioplus 2B or lincofeed, especially at high level of Bioplus 2B. Caecum content of the experimental groups was free of Salmonella, Clostridia and Listeria. The best net return, percentage of economic efficiency, relative economic efficiency and performance index were obtained by the group received 400 mg Bioplus 2B diet during the whole experimental period.

Key words: Bioplus 2B, blood, digestibility, lincofeed, performance.

Recently, manufacturers produced microorganisms (probiotics) commercially as growth promotion to substitute antibiotics in animal feeds to avoid its harmful effect on human health. The addition of probiotics to the diet has been found to improve growth performance and feed conversion ratio in growing and breeding rabbits (Hollister *et al.*, 1990; Tawfeek and El-Hindawy, 1991; El-Hindawy *et al.*, 1993 and Tawfeek and Marai, 1997). The mode of action of probiotics includes: maintaining normal intestinal microflora by competitive exclusion and antagonism, altering metabolism by increasing digestive enzyme activity and decreasing bacterial enzyme activity and ammonia production, improving feed intake and digestion and neutralizing enterotoxins and stimulating the immune system (Boham and Sroar, 1995 and Jin *et al.*, 1997). Suppressing ammonia production and urease activity can be beneficial for improving animal and enhancing growth because ammonia produced by ureolysis in the intestinal mucosa can exert significant damage to the surface of cells (Li *et al.*, 1995).

Use of antibiotics in animal nutrition might have unfavorable side effects, however; they are still mainly used in the control of coccidiosis and enteritis, although these substances are also considered to have growth promoting properties (Elwinger *et al.*, 1998). Mode of action of antibiotics as feed additives is mainly related to stimulate growth of animal by eliminating undesirable micro-organisms that produce toxins or metabolic products that irritate and increase the thickness of the intestinal wall that decrease the absorption of nutrients (Engberg *et al.*, 2000). El-Adawy *et al.*, (2000) suggested that probiotics could replace antibiotics as growth promoters, but not in the treatment of disease.

Probiotic Bioplus 2B consists of *Bacillus licheniformis* and *Bacillus subtilis*, which germinate in the intestine and use a large number of sugars (carbohydrates) for their growth and they produce a range of relevant digestive enzymes (amylase, protease, lipase). While, antibiotic such as Lincofeed is used for treatment of necrotic enteritis caused by Clostridia species in rabbits to stimulate growth promotion and to improve feed efficiency by alteration intestinal mircoflora.

The present study was carried out to evaluate the beneficial effects of using either probiotic (Bioplus 2B) or antibiotic (lincofeed) in the diets on the performance of growing rabbits.

MATERIALS AND METHODS

This work was carried out at the Center of Agriculture Studies and Consultations (CASC), Rabbit Production Unit, Faculty of Agriculture, Ain Shams University, Cairo, Egypt, during the period from March to May 2007.

A total number of 96, unsexed, New Zealand White (NZW) weaned rabbits, (5 weeks old) were randomly divided into four experimental groups (24 rabbits/group). Each group was subdivided into six replicates of 4 rabbits. Average of initial body weights of all groups were almost equal. The basal experimental diet was formulated and pelleted to cover the nutrient requirements of rabbits according to NRC (1977). The first group as a control group and was given the basal diet without supplementation, while the 2nd to 4th groups received the basal diet supplemented with either 200 mg licnofeed (as an antibiotic), 200 mg Bioplus 2B (as a probiotic) or 400 mg Bioplus 2B/kg diet, respectively. Bioplus 2B which contained $3.2x10^9$ colony forming units (CFU) per gram of produced probiotic ($1.6x10^9$ CFU/g of Bacillus licheniformis CH200 and $1.6x10^9$ CFU/g of Bacillus subtilis CH201). Lincofeed premix contained 44 gram Lincomycin/kg in soybean carrier. Ingredients and chemical composition of the basal diet is presented in Table 1. Individual live body weight, feed consumption, feed conversion ratio (FCR, g feed/g gain), protein efficiency ratio (PER, g gain/g crude protein consumed) and efficiency of energy utilization (EEU, DE consumed kcal/g gain) were recorded at weekly intervals during the experimental period (5-13 weeks of age). The rabbits were housed in galvanized metal wire cages provided with feeders and automatic drinking system and were kept under the same managerial and hygienic conditions.

At the end of the experiment, a digestibility trial was carried out. The animals (6 males in each) were housed individually in metabolic cages for 7 days as a preliminary period and 5 days as a collection period. Amounts of feed were offered and faeces of each animal were measured daily during the collection period. Coprophagy was not prevented. The analysis of experimental diet and faeces were carried out according to A.O.A.C (1990). The total digestible nutrients (TDN) was calculated according to the classic formula (Cheeke *et al.*, 1982).

Blood samples were collected from 6 rabbits/ group at the end of the experimental period. The blood samples were collected un-heparinized tubes and centrifuged at a speed of 3000 rpm for 15 minutes and blood serum was stored frozen till biochemical analysis. Estimations were carried out for serum total proteins (Doumas and Biggs., 1972), albumin (Doumas *et al.*, 1971), urea-N (Fawcett and Scott., 1960), total lipids (Zollner and Kirsch, 1962), cholesterol

(Richmond, 1973) and serum transaminases (Reitman and Frankel., 1957). The globulin values were obtained by subtracting the values of albumin from the corresponding values of total proteins.

After complete bleeding of rabbits, pelt, viscera and tail were removed, then carcass and giblets (liver, heart, kidney) were weighed. Dressing percentage included relative weights of carcass, giblets and head.

The microbial diagnosis examination was carried out on samples of caecum contents (4 males in each) according to Mackie and Mc Carteny (1953), American Public Health Association, APHA (1960) and Difco Mannual (1977).

Table 1. Composition and analysis of the experimental basal diet.

Ingredients	**%**
Clover hay	32.50
Yellow corn	15.00
Barley grains	17.00
Wheat bran	14.00
Soy bean meal (44% CP)	18.00
Di-calcium phosphate	1.20
Molasses	1.00
Limestone	0.60
Salt (Nacl)	0.30
Premix*	0.30
DL-Methionine	0.10
Total	**100.00**
Chemical analysis (As fed basis)	
A. Determined analysis (%)	
Dry matter (DM)	91.53
Organic matter (OM)	82.50
Crude protein (CP)	17.03
Crude fibre (CF)	14.03
Ether extract (EE)	3.81
Nitrogen-free extract (N.F.E.)	47.63
Crude ash	9.03
B. Calculated analysis	
DE (kcal/kg)	2600
Methionine + cystine	0.67
Lysine	0.98
Calcium	1.04
Total phosphorous	0.64

*One kilogram of premix provides: 2000.000 IU vit. A, 150.000 IU vit. D, 8.33g vit. E, 0.33g vit K, 0.33g vit. B1, 1.0g vit. B2, 0.33g vit. B6, 8.33g vit. B5, 1.7 mg vit. B12, 3.33g Pantothenic acid, 33mg Biotin, 0.83g Folic acid, 200g Choline chloride, 11.7g Zn, 12.5g Fe, 16.6 mg Se, 16.6 mg Co, 66.7g Mg and 5g Mn.

The economic efficiency (EEf) was calculated according to the following equation: EEf = (A-B/B) X 100 where A is the selling cost of obtained gain (LE per kg) and B is the feeding cost of this gain. The

performance index (PI) was calculated according to the equation described by North (1981) as follows: PI = Live body weight (kg)/ Feed conversion x 100

Data were statistically analyzed using SAS program (SAS,1998), as the following model. $Y_{ij} = \mu + T_i + e_{ij}$ where: Y_{ij} = The observation on the I^{th} treatment, μ = Overall mean, T_i = Effect of the I^{th} treatment, e_{ij} = Random error treatment. Duncan's Multiple Range test (Duncan, 1955) was also used for the comparison among means of the experimental groups.

RESULTS AND DISCUSSION

1. Nutrients digestibility coefficients and nutritive values:

Mean nutrients digestibility coefficients and nutritive values are presented in Table 2. The results showed that, all supplemented groups recorded insignificant differences in nutrients digestibility coefficients of DM, OM, EE and NFE as compared to control group. The digestibility coefficient value of CP increased significantly ($P \leq 0.01$) with all levels of Bioplus 2B and Lincofeed as compared to un-supplemented basal diet. The highest ($P \leq 0.05$) digestibility coefficient value of CF was for the group fed the basal diet plus 400 mg Bioplus 2B/kg feed, followed by the group supplemented with 200 mg Bioplus 2B than the antibiotic and control groups. In terms of nutritive value, the highest ($P \leq 0.01$) DCP value was obtained in the group fed the basal diet plus 400 mg Bioplus 2B/ kg of feed, followed by 200 mg Lincofeed/ kg of feed, while the control group recorded the lowest value of DCP. However, values of TDN were insignificantly ($P > 0.05$) different by adding Bioplus 2B and Lincofeed to the growing rabbit diets. The beneficial effect of probiotics or antibiotics on nutrients digestibility coefficients is mainly related to the inhibiting effect of certain intestinal harmful bacteria that produce toxins and decrease intestinal pH (Sissons, 1988 and Engberg *et al.*, 2000). Moreover, antibiotics have useful effects in modification of gut bacterial population (Cheeke, 1987) as well as increase absorption and sparing of nutrients (Ghazalah *et al.*, 1990). Abdel-Azeem *et al.* (2007) showed that supplementation of Biogen as a proboitic at level of 2.5g/kg into rabbit diets increased significantly DM, OM, CP and CF digestibility coefficients, in addition to improvement of the nutritive values as TDN and DCP. Fairly *et al.* (1985) attributed the improvement in feed efficiency by probiotics to an increase in the efficiency of nutrient absorption and nutrient utilization. In other works the improvement of feed efficiency was due to a higher apparent digestibility of CF and CP when probiotics and enzymes were provided together (Gippert *et al.*, 1992, Kamra *et al.*, 1996, Kermauner and Struklec, 1997). The mode of action of Bioplus 2B may be related to its production of significant amount of enzymes, which reduces the viscosity of intestinal contents and support digestion and absorption of nutrients, especially CP and CF digestibility coefficients.

2.Growth performance:

Mean values of live body weight, daily weight gain, feed consumption and feed conversion from 5 to 13 weeks of age are shown in Table 3. Rabbit group fed the diet supplemented with 400 mg Bioplus 2B/kg feed showed the highest ($P \leq 0.01$) values for final body weight and daily weight gain. On the other hand, the groups fed diets supplemented with 200 mg/kg feed either Bioplus 2B or lincofeed showed insignificantly ($P > 0.05$) higher final body weight and daily weight gain than in the control. Abdel-Azeem *et al.* (2004) found that final body weight and daily weight gain were significantly improved by antibiotics (zinc bacitracin) or by probiotics (Bioaction and dry yeast) supplementation. On the other hand, Matusevičius *et al.* (2006) found that addition of Bioplus 2B at level of 400 mg/kg diet did not affect significantly the body weight and daily weight gain of rabbits, during the period between 35 and 77 days of age.

Average daily feed consumption values increased significantly ($P \leq 0.01$) in the group fed the control or 200 mg lincofeed/kg diet. These results were similar to those obtained by Abdel-Azeem *et al* (2004) who reported that daily feed consumption in the growing rabbits supplemented with 100 mg zinc bacitracin was higher in comparison to the other experimental groups.

Feed conversion ratio (FCR) was improved significantly ($P \leq 0.01$) by addition of Bioplus 2B to the growing rabbit diets and the best value was recorded by the high level of Bioplus 2B. Addition of Bioplus 2B at any level to growing rabbit diets caused a significant ($P \leq 0.01$) increase in protein efficiency ratio (PER) when compared to the Lincofeed or the control group. Similar trend was obtained for efficiency in energy utilization (EEU). Feed conversion ratio tended to be improved with supplementation with Bioplus 2B due to the relatively lower feed intake and better digestibility of the nutrients. Fuller (1997) explained improvement of FCR values by probiotics by the balance of microbial population created in the digestive tract and the role of *Lactobacillus* in preventing the harmful bacteria (Hollister *et al.*, 1990). Ezzat *et al.* (1988) reported similar result in *Lactobacillus* preparation and explained that a possible increase in gut motility may occur in the presence of excessive number organisms, thereby altering nutrient availability for absorption, in addition to that other beneficial bacterial populations may be altered, disrupting cohabitation of the established microflora (Miles, 1993).

As shown in Table 3 the numbers of dead rabbits were 4, 2, 1 and 2 for the groups fed basal diet, diets containing either 200 or 400 mg Bioplus 2B and 200 mg Lincofeed/kg diet, respectively. Therefore, mortality rate for growing NZW rabbits in the present study was normal, since it represents 10.0% of the total number of rabbits during the whole experimental period.

Table 2. Effect of supplementation of Bioplus 2B and Lincofeed on the nutrients digestibility coefficients and nutritive values of rabbits.

Items	Control	200 mg Bio plus 2B/kg diet	400 mg Bio plus 2B/kg diet	200 mg Lincofeed /kg diet	Sig.
Nutrients digestibility coefficients:-					
Dry matter (DM)	70.62 ±0.36	71.72±0.89	70.17±0.70	69.86±1.54	NS
Organic matter (OM)	72.39±0.42	73.48±0.77	71.77±0.71	71.65±1.58	NS
Crude protein (CP)	70.04^{b}±0.22	74.69^{a}±1.39	77.85^{a}±0.46	75.00^{a}±1.70	**
Ether extract (EE)	85.44±1.49	87.88±1.31	85.90±0.51	88.58±0.58	NS
Crude fiber (CF)	33.66^{b}±1.04	39.87^{ab}±3.8	42.99^{a}±2.23	33.30^{b}±2.42	*
Nitrogen free extract (NFE)	82.57 ±0.83	81.59±0.45	77.41±0.49	80.50 ±2.00	NS
Nutritive values:-					
DCP%	11.93^{c}±0.04	12.72^{b}±0.24	13.26^{a}±0.08	$13.\cdot5^{ab}$±1.0	**
TDN%	64.53±0.21	65.43 ±0.67	63.88±0.32	65.91 ±0.71	NS

[a, b, c] Means within the same row with different superscripts are significantly (P≤.05) different, Sig. =Significance, NS=Non Significant, * (P≤0.05), ** (P≤0.01).

Table 3. Effect of supplementation of Bioplus 2B and Lincofeed on the productive performance of growing rabbits.

Items	Control	200 mg Bio plus 2B/kg diet	400 mg Bio plus 2B/kg diet	200 mg Lincofeed/ kg diet	Sig.
No.of Rabbits	24	24	24	24	
Live body weight (g) at:					
5 weeks	722.6±32.9	720.4±34.03	723.8±17.82	722.5±33.47	NS
13 weeks	2257.3^{b}±13.9	2311.6^{b}±9.9	2423.1^{a}±13.5	2289.0^{b}±40.9	**
Daily weight gain (g) from:					
5 – 13 weeks	27.41^{b}±0.4	28.42^{b}±0.5	30.34^{a}±0.4	27.97^{b}±0.5	**
Daily feed consumption (g) from:					
5 – 13 weeks	92.41^{a}±0.25	88.41^{b}±0.72	90.72^{ab}±1.34	92.37^{a}±0.40	**
Feed conversion ratio (FCR) from:					
5 – 13 weeks	3.37^{a}±0.03	3.11^{bc}±0.07	2.99^{c}± 0.08	3.30^{ab}±0.05	**
Protein efficiency ratio (PER):					
5 – 13 weeks	1.74^{c}±0.02	1.89^{ab}±0.05	1.97^{a}±0.06	1.78^{bc}±0.03	**
Efficiency of energy utilization (EEU):					
5 – 13 weeks	8.77^{a}±0.10	8.10^{bc}±0.19	7.78^{c}±0.22	8.60^{ab}±0.14	**
Mortality No.	4	2	1	2	

[a, b, c] Means within the same row with different superscripts are significantly different (P≤.05), Sig. =Significance, NS=Non Significant, * (P≤0.05), ** (P≤0.01).

3. Carcass traits:

Percentages of each of dressing, carcass, giblets, head, liver and kidneys were insignificantly affected by feeding rabbits on diets containing either Bioplus 2B or Lincofeed (Table, 4). Relative weight of heart increased significantly and relative weight kidneys fat decreased significantly for the groups received diet supplemented with 200 mg Bioplus 2B/kg of feed when compared to the other experimental groups. El-Adway *et al* (2002) reported that carcass traits and internal organs as percentages of live body weight were insignificantly affected by dietary supplementation with Biogen (as a probiotic), except the dressing percentage which increased significantly with the supplementation.

4. Blood components:

Results in Table 5 showed significant ($P \leq 0.01$) decrease in total serum proteins and globulin values and a significant ($P \leq 0.01$) increase in albumin, albumin/globulin ratio (A/G ratio) and urea-N concentration for rabbits received diet supplemented with 200 mg Lincofeed/kg feed when compared with the Bioplus 2B groups and the control group. Probiotics addition was accompanied with the highest value of serum globulin, which reflects the good immunity status of the animals. It is known that, the change in albumin level reflects the change in liver function. The liver is the site of albumin synthesis but globulin is formed by lymphatic tissues (Jones and Bark, 1979). Ashour *et al.* (2004) stated that the concentration of albumin was considered as a reflection of the animal ability to synthesize and store protein. Bioplus 2B acts as an immune modulator due to the ability of the *Bacillus Licheniformis* and *Bacillus subtilis* to synthesize several non specific immune stimulant ingredients.

Cholesterol content and ALT enzyme in serum blood were reduced significantly ($P \leq 0.01$ or 0.05) for rabbits fed a diet containing 400 mg Bioplus 2B/kg feed as compared to the other groups. This reduction may be attributed to that these bacteria may assimilate or degrade the cholesterol to bile acids followed by deconjugation to prevent resynthesis (Tortuero *et al.*, 1975). On the other hand, total lipids and enzyme of AST were insignificantly different among dietary treatments. Zanaty (2002) found that Biogen addition at level of 1 g/kg diet decreased serum total cholesterol and Transaminase enzymes (AST and ALT).

5. Caecum microbial activity:

The results in Table 6 showed that total count of bacteria increased in caecum content for rabbits fed control diet as compared to those received diets containing either Bioplus 2B or lincofeed. These results indicated that addition of Bioplus 2B or lincofeed in rabbit diets reduced number of total bacterial count (especially pathogenic bacteria) in caecum content of rabbits, especially, at high level of Bioplus 2B (400 mg Bioplus 2B/kg diet).

Table 4. Effect of supplementation of Bioplus 2B and Lincofeed on carcass traits of growing rabbits.

Items	Control	200 mg Bioplus 2B/kg diet	400 mg Bioplus 2B/kg diet	200 mg Lincofeed/ kg diet	Sig.
Dressing percentage	57.48±0.7	57.80±0.7	59.14±0.3	58.75±0.8	NS
Hot carcass weight (%)	47.85±0.6	48.37±0.8	49.48±0.3	48.74±1.0	NS
Giblets weight (%)	4.19±0.17	4.27±0.24	4.38±0.26	4.23±0.10	NS
Head skinless weight (%)	5.44±0.29	5.14±0.24	5.27±0.20	5.78±0.27	NS
Liver weight (%)	3.21±0.10	3.19±0.25	3.33±0.27	3.11±0.05	NS
Kidneys weight (%)	0.67±0.07	0.63±0.02	0.67±0.02	0.72±0.05	NS
Heart weight (%)	0.31^{b}±0.01	0.44^{a}±0.04	0.37^{a}±0.01	0.39^{b}±0.02	*
Kidney fat weight (%)	0.77^{ab}±0.2	0.53^{b}±0.1	0.93^{a}±0.05	0.89^{a}±0.05	*

^{a,b} Means within the same row with different superscripts are significantly (P≤.05) different, Sig. =Significance, NS=Non Significant, * (P≤0.05), ** (P≤0.01).

Table 5. Effect of supplementation of Bioplus 2B and Lincofeed on some blood components of growing rabbits.

Parameters	Control	200 mg Bioplus 2B/kg diet	400 mg Bioplus 2B/kg diet	200 mg Lincofeed/ kg diet	Sig.
Total proteins (g/dl)	7.93^{a}±0.24	7.67^{a}±0.11	8.10^{a}±0.13	7.01^{b}±0.07	**
Albumin (g/dl)	4.25^{b}±0.07	4.19^{b}±0.09	4.72^{a}±0.13	4.90^{a}±0.19	**
Globulin (g/dl)	3.67^{a}±0.28	3.48^{a}±0.18	3.37^{a}±0.15	2.11^{b}±0.23	**
A/G ratio	1.20^{b}±0.09	1.23^{b}±0.09	1.42^{b}±0.09	2.49^{a}±0.31	**
Total Lipids (g/dl)	474.8±23.3	462.3±37.2	518.7±19.1	473.6±32.2	NS
Cholesterol (mg/dl)	108.2^{a}±2.5	110.9^{a}±5.1	92.2^{b}±3.38	105.3^{a}±2.5	**
AST (µ/L)	25.60±1.12	24.33±2.24	27.67±1.33	25.50±0.99	NS
ALT (µ/L)	10.30^{a}±0.76	10.53^{a}±1.24	6.75^{b}±1.25	10.75^{a}±0.47	*
Urea-N (mg/dl)	25.13^{b}±1.98	22.84^{b}±1.48	23.55^{b}±1.99	33.08^{a}±2.73	**

^{a,b} Means within the same row with different superscripts are significantly (P≤.05) different, Sig. =Significance, NS=Non Significant, * (P≤0.05), ** (P≤0.01).

Moreover, caecum content of the experimental groups was free of *Salmonella*, *Clostridia* and *Listeria*. Probiotic microorganisms inhibit growth of potentially pathogenic microorganisms by competitive exclusion (CE). Competitive exclusion of commensal microflora against pathogens include: 1.Lowering the pH through production of lactate, lactic acid and short chain fatty acids (SCFA); 2.Competing for gut lining attachment and available nutrients, 3.Producing bacteriocins, 4.Stimulating the gut associated immune system through cell wall components (Nousiainen and Setala, 1998), and 5.Increasing the production of SCFA, which have bacteriostatic and bactericidal properties (Fuller, 1997) and stimulate intraepithelial lymphocytes, and natural killer cells (Ishizuka and Tanaka, 2002; Ishizuka *et al.*, 2004). Thus, probiotics have been shown to improve performance, decrease mortality, and improve FCR of rabbits.

Antibiotic Lincofeed (Lincomycin) is used for the treatment of necrotic enteritis caused by *Salmonella* and *Clostridia* species in poultry and animals These natural feed additives promote intestinal health by several possible mechanisms: altering intestinal pH, maintaining protective intestinal mucins, selection for beneficial intestinal organisms or against pathogens, enhancing fermentation acids; enhancing nutrient uptake and increasing the humoral immune response (Ferket, 2003). The growth of commensal bacteria in the gastro-intestinal has an important influence on the colonization of pathogenic species. The main products of fermentation of *Lactobacillus* and *Bifidobacterium* are acetic acid and lactic acid (Taki *et al.*, 2005).

6. Economic evaluation:

Addition of Bioplus 2B at level 200 or 400 mg/kg into rabbit diets increased significantly (P≤0.05 or 0.01) percentage of economic efficiency (expressed as % of net return/feed cost, EEf), relative economic efficiency (REE) and performance index (PI) than those received un-supplemented diet or 200 mg Lincofeed per kg diet during the whole experimental period (Table 7). This was due to the improvement in body weight and feed conversion ratio of rabbits fed dietary levels of Bioplus 2B. The results were in agreement with those reported by El-Adway *et al* (2002) who found that PI increased significantly in groups fed diets supplemented with Biogen, especially at levels of 0.15 and 0.20%. Zanaty (2002) found that, values of EEf improved with Biogen supplementation. Moreover, El-Adawy *et al* (2000) and Abdel-Azeem *et al* (2004) postulated that the highest economical efficiency value was obtained in the probiotics supplemented groups.

Table 6. Effect of supplementation of Bioplus 2 B and Lincofeed on caecum mirobial activity of rabbits.

Items	Control	200 mg Bio Plus 2B/kg diet	400 mg Bio Plus 2B/kg diet	200 mg Lincofeed /kg diet	Sig.
No. of examined rabbits	4	4	4	4	
Total bacterial count ($x10^5$)#	80.67^a±10	3.00^b±0.5	1.80^b±0.3	3.87^b±0.4	**
Pathogenic Bacteria					
Salmonella	ND	ND	ND	ND	
Clostridia	ND	ND	ND	ND	
Listeria	ND	ND	ND	ND	

^{a,b} Means within the same row with different superscripts are significantly (P≤.05) different, Sig. =Significance, ** (P≤0.01) . ND= Not dectected , # = Number of bacterial cells per gram of caecum content.

Table 7. Effect of supplementation of Bioplus 2B and Lincofeed on economic traits of growing rabbits.

Items	Control	200 mg Bioplus 2B/kg diet	400 mg Bioplus 2B/kg diet	200 mg Lincofeed/ kg diet	Sig.
Body weight gain (kg)	$1.54^{b}\pm0.02$	$1.59^{b}\pm0.04$	$1.67^{a}\pm0.03$	$1.57^{b}\pm0.03$	**
Total feed intake (Kg/rabbit)	$5.18^{a}\pm0.01$	$4.95^{b}\pm0.04$	$5.08^{ab}\pm0.08$	$5.17^{a}\pm0.03$	**
Total feed cost (LE)	$7.76^{ab}\pm0.02$	$7.55^{b}\pm0.06$	$7.88^{a}\pm0.12$	$7.89^{a}\pm0.03$	**
Total return (LE)	$23.0^{b}\pm0.3$	$23.9^{b}\pm0.45$	$25.5^{a}\pm0.36$	$23.5^{b}\pm0.45$	**
Net return (LE)	$15.26^{b}\pm0.3$	$16.32^{ab}\pm0.5$	$17.61^{a}\pm0.5$	$15.60^{b}\pm0.4$	**
Economic efficiency (%)	$196.6^{b}\pm3.4$	$216.2^{ab}\pm8.0$	$223.9^{a}\pm9.2$	$197.7^{b}\pm4.6$	*
Relative economic efficiency (REE)	100.00	110.00	113.89	100.56	
Performance index	$45.53^{b}\pm1.1$	$51.24^{ab}\pm2.3$	$56.97^{a}\pm2.4$	$47.47^{b}\pm1.6$	**

[a, b] Means within the same row with different superscripts are significantly ($P\leq.05$) different, Sig. =Significance, NS=Non Significant, * ($P\leq0.05$), ** ($P\leq0.01$).
Assuming that the relative EEf of the control diet equals 100.

Conclusively, it could be concluded that, supplementing Bioplus 2B as a probiotic can be used as a growth promoter in growing rabbits to improve efficiency of feed utilization and rabbit performance. The best results were obtained by the group supplemented with 400 mg Bioplus 2B/kg of feed.

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دراسة مقارنة بين المعضد الحيوي (Bioplus 2B) والمضاد الحيوى (Lincofeed) على أداء الأرانب النامية.

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تهدف هذه الدراسة لتقييم تأثير كل من **Bioplus 2B** (كمعضد حيوي) و **Lincofeed** (كمضاد حيوى) كمحفزات للنمو فى علائق الأرانب النامية. استخدم فى هذه الدراسة عدد ٩٦ ارنب نيوزيلندى أبيض مختلط الجنس مفطوم عمر ٥ اسابيع تم توزيعهم عشوائيا إلي أربع مجموعات تجريبية (٢٤ ارنب/ مجموعة). قسمت كل مجموعة الى ٦ تكرارات بحيث احتوى كل تكرار على اربع ارانب. الأوزان المبدئية للارانب فى المجاميع المختلفة كانت متقاربة الى حد كبير. تمثلت المجموعة الاولى فى كمجموعة كنترول و غذيت علي العليقة الأساسية، فى حين غذيت المجموعات من الثانية الى الرابعة علي العليقة الاساسية مضاف اليها ٢٠٠ملجم Licnofeed ، ٢٠٠ ملجم Bioplus 2B أو ٤٠٠ ملجم Bioplus 2B لكل كجم عليقة، على الترتيب. امتدت الفترة التجريبية الى عمر ١٣ اسبوع.

يمكن تلخيص النتائج المتحصل عليها كما يلى:

- أعلى وزن جسم نهائى و وزن مكتسب يومى تم التحصل عليه عند اضافة Bioplus 2B بمستوى ٢٠٠ أو ٤٠٠ ملجم/كجم عليقة.

- أعلى معدل استهلاك غذائى تم التحصل عليه مع الكنترول و مجموعة Lincofeed بالمقارنة بمجموعات Bioplus 2B .
- أفضل معدلات تحويل غذائى، معدلات كفاءة البروتين وكفاءة الاستفادة من الطاقة تم تسجيلها عند اضافة Bioplus 2B بمستويات ٢٠٠ أو ٤٠٠ ملجم/كجم بالمقارنة بالمجموعة كنترول أو مجموعة Lincofeed.
- معاملات هضم البروتين الخام ازدادت معنويا مع كل مستويات Bioplus 2B و Lincofeed بالمقارنة بالعليقة الاساسية. أعلى معاملات هضم للالياف الخام و البروتين الخام المهضوم كانت للمجموعة المغذاة العليقة الاساسية مضاف اليها ٤٠٠ مجم Bioplus 2B / كجم عليقة.
- نسبة التصافى زادت معنويا فى المجموعة المغذاة ٤٠٠ مجم Bioplus 2B أو ٢٠٠ مجم Lincofeed /كجم عليقة. وزن القلب النسبى ازداد فى حين انخفض وزن دهن الكلى النسبى مع الارانب المغذاة ٢٠٠ مجم Bioplus 2B /كجم عليقة.
- مستويات بروتينات و جلوبيولين السيرم انخفضت فى حين ارتفعت نسبة الالبيومين الى الجلوبيولين و كذلك تركيز اليوريا مع المجموعة المغذاة ٢٠٠ مجم Lincofeed /كجم بالمقارنة مع مجموعات Bioplus 2B و الكنترول. نسبة الكوليستيرول و GPT فى سيرم الدم انخفضت معنويا فى المجموعة المغذاة ٤٠٠ مجم Bioplus 2B /كجم عليقة بالمقارنة بغيرها من المجموعات وكذلك الكنترول.
- ولوحظ انخفاض في العدد الميكروبي في محتوي الأعور للأرانب المغذاة علي علائق تحتوي علي المعضد الحيوي أو المضاد الحيوي وخاصية المستوي العالي من المعضد الحيوي. فضلا عن ذلك خلو محتوي أعور الأرانب من الميكروبات الممرضة المسببة للاسهالات المعوية.
- أفضل عائد اقتصادي ، كفاءة اقتصادية، كفاءة اقتصادية نسبية و دليل الأداء على مدار الفترة التجريبية كلها تم التحصل عليهم مع المجموعة المغذاة ٤٠٠ مجم Bioplus 2B/كجم.

يمكن استنتاج ان اضافة ٤٠٠ مجم Bioplus 2B /كجم عليقة (كمعضد حيوي) يمكن ان يوصى به فى علائق الارانب النامية لتحسين آداء النمو و معاملات الهضم (خاصة معامل هضم البروتين و الالياف) ومكونات الدم و التقييم الاقتصادى و خفض العدد الميكروبي في محتوي أعور الأرانب . اضافة الى ذلك، فان هناك حاجة الى دراسات تالية لتقدير كفاءة اضافة Bioplus 2B فى مختلف الظروف البيئية و ظروف الاسكان.