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SUMMARY. *A factorial design experiment was carried (3X3) including three levels of dietary energy (2400, 2600 and 2800 DE Kcal/ kg feed) and inclusion of three groups. The 1st and 2nd groups were supplemented with Lacto-Sacc and Bospro diets, respectively, while the 3rd group was nonsupplemented as a control group. The basal diets were nearly isonitrogenous. A total of 126 purebred NZW rabbits were divided randomly into 9 treatment groups (equal in numbers and with insignificantly different live weights, at 5 weeks of age) and studied on growth response, digestibility and carcass traits during the period from 5 up to 12 weeks of age (marketing age).*

Results obtained could be summarized as follows:

High level of energy was significantly (P< 0.01 and P< 0.05) the highest in values of live body weight, daily weight gain, feed conversion, nutrient digestibility coefficients, nutritive values (DCP, TDN and DE) and most of carcass traits as compared to the other levels of energy during the experimental period. The same trend was observed in viability (%) and performance index.

Feeding rabbits with Lacto-Sacc or Bospro improved significantly (P< 0.01 and P< 0.05) live weight, daily weight gain, feed conversion, nutritive values (DCP, TDN and DE) and most of carcass traits as compared to the control group. The same trend was observed in performance index and economical efficiency. High dietary energy level, inclusion of either Lacto- Sacc or Bospro to the diet and the interaction between high dietary energy level and the biobiotics inclusion to weanling rabbit diet improved significantly (P< 0.01 and P< 0.05) most of growth performance traits and were of favourable effect on most of the nutritional parameters, digestibility of nutrients and all carcass traits except giblets (%). The performance index and economic value for both the high dietary energy level and the inclusion of biobiotics were pronounced.

Key words: *Energy level, biobiotic,growth, nutritional parameters, carcass traits*.

Introduction

The commercial rabbits of energy and protein requirements, as well as, the other nutrients for growth, continuous reproduction and lactation have been reviewed but still under investigation (Cheeke,1987) . Natural biobiotics feed supplements such as, Lacto-Sacc and Bospro are used in rabbit diets as growth promoters increasing weight gain and improving feed efficiencies.

The objectives of this study were to throw more lights on the effect of dietary energy levels, inclusion of biobiotics and the interaction effect between dietary energy level and inclusion of biobiotic sources on growth performance, digestibility of nutrients as well as carcass traits of weanling rabbits.

Materials and Methods

The experimental and laboratory work of the present study were carried out at the National Rabbit Research Project, Department of Animal Production, Faculty of Agriculture, Zagazig University, Egypt. Two biobiotics such as Lacto-Sacc (Probiotic) and Bospro (pre-probiotic) were available in the Egyptian market through the agents of ALLTECH- Biotechnology Center, USA and Pet-Ag, Inc., Illinois, U.S.A., respectively. Pelleting of the diets of growing rabbits was carried out at Commercial Feed Mill of the Investment Sector, Egypt.

A total of 126 purebred New Zealand White (NZW) rabbits, 5 weeks of age (weaning age) were divided randomly into three treatment groups of similar number (42 per group) and of insignificant difference in live body weight ($P \leq 0.05$). Each group was distributed into three sub-groups with 14 rabbits each.

A factorial design experiment (3 x 3) included three levels of energy (2435, 2629 and 2825 DE kcal/ kg feed) and three groups. The 1st and 2nd groups were supplemented with Lacto-Sacc (1 g/ kg feed) and Bospro (2.5 g/kg feed) as recommended by Alltech, 1989 and Pet-Ag, Inc., 1987, respectively, while the 3rd group was non supplemented as a control group. All the experimental groups were nearly isonitrogenous. The composition and chemical analysis of the experimental diets are presented in Table 1.

All animals were housed (each 2 together) in galvanized wire cages (60 x 55 x 40 cm) in a well ventilated building provided with electric fans. The experimental groups were fed ad libitum. Fresh water was automatically available all the time by the stainless steel nipples for each cage. The experimental groups were kept under the same managerial and hygienic conditions.

Rabbits were individually weighed from 5 up to 12 weeks of age. Nutritional and economical parameters were calculated. Traits studied were live body weight, daily weight gain, feed conversion (g feed/ g gain) and viability (%). The economical efficiency (E.E.) was calculated as the following equation:

$$E.E. = A - B/ B \times 100$$

where :

A= Price of kg gain (L.E.) and
B= Feed cost / kg gain (L.E.) .

The performance index (PI was calculated according to North (1981) as the following equation:

Table 1. Comosition chemical analysis of the basal experimental diets.

Items	Basal diets		
	2400 Kcal	2600 Kcal	2800 Kcal
Barley	---	13.00	33.00
Wheat bran	42.00	44.00	21.00
Soybeen meal 44%	15.00	9.00	10.00
Alfalfa meal 15.7 %	14.00	29.00	28.00
Cotton seed meal (40 CP)	---	---	3.00
Bean straw	22.00	---	---
Meat meal (60 % CP)	1.64	---	0.30
Molasses	3.00	3.00	3.00
Limeston	1.50	1.24	1.00
Salt	0.50	0.40	0.34
Vit. and Min. Premix*	0.30	0.30	0.30
Methionine	0.06	0.06	0.06
Total	100.00	100.00	100.0
Chemical analysis (% as fed) :			
crude protein	16.11	16.10	16. 14
DE Kcal/ kg **	2435.00	2629.00	2825.00
Ether extract	2.33	2.31	2.23
Crude fiber	12.89	12.82	12.74
NFE	50.31	50.22	50.53
Ash	9.33	9.53	9.41
Feed cost/ton (LE)	475	480	550

* Vitamin and mineral premix per 1 kg contained: Vit. A, 4.000.000 IU; Vit. D_3, 500.000 IU; Vit. E, 16.7 g; Vit. K 0.67 g, Vit. B_1 0.67 g, Vit. B_2 2.0 g, Vit B_6 0.67 g, Vit. B_{12}, 0.004 g; Vit. PP, 16.7 g; Pantothenic acid; 6.67 g; Biotin; 0.07 g; Folic acid, 1.67 g; Choline chloride, 400 g; Zn, 23.3 g; Mn, 10 g; Fe, 25 g; Cu, 1.67 g; I , 0.25 g; Se, 0.033 g; Mg, 133.4 g.

** Calculated according to NRC.(1977) on Rabbits.

$$PI = \frac{\text{Live body weight (kg)}}{\text{Feed conversion}} \times 100.$$

At the end of the experiment, nine digestibility trails were undertaken. Four animals from each treatment group were housed in individual metabolism cages that allowed faeces and urine separation. The preliminary period continued for 7 days, while the collection extended to 6 days. Feed intake was accurately determined, but coprophagy was not prevented. Faeces samples were dried at 70°C for 24 hours then ground. The chemical composition of the basal diet and faeces samples were analysed according to A.O.A.C. (1980).

The total digestible nutrients (TDN) were calculated according to the classic formula of Cheeke *et al.* (1982), while the digestible energy (DE kcal/ kg) was calculated by multiplying digestible crude protein (DCP; g/ kg), digestible ether extract (DEE, g/ kg), digestible crude fibre (DCF, g/ kg) and nitrogen free extract (NFE, g/ kg) by 5.28, 9.51, 4.20 and 4.20, respectively, according to Schiemann *et al.* (1972).

At marketing age, a total of 36 rabbits were available for slaughter test. Four representative rabbits from each treatment were sacrificed for carcass traits by the standard technique according to Cheek *et al.* (1987).

Analysis of variance was carried out according to Snedecor and Cochran (1982) by using factorial design. The following model was used:

$$Y_{ijk} = m + E_i + S_j + ES_{ij} + e_{ijk}$$

where

Y_{ijk} = An observation, m = Overall mean, E_i = levels of energy (i = 1,2 and 3), S_j = Sources of Biobiotics (j = 1,2 and 3), ES = The interaction effect between levels of energy and sources of biobiotics (ij = 1,2, ...9), e_{ijk} = Random error. The significant differences among means were calculated by using Duncan's New Multiple Range-test. Viability was analysed by using Chi - Square.

Results and Discussion

Growth performance traits:

Data presented in Table 2, the level of energy at 2800 DE k cal/ kg feed was significantly the highest ($P < 0.01$) in values of live weight, daily gain weight and feed conversion as compared to the other levels of energy from 5 to 12 weeks of age (marketing age). The same trend was observed in viability (%) and performance index. Similar results were obtained by Castello and Gurri, (1992). However, the high level of energy was lower in economical efficiency (EE) than the other groups studied. From these results, it could be concluded that level energy at 2600

K cal, which was higher in economical efficiency and was suitable performance index (PI) than the other experimental groups (Table 2).

Table 3 shows that feeding rabbits, supplemented with Lacto-sacc or Bospro diets significantly (P < 0.01), improved live weight, daily weight gain and feed conversion. The same trend was observed in percentages of EE, PI and viability, which were slightly higher in diet supplemented with Bospro than those supplemented with Lacto-Sacc from weaning to marketing age (Table 5). Sonbol and EL-Gendy (1992) reported that average daily weight gain and feed conversion improved significantly (P < 0.01) for rabbits fed on a diet supplemented with Lacto-Sacc (1g/ kg feed) compared with those fed the basal diet alone or supplemented with Bospro (1g/ kg feed), however, feed conversion slightly improved with Bospro. These results are in agreement with those obtained by Tawfeek and Hindawy (1991), De Blas *et al.* (1991) and El-Maghawry *et al.* (1993) on weanling rabbits.

The interaction effects between energy levels and the biobiotics sources on all traits of growth performance were significant (P < 0.01) during the experimental period (Table 4). Within each level of energy and supplementation with Lacto-Sacc or Bospro diets were significantly (P < 0.01) heavier in live weight and daily weight gain than in these of the control group. Moreover, feed conversion ratio improved with the supplement of Lacto-Sacc or Bospro within each energy levels at the same period. The same interaction effects on performance index were pronounced in Lacto-sacc or Bospro with different levels of energy, but was more pronounced with high level of energy and supplementation with Lacto-Sacc or Bospro in growing rations (Table 4). It may be concluded that Lacto-Sacc or Bospro diet lowered the feed cost per Kg gain and improved the economical efficiency within each level of energy. However, Lacto-Sacc or Bospro in the diet with (2600 kcal DE /kg feed) was more economically efficient of the growing rabbits (Table 4) .

Digestibility coefficients:

Data presented in Table 5 indicated that the digestibility coefficients of nutrients, as well as, the nutritive value as DCP, TDN and DE were improved significantly (P< 0.05 and P< 0.01) as the dietary digestible energy increased from 2400 to 2800 Kcal DE/ Kg feed. The improvement may be related to calory/ protein ratio.

Table 2. Growth performance of growing NZW rabbits as affected by different levels of energy during period from 5 to 12 weeks of age (marketing age).

Traits	Levels of energy (kcal/ kg)		
	2400	2600	2800
No. of rabbits	42	42	42
Initial weight (5 weeks)	646.79±1.83	645.71±2.24	644.40±1.46
Live weight (12 weeks)	1830.69±10.30[c]	2090.37±8.46[b]	2181.43±16.62[a]
Daily weight gain	24.16±0.22[c]	29.48±0.17[b]	31.37±0.34[a]
Feed conversion	3.88±0.04[a]	3.69±0.03[b]	3.49±0.03[c]
Viability (%)	85.71	97.62	100
Performance index (%)	47.18	56.65	62.51
Feed cost/ kg gain (LE)	1.921	1.845	1.989
EE (%)	212.34	225.20	201.66

Means in the same raw having different letters, differ significantly (P< 0.05).

Table 3. Growth performance of NZW rabbits as affected by biobiotics sources in growing diets during the period from 5 to 12 weeks of age.

Traits	Source of pre -probiotic		
	Control	Lacto-Sacc	Bospro
No. of rabbits	42	42	42
Initial weight (5 weeks)	645.0±1.88	645.48±1.95	646.43±1.80
Live weight (12 weeks)	1948.25±20.35[b]	2078.38±8.46[a]	2106.79±25.43[a]
Daily weight gain	26.60±0.42[b]	29.23±0.53[a]	29.80±0.53[a]
Feed conversion	3.90±0.03[a]	3.56±0.03[b]	3.53±0.03[b]
Viability (%)	95.24	95.24	92.86
Performance index (%)	49.96	58.38	59.68
Feed cost/ kg gain (LE)	1.958	1.898	1.878
EE (%)	206.43	216.12	219.49
Feed cost/ kg (L.E.)	0.502	0.533	0.532

Means in the same raw having different letters, differ significantly (P< 0.05).

Table 4. Interaction effect between energy level and biobiotic sources on growth performance traits during the period from 5 to 12 weeks of age.

Energy levels (kcal/ kg)	Biobiotic sources	Initial weight (5 weeks)	Final weight (12 weeks)	Daily weight gain	Feed conversion	Viability (%)	PI (%)	Feed cost/kg	Feed cost/ kg gain	EE (%)
	Control	646.8±2.6	1758.8±9.8 g	22.7±.2 g	4.1±.04 a	85.7	42.5	.475	1.966	205.2
2400	Lacto-Sacc	645.0±4.1	1846.7±9.3 f	24.5±.2 f	3.8±.06 c	85.7	48.6	.506	1.923	212.0
	Bospro	648.6±2.7	1886.7±8.3 e	25.3±.2 e	3.7±.03 c	85.7	50.7	.505	1.879	219.3
	Control	643.9±4.4	2023.2±4.6 d	28.1±.1 d	3.9±.03 b	100	51.2	.480	1.896	216.5
2600	Lacto-Sacc	645.7±3.2	2108.9±4.3 c	29.9±.1 c	3.6±.02 c	100	58.6	.511	1.840	226.1
	Bospro	647.5±4.1	2142.7±6.6 b	30.5±.2 b	3.5±.02 d	92.9	60.7	.510	1.800	233.3
	Control	644.3±3.5	2035.7±9.14 d	28.40±.2 d	3.7±.03 c	100	54.4	.550	2.057	191.7
2800	Lacto-Sacc	645.7±3.0	2246.4±5.8 a	32.7±.1 a	3.4±.02 e	100	66.7	.581	1.958	206.4
	Bospro	643.2±2.2	2262.1±6.1 a	33.0±.1 a	3.4±.03 e	100	66.5	.580	1.972	204.3

Means in the same column having different letters, differ significantly ($P < 0.05$).

Table 5. **Effect of energy levels, biobiotic sources and interaction between them on digestibility coefficients and nutritive value.**

Items		Digestibility coefficients						Nutritive value		
		DM	OM	CP	EE	CF	NFE	DCP	TDN	DE Kcal/ kg
Energy levels (Kcal/ kg) (E):		x	x	x	x	x	x	x	xx	xx
	2400	66.57^{c} ±0.07	68.33^{b} ±0.15	76.49^{c} ±0.17	64.80^{c} ±0.17	56.20^{b} ±0.14	69.14^{c} ±0.15	11.68^{b} ±0.09	57.73^{b} ±0.16	2559.61 ±1.28^{c}
	2600	67.94^{b} ±0.18	70.07^{a} ±0.12	78.28^{b} ±0.05	65.87^{b} ±0.22	57.33^{a} ±0.17	70.25^{b} ±0.19	12.26^{a} ±0.10	59.07^{a} ±0.18	2600.67 ±1.11^{b}
	2800	68.77^{a} ±0.10	70.15^{a} ±0.14	78.93^{a} ±0.16	67.88^{a} ±0.17	57.43^{a} ±0.07	71.55^{a} ±0.13	12.41^{a} ±0.05	59.35^{a} ±0.03	2642.41 ±1.54^{a}
Biobiotics sources (B)		NS	NS	NS	NS	NS	NS	NS	*	NS
	Control	67.67±0.32	69.32±0.33	77.85±0.38	66.22 ±0.40	56.96 ±0.25	70.27 ±0.37	12.05 ±0.13	58.48^{b} ±0.31	2599.41 ±10.29
	Lacto-Sacc	67.89±0.37	69.53±0.32	77.96±0.38	66.07 ±0.58	57.06 ±0.26	70.46 ±0.38	12.14 ±0.15	59.01^{a} ±0.20	2604.65 ±10.45
	Bospro	67.71±0.34	69.70±0.32	77.89±0.41	66.28 ±0.47	56.94 ±0.20	70.21 ±0.39	12.16 ±0.13	58.67^{ab} ±0.31	2598.63 ±9.99
Interaction effect (B x E):		x	x	x	x	x	x	x	x	NS
2400	Control	66.66^{c}±0.19	68.15^{b}±0.32	76.44^{b}±0.28	65.10^{cd}±0.27	56.05^{d}±0.24	68.95^{d}±0.27	11.65^{c}±0.08	57.38^{c}±0.12	2554.83±0.31
	Lacto-Sacc	66.45^{c}±0.09	68.35^{b}±0.23	76.63^{b}±0.31	64.66^{d}±0.28	56.08^{cd}±0.03	69.40^{cd}±0.10	11.72^{a}±0.25	58.22^{b}±0.08	2565.14±0.10
	Bospro	66.61^{c}±0.06	68.48^{b}±0.27	76.41^{b}±0.40	64.65^{d}±0.38	56.48^{c}±0.37	69.09^{d}±0.35	11.68^{a}±0.18	57.58^{c}±0.34	2558.86±0.15
2600	Control	67.67^{bc}±0.29	69.98^{a}±0.28	78.18^{a}±0.02	65.92^{bc}±0.36	57.28^{b}±0.24	70.54^{b}±0.29	12.24^{a}±0.26	58.75^{ab}±0.39	2605.65±0.35
	Lacto-Sacc	68.36^{ab}±0.11	69.98^{a}±0.23	78.30^{a}±0.08	65.22^{c}±0.00	57.74^{a}±0.14	70.15^{c}±0.33	12.18^{ab}±0.19	59.40^{a}±0.05	2555.33±0.25
	Bospro	67.78^{b}±0.42	70.24^{a}±0.07	78.36^{a}±0.10	66.96^{b}±0.22	56.96^{bc}±0.34	70.05^{c}±0.41	12.37^{a}±0.10	59.07^{a}±0.38	2597.02±0.04
2800	Control	68.68^{a}±0.16	69.83^{a}±0.30	78.93^{a}±0.24	67.63^{a}±0.27	57.54^{ab}±0.14	71.33^{ab}±0.20	12.27^{a}±0.04	59.30^{a}±0.04	2637.75±0.09
	Lacto-Sacc	68.87^{a}±0.08	70.25^{a}±0.22	78.96^{a}±0.39	68.32^{a}±0.22	57.35^{b}±0.15	71.85^{a}±0.16	12.53^{b}±0.08	59.40^{a}±0.02	2649.45±0.43
	Bospro	68.75^{a}±0.28	70.37^{a}±0.10	78.90^{a}±0.33	67.69^{a}±0.31	57.39^{b}±0.07	71.48^{a}±0.27	12.42^{c}±0.05	59.36^{a}±0.08	2640.01±0.10

Mean in the same columen within each class with different superscripts, differed significantly ($P < 0.05$).

x $P < 0.05$ xx $P < 0.01$

Sankhyan *et al.* (1990) found that the DM and CP digestibilities of (high protein and high energy) and (normal protein and normal energy) diets were significantly higher (P< 0.05) than those of (low protein and low energy) diet. On the other hand, Grobner *et al.* (1985) found that the dry matter, energy and crude protein digestibility were lowest with the low energy high fibre diet.

Results in Table 5 shows that feeding rabbits with Lacto-Sacc or Bospro diets did not show any significant effect on either digestibility coefficients or nutritive value, except, TDN, which improved significantly (P<0.05) by Lacto-Sacc inclusion to the diet. Similar results were obtained by Sonbol and El-Gendy (1992).

The interaction effect of dietary energy level and biobiotics supplementation resulted in different flactuation effects on the digestibilities and nutritive values of the diets. However, 2800 Kcal /Kg feed with Lacto-Sacc showed the highest significant values of digestibilities or nutritive values as compared to other groups (Table 5). The improvement obtained may be due to the digestive action of some enzymes presented in the composition of Lacto-Sacc. El-Hindawy *et al.* (1993) reported that inclusion of 1.0 or 1.5 g Lacto-Sacc/ kg feed in rabbit diets improved (P < 0.05) digestibility coefficients or nutritive values of the supplemented diets. Similar results were obtained by Tibor (1992) and Yamani *et al.* (1992).

Slaughter Test:

Data presented in Table 6 show that low level of energy was lower significantly (P<0.01) in values of eviscerated (empty body weight), boneless meat and dressing percentages as compared to the high level of energy. Similar results were obtained by Castello and Gurri (1992).

Table 6 show that rabbits fed on supplemented diet with biobiotics increased significantly (P < 0.01) in eviscerated, boneless and dressing percentages and decreased significantly (P< 0.01) in giblets (%) as compared to the nonsupplemented group. Similar results were obtained by El-Maghawry *et al.* (1993) and El-Hindawy *et al.* (1993).

The interaction effects between energy levels and biobiotic sources were significant on each of eviscerated (P < 0.05), giblets (P < 0.01), boneless meat (P < 0.05) and dressing percentages (P < 0.01) as shown in Table 6. Within each

Table 6. Effect of energy levels, biobiotic sources and their interaction between them on carcass trait.

Treatments		Preslaughter Weight g	Eviscerated %	Giblets %	Dressing %	Boneless meat %
Energy levels (Kcal/ kg) (E) :						
2400		1832.08 ± 15.03	52.10^{b}	4.22^{b}	63.09^{b}	84.56^{c}
2600		2094.17 ± 15.47	54.53^{a}	4.53^{a}	64.99^{a}	85.09^{b}
2800		2179.58 ± 30.89	54.83^{a}	4.31^{b}	64.92^{a}	85.94^{a}
Source of biobiotics (B) :						
Control		1941.67 ± 37.44	53.10^{b}	4.49^{a}	63.50^{c}	84.26^{b}
Lacto-Sacc		2068.33 ± 50.55	54.05^{a}	4.26^{b}	64.44^{b}	85.73^{a}
Bospro		2095.83 ± 46.85	54.35^{a}	4.30^{b}	65.06^{a}	85.60^{a}
Interaction effect (E x B) :						
2400	Control	1766.25 ± 2.39	51.79^{d}	4.73^{a}	63.09^{d}	83.47^{e}
	Lacto-Sacc	1843.75 ± 2.39	52.28^{d}	3.94^{d}	62.87^{d}	85.32^{bc}
	Bospro	1886.25 ± 2.39	52.25^{d}	3.99^{d}	63.32^{c}	84.90^{c}
2600	Control	2023.75 ± 2.39	53.87^{c}	4.32^{a}	63.86^{c}	84.34^{d}
	Lacto-Sacc	2115.00 ± 2.04	54.96^{b}	4.58^{b}	65.34^{b}	85.38^{b}
	Bospro	2143.75 ± 2.39	54.93^{b}	4.68^{c}	65.79^{a}	85.45^{b}
2800	Control	2035.00 ± 2.04	53.67^{c}	4.42^{c}	63.55^{c}	84.96^{c}
	Lacto-Sacc	2246.25 ± 2.39	54.91^{b}	4.27^{a}	65.13^{b}	86.49^{a}
	Bospro	2527.50 , 3.23	55.88^{a}	4.23^{d}	66.08^{a}	86.36^{a}

Means in the same column within each classification within different superscripts, differed significantly ($P < 0.05$).

level of energy and supplementation with Lacto-Sacc or Bospro resulted significant higher in slaughter traits than the control group. These findings were very pronounced with high level of energy and supplementation with biobiotic sources on all traits of slaughter.

Conclusion

The addition of Lacto - Sacc (1 g/kg feed) or Bospro (2.5 g/kg feed) to the level of energy (2600 or 2800 k cal DE/ kg feed) seems to have a positive effect on efficiency of broiler rabbits, such practice may be of a high economical value.

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