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NEW TREND IN RABBIT'S GROWTH IN RELATION TO ENERGY AND PROTEIN REQUIREMENTS

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This study was designed to determine the adequate allowances of energy and protein during two successive growth periods in order to maximize growth performance, consequently economic efficiency. Four dietary protein levels; 16, 18, 19 and 20% with three levels of digestible energy; 2500, 2800 and 3000 kcal/kg diet in a(4 x 3) factorial design were fed to growing New Zealand White (NZW) rabbits. A total of 180 rabbits were randomly assigned into twelve group (15 rabbit each), of nearly similar age (5 weeks) and initial weights. The experimental period was subdivided into two equal periods (four weeks each).

Results showed that increasing energy and protein concentration (during the first period) up to 112% (2800 DE) and 118.75% (19% CP), respectively more than NRC, (1977) gave the best values ($P \leq 0.01$) for body weight gain and feed conversion, so the best economic efficiency value. While, during the second period, the mentioned values were the best ($P \leq 0.01$) when energy and protein levels increased up to 120% (3000 DE) and 112.5% (18% CP), respectively more than NRC, (1977). The best values of DM and OM digestion coefficients, carcass weight, blood total protein and liver function (ALT and AST enzymes) were recorded for rabbits fed 18% CP and 3000 kcal DE/kg diet.

In conclusion, increasing dietary energy and protein levels in NZW growing rabbit's diets with portioning the growth periods into two successive periods improved growth performance and economic efficiency.

Keywords: Energy levels, growth performance, protein, rabbits.

Rabbits are an excellent and economical producer animals for protein to satisfy increasing demand for human needs in developing countries. The nutrition of rabbits is most important factor affecting productive and reproductive traits. However, protein and energy requirements of growing rabbits have been studied by several investigators to determine the exact levels of both protein and energy for growing rabbits. In this concern, Lebas, (1975 a & b) has voted good productive and reproductive performance of rabbits fed diets of a wide range of energy, i.e. from 2500 to 2900 kcal DE/kg diet. Besides, Martin, (1977) suggested that, the range of 17 to 20% crude protein for growing was recommended. Also, Omole (1982) stated that, the range of 17 to 20% crude protein could be optimal for growing rabbits.

Therefore, the present study aimed to determine new allowances of energy and protein for growing rabbits based on two growth periods to find out the optimum growth performance and economic efficiency.

MATERIALS AND METHODS

The present study was carried out at a Private rabbitary Farm in the North of Dakahlia Governorate, Egypt. A total of 180 New Zealand White (NZW) weanling rabbits at 5 weeks of age were divided randomly into 12 groups (15 each). All weanling rabbits were nearly equal in live body weight at the beginning of the experiment.

Four dietary levels of crude protein, *i.e.*16%,18%, 19% and 20 % (0, 12.5, 18.75 and 25 % more than NRC, 1977) and three levels of digestible energy, i.e. 2500, 2800 and 3000 kcal/kg diet (0. 12 and 20% more than NRC, 1977) were used in (4 X 3) factorial design for eight weeks which were subdivided into two equal periods (first ad second) to possibly determine the requirements of energy and protein in each period in order to maximize weight gain, so its margin.

The level of 16% crude protein (CP) with the energy level of 2500 kcal DE/kg diet was used as a control group according to the recommended energy and protein levels by NRC (1977) for growing rabbits. Essential amino acids, lysine and sulphur amino acids, in addition to, the minerals and vitamins were adjusted in all diets to cover the requirements according to NRC (1977). Ingredients and chemical analysis of the experimental diets were presented in Table 1.

All groups were kept under the same managerial and hygienic conditions and were housed in batteries provided with feeders and automatic drinkers. Diets were offered *ad libitum* and given twice a day. Fresh water was available all the times. Rabbits were weighed at weekly intervals during the two experimental periods. At the same time, feed intake was recorded to calculate feed consumption and feed conversion (g feed/g gain).

At the last week of the experimental period, a digestible trial was carried out by using three male rabbits from each group to determine the digestible coefficients of nutrients of the experimental diets according to Radwan *et al.*,

Table 1. Composition and chemical analysis of the experimental diets.

Ingredients	2500 kcal DE/kg diet CP				2800 kcal DE/kg diet CP				3000 kcal DE/kg diet CP			
	16%	18%	19%	20%	16%	18%	19%	20%	16%	18%	19%	20%
Corn yellow	4.00	2.10	0.00	0.00	13.00	7.60	5.50	2.0	18.50	14.10	11.25	8.65
Soybean 44%	6.97	8.01	12.00	12.00	12.70	18.84	21.99	24.50	15.00	21.10	24.00	27.00
Soybean 48%	3.00	7.30	6.49	9.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wheat bran	34.25	31.26	32.28	32.28	18.00	18.00	18.00	20.14	9.49	9.49	9.49	9.09
Clover hay	36.29	35.89	35.89	35.89	31.74	31.20	30.20	29.05	33.80	32.80	32.80	32.80
Barley grains	8.32	8.35	6.34	3.31	17.00	17.00	17.00	17.00	13.00	13.00	13.00	13.00
DL. Methionine	0.28	0.26	0.20	0.20	0.25	0.20	0.15	0.15	0.25	0.20	0.15	0.15
L. Lysine	0.19	0.03	0.00	0.00	0.15	0.00	0.00	0.00	0.20	0.00	0.00	0.00
Vegetabl oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50	2.15	2.15	2.15
Limestone	0.70	0.70	0.70	0.70	0.90	0.90	0.90	0.90	0.40	0.30	0.30	0.30
Dicalcium-phosphate	1.20	1.30	1.30	1.30	1.4	1.40	1.40	1.40	2.00	2.00	2.00	2.00
Molasses	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
NaCl (Salt)	0.30	0.30	0.30	0.30	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Premix	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Choline chloride	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Anticoccidia	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
****Calculated analysis**												
DE kcal/kg	2517	2500	2517	2501	2796	2802	2811	2811	2996	2996	2996	3000
Crude protein%	16.09	18.00	19.03	20.05	16.01	18.03	19.09	20.08	16.00	17.98	19.00	20.06
Crude fiber%	14.15	13.92	14.14	14.11	12.24	12.33	12.36	12.31	12.00	11.99	12.14	12.25
Crude fat%	2.28	2.16	2.19	2.20	2.19	2.02	1.94	1.87	2.14	2.00	1.92	1.85
Calcium%	1.13	1.13	1.14	1.15	1.17	1.18	1.18	1.17	1.14	1.11	1.12	1.13
Phosphorus%	0.80	0.80	0.80	0.81	0.80	0.81	0.81	0.82	0.83	0.83	0.83	0.83
Lysine%	0.70	0.72	0.78	0.86	0.71	0.75	0.84	0.92	0.76	0.77	0.85	0.90
Methionine + Cys.	0.60	0.64	0.63	0.65	0.61	0.62	0.60	0.63	0.60	0.60	0.60	0.63
Methionine%	0.37	0.40	0.40	0.41	0.41	0.40	0.36	0.38	0.42	0.37	0.37	0.38

*Each 3 kg of vit. and min in premix contain: 6000000 IU Vit. A, 900000 IU Vit.. D3, 40000 mg Vit.. E, 2000 mg Vit.. K, 2000 mg Vit. B1, 4000 mg Vit. B2, 2000 mg Vit. B6, 10 mg Vit.. B12, 50000 mg Niacin, 10000 mg Pantothenic acid, 50 mg Biotin, 3000 mg Folic acid, 250000 mg Choline, 50000 mg Zn, 8500 mg Mn, 50000 mg Fe, 50000 mg Cu, 200 mg I, 100 mg Se and 100 mg Co.

**According to NRC, 1977.

(1971). Samples of diets and faeces were chemically analyzed according to A.O.A.C. (1999.

At the end of the experimental period, six representative rabbits from each group were randomly chosen for slaughtering and collecting blood samples, after being fasted for 12 hours. After complete bleeding the carcass and their cuts (fore parts, trunk and hind parts) were weighed. The blood samples were collected heparinized glass tube and centrifuged at 3000 RBM for 20 minutes to separate plasma. The collected plasma was stored at - 20°C until assay. Total lipids, triglycerids, cholesterol, total protein, albumin, aspartate aminotransferase (AST), alanine aminotransferase (ALT), urea and creatinine were determined colorimetrically using kits from Bio-Matrieux (France).

Economical efficiency were calculated as follows:

Economical efficiency = Net revenue / Total feed cost

While: Net revenue = Selling price of total weight gain – total feed cost

Data were statistically analyzed using the General Linear Model Procedure of SAS, (1994). Duncan's multiple range tests was performed (Duncan, 1955) to detect significant differences between means.

RESULTS AND DISCUSSIONS

1. Growth performance:

Concerning the effect of dietary energy levels (Table 2a), results showed that, during the first (6-9 wks), second (10-13 wks) and the whole experimental periods (6-13 wks), the best values of live body weight, weight gain and feed conversion were recorded for rabbits fed diets containing the high energy level (3000 kcal DE/kg diet), followed by those fed 2800 kcal DE/kg diet, then rabbits fed 2500 kcal DE/kg diet, which plays as the control diet.

The proportional increment of weight gain for rabbits fed 3000 kcal DE/kg diet during the first and second periods were 18.26 and 8.52 %, respectively, vis-à-vis 9.38 and 7.28 for those fed 2800 kcal DE/kg diet, respectively, when compared to the controls. It was quit clear to note that, weight gain increased by increasing the energy level in growing rabbit diets, especially during the first period where rabbits gained more. Regarding this, Bassuny *et al.*, (1997) reported that, the final body weight was significantly increased when energy level increased from 2500 to 2700 kcal DE/kg diet.

Respecting feed consumption, it was decreased by increasing the dietary energy level during the first and second periods, as well as the overall period (Table 2a). The proportional decrement for rabbits fed 3000 kcal DE/kg diet, during the first and second periods were 5.04 and 5.54%, respectively comparable to those fed the control diet. As for, feed conversion, Table (2a)

Table 2a. Effect of energy, protein levels and their Interaction on growth performance of NZW rabbits.

Treatments	Live body weight (g)			Body weight gain (g)			Feed consumption (g)			Feed conversion (g feed/g gain)			Mortality %
	Initial weight	After the first period	At the end of the experiment	During the first period	During the second period	Total	During the first period	During the second period	Total	During the first period	During second period	Total	
Effect of energy levels (kcal DE/kg diet)													
2500	647.00 ±4.02	1097.41^{b} ±13.04	1733.68^{b} ±15.60	450.41^{b} ±8.11	636.27b ±9.13	1086.68^{b} ±14.00	1831.00^{a} ±20.01	2789.75^{a} ±22.67	4620.75^{a} ±20.19	4.06a ±0.08	4.38^{a} ±0.13	4.25^{a} ±0.03	1.67
2800	649.00 ±5.00	1141.68^{ab} ±14.10	1824.30^{a} ±19.01	492.68^{ab} ±7.94	682.62a ±11.21	1175.30^{a} ±14.11	1775.50^{ab} ±15.01	2715.00^{ab} ±20.11	4490.50^{ab} ±24.90	3.60b ±0.17	3.98^{b} ±0.16	3.82^{b} ±0.11	1.67
3000	652.25 ±3.99	1184.91^{a} ±13.91	1875.36^{a} ±22.01	532.66^{a} ±9.03	690.45a ±9.00	1223.11^{a} ±13.91	1738.75^{b} ±19.00	2635.25^{b} ±23.61	4374.00^{b} ±26.30	3.26c ±0.16	3.82^{b} ±0.07	3.58^{c} ±0.12	1.67
Sig.	NS	*	*	*	*	**	*	*	*	**	*	*	NS
Effect of protein levels													
16%	651.78 ±7.11	1106.21^{b} ±14.11	1770.40 ±19.01	454.43^{b} ±8.03	664.19 ±9.01	1118.62^{b} ±15.11	1798.33 ±22.01	2710.00 ±20.91	4508.33 ±31.51	3.96^{a} ±0.13	4.08 ±0.04	4.03^{a} ±0.03	2.22
18%	649.33 ±4.01	1121.09^{b} ±12.38	1805.13 ±18.70	471.76^{b} ±6.03	684.04 ±7.93	1155.80^{ab} ±14.00	1786.33 ±20.22	2719.67 ±24.17	4506.00 ±19.95	3.79^{a} ±0.07	3.98 ±0.13	3.90^{ab} ±0.15	2.22
19%	645.55 ±5.01	1177.25^{a} ±11.01	1847.78 ±18.22	531.70^{a} ±6.33	676.53 ±8.77	1201.23^{a} ±13.93	1768.67 ±19.11	2743.67 ±22.11	4512.34 ±30.11	3.33^{b} ±0.11	4.09 ±0.17	3.75^{b} ±0.07	2.22
20%	651.00 ±5.11	1160.76^{ab} ±12.01	1821.14 ±17.03	509.76^{ab} ±8.01	660.38 ±8.77	1170.14^{ab} ±14.11	1773.67 ±17.91	2680.00 ±22.01	4453.67 ±26.32	3.48^{b} ±0.09	4.06 ±0.05	3.81^{b} ±0.03	2.22
Sig.	NS	*	NS	**	NS	*	NS	NS	NS	*	NS	*	NS

Means in the same column having different letters, differ significantly.
**: $P<0.01$, *: $P\leq 0.05$, NS: Not significant, Sig. = Significant.

Continuation of the Table 2b.

Treatments		Live body weight (g)			Body weight gain (g)			Feed consumption (g)			Feed conversion (g feed/g gain)			Mortality %
		Initial weight	After the first period	At the end of the experiment	During the first period	During the second period	Total	During the first period	During the second period	Total	During the first period	During second period	Total	
Interaction effect between energy and protein levels.														
2500	16%	650.67 ±6.13	1055.33^{c} ±13.21	1705.33^{b} ±17.31	404.66^{c} ±6.11	650.00^{b} ±8.13	1054.66^{c} ±12.01	1855.00^{a} ±18.17	2816.00^{a} ±23.93	4671^{a} ±21.05	4.58a ±0.15	4.33^{a} ±0.06	4.43^{a} ±0.07	6.67
	18%	647.33 ±4.01	1050.71^{c} ±12.10	1721.54^{b} ±17.81	403.38^{c} ±5.93	670.83^{ab} ±7.91	1074.21^{c} ±14.00	1828.00^{a} ±22.00	2800.00^{a} ±25.13	4628^{a} ±20.11	4.53a ±0.17	4.17^{ab} ±0.03	4.31^{a} ±0.03	0.00
	19%	644.00 ±4.93	1159.29^{a} ±15.01	1772.86^{b} ±16.50	515.29^{a} ±5.15	613.57^{c} ±9.11	1128.86^{b} ±13.11	1821.00^{a} ±18.63	2768.00^{a} ±20.71	4589^{a} ±24.50	3.53^{c} ±0.04	4.51^{a} ±0.12	4.06^{b} ±0.08	0.00
	20%	646.00 ±4.33	1124.29^{ab} ±16.02	1735.00^{b} ±17.99	478.29^{b} ±8.11	610.71^{c} ±7.71	1089.00c ±12.00	1820.00^{a} ±18.31	2775.00^{a} ±19.90	4595^{a} ±26.30	3.80^{c} ±0.05	4.54^{a} ±0.06	4.22^{a} ±0.16	0.00
2800	16%	653.33 ±5.45	1087.14^{bc} ±11.01	1773.57^{b} ±20.01	433.81^{bc} ±4.99	686.43^{ab} ±5.45	1120.24bc ±15.00	1789.00^{a} ±17.73	2702.00^{a} ±19.51	4491^{a} ±26.00	4.12b ±0.09	3.94^{bc} ±0.14	4.01^{b} ±0.17	0.00
	18%	648.00 ±7.00	1119.23^{b} ±11.90	1793.85^{b} ±19.91	471.23^{b} ±5.15	674.62^{ab} ±7.11	1145.85b ±14.11	1786.00^{a} ±18.01	2721.00^{a} ±22.11	4507^{a} ±20.01	3.79c ±0.13	4.03b ±0.15	3.93^{b} ±0.08	0.00
	19%	645.33 ±6.11	1195.33^{a} ±14.81	1893.33^{a} ±20.21	550.00^{a} ±4.66	698.00^{a} ±9.10	1248.00a ±14.38	1762.00^{ab} ±22.31	2796.00^{a} ±22.91	4558^{ab} ±25.30	3.20^{d} ±0.07	4.01^{b} ±0.03	3.65^{c} ±0.08	0.00
	20%	649.33 ±6.91	1165.00^{a} ±13.01	1836.43^{a} ±21.03	515.67^{a} ±6.17	671.43^{ab} ±9.15	1187.10ab ±13.10	1765.00^{ab} ±16.93	2641.00^{b} ±24.50	4406^{ab} ±25.9	3.42^{d} ±0.15	3.93^{c} ±0.01	3.71^{c} ±0.02	6.67
3000	16%	651.33 ±4.02	1176.15^{a} ±14.02	1832.31^{a} ±19.10	524.82^{a} ±8.00	656.16^{b} ±11.10	1180.98b ±15.90	1751.00^{b} ±15.11	2612.00^{b} ±19.63	4363^{b} ±23.31	3.34^{e} ±0.13	3.98^{b} ±0.11	3.69^{c} ±0.02	0.00
	18%	652.67 ±5.11	1193.33^{a} ±14.03	1900.00^{a} ±21.00	540.66^{a} ±8.10	706.67^{a} ±9.18	1247.33^{a} ±15.11	1745.00^{b} ±20.11	2638.00^{b} ±20.11	4383b ±22.10	3.23^{e} ±0.04	3.73^{d} ±0.06	3.51^{cd} ±0.11	6.67
	19%	647.33 ±3.91	1177.14^{a} ±14.31	1877.14^{a} ±20.31	529.81^{a} ±5.38	700.00^{a} ±7.11	1229.81^{a} ±14.80	1723.00^{b} ±19.10	2667.00^{b} ±26.51	4390b ±22.90	3.25^{e} ±0.08	3.81^{cd} ±0.03	3.57^{c} ±0.15	0.00
	20%	657.67 ±6.25	1193.00^{a} ±13.21	1892.00^{a} ±17.05	535.33^{a} ±8.03	699.00^{a} ±9.01	1234.33^{a} ±14.93	1736.00^{b} ±20.15	2624.00^{b} ±22.10	4360^{b} ±24.10	3.24^{e} ±0.04	3.75^{d} ±0.06	3.53^{cd} ±0.15	0.00
Sig.		NS	**	**	**	**	**	*	*	*	**	**	**	NS

Means in the same column having different letters, differ significantly.
**: P<0.01. *: P<0.05, NS: Not significant. Sig. = Significant.

revealed that, the proportional improvement during the first and second period for rabbits fed 3000 kcal DE/kg diet were 19.70 and 12.79, respectively, vis-à-vis 11.33 and 9.13% for those fed 2800 kcal DE/kg diet, respectively when compared to rabbits fed the control diet.

Analysis of variance showed significant differences between treatments for live body weight, weight gain, feed consumption and feed conversion due to different dietary energy levels during the first and second period, as well as, overall the experimental period. In agreement with the obtained results, Taie and Zanaty (1993), showed that, feed efficiency was significantly improved by increasing the energy level from 2500 to 2800 kcal DE/kg diet. In addition, Ayyat *et al.* (2002) showed that, final body weight and feed conversion were improved while feed consumption was decreased when rabbits fed 3000 kcal DE/kg diet comparable to those fed 2500 kcal DE/kg diet.

Respecting the effect of protein levels (Table 2a), it was clearly noted that, during the first period the best weight gain was recorded for rabbits fed 19% CP. The proportional increment was 17.00% comparable to those fed the control diet (16% CP). Significant effect was detected for live body weight and weight gain referable to different protein levels. While during the second period there were no significant differences between treatments. However, rabbits fed 18% CP gave a better value for weight gain among dietary treatments. The proportional improvement was 2.99% comparable to the controls.

It was clearly noted that body weight gain was increased by increasing dietary protein level up to 19% in the first period. While during the second period it was increased up to 18% CP. Moreover, the proportional increment was 17% in the first period vis-à-vis 2.99%, during the second period (Table 2). It may be illustrated that, during the first period (early growth period) the need of growing rabbits for dietary protein was more than during the second period. In conformity, Wahba, (1969) and Murray *et al.* (1991) showed that, the protein is the most essential nutrient for growth. They added that, among proteins are the enzymes and hormones which regulate metabolism.

No significant differences were observed in feed consumption during the first, second and the whole experimental period due to different protein levels (Table 2a). On the other hand, there were significant variations between treatments for feed conversion due to different dietary protein levels during the first period. Rabbits fed 19% CP exhibited the best value of feed conversion, being 3.33 g feed/g gain, with proportional improvement of 15.91% when compared with those fed the control diet. While during the second period analysis of variance showed no significant differences between dietary treatments for feed conversion due to different protein levels. However, rabbits fed 18% CP gave a favorable value of feed conversion among different dietary treatments, being 3.98 g feed/g gain. While those fed the control diet gave a value of 4.09 g feed/g gain.

These findings agree with those reported by Lebas (1973); Omole (1982); Anubrate *et al*. (1999); Abdel-Malak, (2000) and Lei *et al*.(2004). They stated that, increasing protein level in rabbit diets up to 20 or 22% lead to increasing body weight gain and improving feed conversion. In addition, Ismail (1999) observed that growth performance of rabbits was improved by increasing dietary protein level.

Regarding to the interaction between energy and protein levels, it is worthy to note that, during the first period the best value of weight gain was recorded for rabbits fed 19% CP and 2800 kcal DE/kg diet, being 550 g (Table 2). The proportional increment was 35.92% comparable to those fed the control diet. This highly proportion of increment is command to more studies and commendation. Taie and Zanaty (1993) observed that, final body weight was heavier for rabbits fed 19.50% CP and 2800 kcal DE/ kg diet than those fed 17% CP and 2700 kcal DE/ kg diet.

As for, during the second period, data illustrated in Table (2a) revealed that, the best value of weight gain was recorded for rabbits fed 18% CP and 3000 kcal DE/kg diet, being 706.67 g. the proportional increment was 8.72%, when compared with those fed the control diet.

From constantly comparing, it was evident that, the proportional increment during the first period (35.92%) was higher than during the second period (8.72%). These values exhibit the superiority of the first period as respond to higher rate of growth than the second period which gave inferior increment. Consequently, this add up to the priority of portioning the growth period into two interval periods with applying the previously energy and protein allowances in each period to maximize body weight gain.

Once more, during the first and second experimental periods, rabbits fed the mentioned two allowances of energy and protein gave the best weight gain (Table 2a), being 1248.00 and 1247.33 g, respectively. While the worst weight gain was recorded for rabbits fed the control diet. Regarding this, the interaction between energy and protein levels revealed that, increasing protein and energy levels increased growth performance, Ayyat *et al*. (2002).

Concerning feed consumption, obtained results (Table 2a) showed that, it was decreased by increasing energy level irrespective of dietary protein levels which had the same trend. This was quit clear since rabbits fed the lowest energy level consumed more feed to meat their energy requirement. In this context, Bombeke (1978) and Nagda *et al*. (1997) found that, feed consumption decreased with increasing energy level. In addition, Gad-Alla *et al*. (2002) showed that feed intake was significantly ($P \leq 0.01$) affected by energy level only.

With respect to. feed conversion (Table 2a). it is clear that. during the first period the best one was observed for rabbits fed 19% CP and 2800 kcal DE/kg diet. being 3.20 g feed/g gain. While during the second period. rabbits fed 18% CP and 3000 kcal DE/ kg diet gave the best value of feed conversion. being 3.73 kcal DE/ kg diet. The same treatment gave a preferable value during the whole experimental period (3.51 g feed/g gain). Taie and Zanaty (1993) stated that. feed conversion was 3.33 g feed /g gain for rabbits fed 19.5% CP and 2800 kcal DE/kg diet during a period of six weeks.

Analysis of variance showed significant differences between dietary treatments for live body weight. weight gain. feed consumption and feed conversion due to energy and protein levels interaction. during the first and second periods as well as overall the experimental period (Table 2b).

Results obtained agree with those reported by Gad-Alla *et al.* (2002) who indicated that. the best values of growth performance traits were recorded for rabbits fed 18% CP and 2800 kcal DE/kg diet.

2. Digestion coefficients of nutrients

No significant differences were observed between dietary treatments for different digestion coefficients of nutrients (Table 3) due to either energy or protein levels except nitrogen free extract (NFE).

Concerning the effect of energy levels. it was observed that. the digestion coefficient of NFE was increased ($P \leq 0.05$) by increasing dietary energy level. However. the digestion coefficients of crude protein (CP). organic matter (OM) and dry matter (DM) were slightly increased by increasing energy level in rabbit diets (Table 3). Alla *et al.* (2002) found no significant differences in the digestible coefficients of DM, EE and CF between rabbits fed different energy levels (2600 or 2800 kcal DE/kg diet).

Regarding. the effect of protein levels, it was observed that (Table 3). the preferable values of the digestion coefficients of CP, EE and CF were recorded for rabbits fed 19% CP. In conformity Ismail (1999) indicated that, increasing dietary protein from 16 to 19 or 22% in rabbit diets improved the digestibility of EE and CF.

Regarding to energy and protein interaction, analysis of variance showed significant differences for the digestion coefficients of nutrients due to energy and protein interaction. Data illustrated in Table (3) revealed that. the digestion coefficient of CP increased with increasing dietary protein level up to 19% with three mentioned successive energy levels. showing the higher value for rabbits fed 19% CP and 3000 kcal DE/kg diet (91.02%). On the other hand. rabbits fed 18% CP with the same energy level gave the best values of OM and DM digestion coefficients. being 69.23 and 71.91%. respectively. In agreement with

Table 3. Effect of energy, protein levels and their Interaction on digestion coefficients of nutrients.

Treatment		Crude protein % (CP)	Ether extract % (EE)	Crude fiber % (CF)	Nitrogen free extract% (NFE)	Organic matter% (OM)	Dry matter% (DM)
Effect of energy levels (kcal DE/kg diet)							
2500		88.83 ±1.88	88.09 ±2.05	75.95 ±1.90	51.04^{b} ±1.01	65.58 ±0.80	68.16 ±1.90
2800		89.43 ±1.90	85.19 ±2.11	73.48 ±2.50	54.39^{b} ±1.11	6597 ±1.10	68.48 ±1.50
3000		90.27 ±1.69	87.93 ±2.53	76.63 ±2.31	56.49^{a} ±0.90	67.85 ±1.31	70.66 ±1.90
Sig.		NS	NS	NS	*	NS	NS
Effect of protein levels							
16%		87.66 ±2.11	87.26 ±1.88	74.93 ±1.55	55.71^{a} ±1.11	65.68 ±1.91	68.42 ±2.01
18%		90.16 ±2.10	87.33 ±1.92	74.75 ±1.91	55.08^{a} ±2.11	67.57 ±1.47	69.96 ±2.11
19%		90.72 ±2.00	87.58 ±2.31	77.34 ±2.11	52.99^{b} ±2.91	66.73 ±1.11	69.37 ±1.19
20%		89.49 ±2.05	86.12 ±2.11	74.40 ±1.90	52.12^{b} ±2.31	65.88 ±1.31	68.64 ±1.81
Sig.		NS	NS	NS	*	NS	NS
Interaction effect between energy and protein levels							
2500	**16%**	85.36^{b} ±2.00	87.39^{a} ±1.88	76.11^{a} ±1.90	52.69^{bc} ±2.11	64.95^{b} ±1.31	67.66^{b} ±2.01
	18%	90.09^{a} ±1.71	88.48^{a} ±1.86	77.07^{a} ±1.91	53.44^{b} ±2.50	67.27^{a} ±1.10	69.65^{a} ±1.50
	19%	90.60^{a} ±1.93	88.41^{a} ±1.23	75.13^{b} ±2.11	50.41^{c} ±2.31	65.64^{b} ±0.80	68.18^{ab} ±1.31
	20%	89.29^{a} ±2.33	88.10^{a} ±1.33	75.51^{b} ±2.61	47.63^{d} ±1.69	64.46^{b} ±1.90	67.15^{b} ±1.31
2800	**16%**	88.31^{a} ±2.11	86.52^{a} ±1.21	71.00^{c} ±1.01	57.46^{a} ±1.93	64.37^{b} ±1.90	67.17^{b} ±1.41
	18%	89.90^{a} ±1.21	84.15^{b} ±2.11	72.00^{c} ±1.11	52.16^{bc} ±1.69	66.21^{a} ±1.91	68.34^{a} ±1.91
	19%	90.56^{a} ±1.20	86.18^{a} ±2.31	77.32^{a} ±0.90	54.44^{b} ±1.00	67.13^{a} ±1.43	69.57^{a} ±1.30
	20%	88.96^{a} ±1.50	83.94^{b} ±2.11	73.63^{bc} ±0.90	53.53^{b} ±1.02	66.17^{a} ±1.33	68.84^{a} ±1.31
3000	**16%**	89.32^{a} ±2.51	87.89^{a} ±1.31	77.69^{a} ±0.93	56.98^{a} ±0.98	67.73^{a} ±2.10	70.44^{a} ±0.80
	18%	90.51^{a} ±2.11	89.36^{a} ±2.40	75.19^{b} ±1.11	59.64^{a} ±1.00	69.23^{a} ±1.83	71.91^{a} ±1.31
	19%	91.02^{a} ±1.21	88.17^{a} ±2.40	79.59^{a} ±1.10	54.14^{b} ±1.10	67.42^{a} ±2.41	70.36^{a} ±2.11
	20%	90.24^{a} ±1.93	86.33^{a} ±1.81	74.08^{b} ±2.11	55.22^{b} ±0.96	67.02^{a} ±2.01	69.95^{a} ±2.00
Sig.		*	*	*	**	*	*

Means in the same column having different letters, differ significantly.
**: $P<0.01$, *: $P<0.05$. NS: Not significant, Sig. = Significant.

obtained results Taie and Zanaty (1993) found an improvement in the digestibility of DM, OM and CP when dietary CP increased. Beside, Grobner (1985) and Anber (1986) showed that. the digestion coefficient of DM and CP were lower with low energy level than with high energy diet.

3. Carcass traits:

Increasing dietary energy level in growing rabbit diets increased ($P \leq 0.05$) the proportional weight of total edible parts (TEP), also increases the abdominal fat (Table 4). Thus the best proportional weight of TEP was recorded with rabbits fed 3000 kcal DE/ kg diet (56.69%). These results coincide with those obtained by Castello and Gurri (1992). They indicated that, increasing energy level in rabbit diets improved significantly carcass yield.

Otherwise, analysis of variance showed no significant differences between dietary treatments for the proportional weights of TEP due to protein levels, (Table 4). However, the proportional weights of TEP slightly increases with increasing dietary protein level in growing rabbits. In contact, Kalita *et al.*, (2000) showed no significant differences for dressing percentage and various carcass traits due to feeding rabbits different protein levels (16 and 19%). Also, Ijaiya and Fasanya (2004) found no significant effect on carcass yield when rabbits fed different protein levels (13, 16 and 20%).

As for, energy and protein interaction, obtained data (Table 4) revealed that, the best carcass proportional weight was recorded for rabbits fed 18% CP and 3000 kcal DE/kg diet, followed by those fed 19% CP with the same energy level. Analysis of variance showed a significant variation between dietary treatment referable to energy and protein interaction. Regarding this, El-Hindawy *et al.*, (1994) showed that, the carcass components were significantly high when rabbits fed high dietary energy level. Also, Ayyat *et al.* (2002) observed that, carcass components were significantly increased in NZW rabbits fed high energy level (3000 kcal DE/ kg diet) than the normal level (2500 kcal DE/ kg diet).

4. Some blood constituents

Obtained data (Table 5) revealed that, plasma total lipids, tryglycerids and cholesterol were significantly increased with increasing energy level. The same trend was observed for plasma total protein, albumin and globulin. The higher values were recorded for rabbits fed 3000 kcal DE/ kg diet. Conversely, analysis of variance showed no significant differences between dietary treatments for liver function enzymes (AST and ALT) or kidney functions (urea and creatinin) referable to energy levels.

Table 4. Effect of energy, protein levels and their interaction on carcass traits as proportional weights (%).

Treatments		Total edible parts (TEP)	Fore parts	Trunk	Hind parts	Liver	Kidney	Heart	Abdominal fat
		Effect of energy levels (kcal DE/kg diet)							
2500		51.05^{b}	11.69^{b}	15.91^{b}	17.66^{b}	4.34	1.08^{c}	0.37^{c}	0.69^{c}
		±2.91	±0.18	±0.27	±0.44	±0.21	±0.09	±0.01	±0.08
2800		54.79^{a}	12.44^{a}	17.67^{a}	18.66^{a}	4.30	1.29^{b}	0.43^{b}	0.79^{b}
		±1.96	±0.16	±0.36	±0.31	±0.19	±0.09	±0.02	±0.08
3000		56.69^{a}	12.44^{a}	18.51^{a}	19.49^{a}	4.34	1.44^{a}	0.47^{a}	0.93^{a}
		±2.54	±0.14	±0.32	±0.45	±0.19	±0.05	±0.02	±0.10
Sig.		*	*	*	*	NS	**	**	**
		Effect of protein levels							
16%		53.80	12.06	17.24	18.47	4.35	1.24^{b}	0.44	0.79^{b}
		±1.90	±0.19	±0.28	±0.41	±0.25	±0.08	±0.01	±0.07
18%		53.98	11.90	17.57	18.51	4.32	1.27^{ab}	0.41	0.75^{b}
		±2.10	±0.16	±0.34	±0.39	±0.29	±0.07	±0.01	±0.07
19%		54.69	12.24	17.55	18.87	4.33	1.20^{b}	0.44	0.82^{a}
		±2.03	±0.18	±0.23	±0.33	±0.18	±0.05	±0.03	±0.09
20%		54.26	12.56	17.09	18.57	4.31	1.31^{a}	0.42	0.83^{a}
		±1.98	±0.20	±0.22	±0.35	±0.20	±0.07	±0.01	±0.10
Sig.		**NS**	**NS**	**NS**	**NS**	**NS**	*	**NS**	*
		Interaction effect between energy and protein levels							
2500	**16%**	50.74^{c}	11.70^{b}	15.78^{c}	17.51^{c}	4.29^{a}	1.06^{f}	0.40^{d}	0.69^{ef}
		±1.13	±0.20	±0.21	±0.36	±0.11	±0.03	±0.01	±0.02
	18%	50.85^{c}	11.39^{c}	15.94^{c}	17.64^{bc}	4.36^{a}	1.13^{e}	0.39^{d}	0.64^{f}
		±1.63	±0.19	±0.24	±0.37	±0.13	±0.03	±0.03	±0.03
	19%	51.14^{b}	11.54^{c}	16.11^{c}	17.82^{bc}	4.29^{a}	1.03^{f}	0.35^{e}	0.71^{e}
		±0.98	±0.16	±0.31	±0.33	±0.17	±0.05	±0.03	±0.04
	20%	51.49^{b}	12.14^{b}	15.82^{c}	17.68^{bc}	4.42^{a}	1.08^{f}	0.35^{e}	0.70^{e}
		±1.08	±0.11	±0.26	±0.35	±0.15	±0.09	±0.02	±0.07
2800	**16%**	54.82^{ab}	12.31^{ab}	17.73^{b}	18.58^{b}	4.50^{a}	1.25^{d}	0.45^{b}	0.77^{d}
		±0.93	±0.11	±0.33	±0.41	±0.11	±0.02	±0.02	±0.07
	18%	53.81^{b}	11.92^{b}	17.88^{b}	18.05^{b}	4.23^{b}	1.34^{c}	0.39^{d}	0.72^{e}
		±0.99	±0.13	±0.30	±0.42	±0.20	±0.03	±0.01	±0.06
	19%	55.69^{a}	12.97^{a}	17.68^{b}	19.00^{a}	4.27^{b}	1.32^{c}	0.45^{b}	0.84^{c}
		±1.63	±0.15	±0.26	±0.45	±0.15	±0.03	±0.03	±0.09
	20%	54.85^{ab}	12.57^{a}	17.39^{b}	19.00^{a}	4.20^{b}	1.26^{d}	0.43^{bc}	0.81^{c}
		±2.01	±0.18	±0.35	±0.37	±0.15	±0.02	±0.05	±0.09
3000	**16%**	55.83^{a}	12.17^{b}	18.21^{a}	19.32^{a}	4.26^{b}	1.41^{b}	0.46^{b}	0.90^{b}
		±1.54	±0.11	±0.34	±0.41	±0.11	±0.05	±0.05	±0.08
	18%	57.28^{a}	12.39^{ab}	18.89^{a}	19.83^{a}	4.38^{a}	1.34^{c}	0.45^{b}	0.89^{b}
		±1.93	±0.11	±0.32	±0.48	±0.13	±0.07	±0.01	±0.07
	19%	57.23^{a}	12.22^{b}	18.87^{a}	19.79^{a}	4.42^{a}	1.42^{b}	0.51^{a}	0.92^{b}
		±2.10	±0.13	±0.27	±0.40	±0.18	±0.02	±0.02	±0.09
	20%	56.44^{a}	12.97^{a}	18.07^{a}	19.03^{a}	4.31^{a}	1.59^{a}	0.47^{bc}	0.99^{a}
		±1.99	±0.18	±0.27	±0.41	±0.21	±0.05	±0.03	±0.10
Sig.		**	*	**	*	*	**	**	**

Means in the same column having different letters, differ significantly.

**: $P<0.01$, *: $P\leq0.05$. NS: Not significant. Sig. : Significant.

Table 5. Effect of energy, protein levels and their interaction on some blood constituents of growing NZW rabbits (mg/100 ml.).

Treatments		Total lipids	Triglyc-eride	Choles-terol	Total protein	Albumin	Globulin	AST	ALT	Urea	Creatinin
					Effect of energy levels (kcal DE/kg diet)						
2500		282.90^{b}	88.90^{c}	71.85^{b}	5.66^{b}	2.87^{b}	2.79^{b}	22.88	14.32	15.01	0.94
		±3.11	±1.81	±1.51	±0.31	±0.11	±0.01	±0.51	±0.21	±0.36	±0.02
2800		309.20^{a}	99.06^{b}	72.60^{ab}	7.01^{a}	3.57^{a}	3.44^{a}	22.53	13.85	15.31	0.95
		±4.11	±1.87	±1.31	±0.22	±0.05	±0.03	±0.48	±0.31	±0.33	±0.11
3000		295.19^{c}	107.92^{a}	76.03^{a}	7.03^{a}	3.57^{a}	3.46^{a}	22.18	13.86	15.02	0.97
		^{b} ±4.10	±1.99	±1.15	±0.24	±0.03	±0.04	±0.47	±0.26	±0.35	±0.03
Sig.		*	**	*	**	**	**	NS	NS	NS	NS
					Effect of protein levels						
16%		305.36^{a}	95.49	73.05	6.34^{b}	3.40	2.94^{b}	22.19	14.88	14.50^{b}	0.93
		±3.00	±2.11	±1.10	±0.23	±0.08	±0.03	±0.55	±0.29	±0.21	±0.01
18%		295.29^{a}	98.54	73.03	6.60^{ab}	3.31	3.29^{a}	22.11	13.58	14.96^{ab}	0.95
		±3.20	±1.81	±1.09	±0.30	±0.09	±0.03	±0.63	±0.30	±0.33	±0.07
19%		272.85^{b}	99.20	73.22	6.74^{a}	3.33	3.40^{a}	22.58	14.52	15.32^{a}	0.95
		±3.11	±1.93	±1.03	±0.23	±0.02	±0.11	±0.61	±0.21	±0.37	±0.06
20%		309.69^{a}	101.29	74.77	6.59^{ab}	3.30	3.29^{a}	23.23	13.08	15.60^{a}	0.98
		±4.11	±1.93	±1.00	±0.23	±0.06	±0.02	±0.49	±0.20	±0.39	±0.09
Sig.		*	NS	NS	*	NS	**	NS	NS	*	NS
					Interaction effect between energy and protein levels						
2500	**16%**	280.70^{c}	85.57^{e}	70.49^{b}	5.32^{d}	2.82^{c}	2.50e	22.43^{ab}	14.61^{cd}	14.39^{d}	0.92b
		±3.00	±2.00	±0.93	±0.21	±0.10	±0.01	±0.71	±0.22	±0.41	±0.03
	18%	286.84^{c}	88.13^{de}	72.62^{b}	5.63^{c}	2.88^{c}	2.75^{d}	22.60^{ab}	14.19^{d}	14.62^{cd}	0.94b
		±3.31	±2.10	±0.98	±0.20	±0.07	±0.02	±0.63	±0.21	±0.31	±0.06
	19%	286.96^{c}	91.04^{d}	71.33^{b}	5.99^{b}	2.95^{c}	3.04^{bc}	22.97^{ab}	14.16^{d}	15.45^{ab}	0.92b
		±3.25	±1.95	±1.32	±0.25	±0.03	±0.03	±0.61	±0.30	±0.33	±0.07
	20%	277.12^{c}	90.87^{d}	72.97^{b}	5.73^{bc}	2.83^{c}	2.90c	23.54^{a}	14.35^{d}	15.58^{a}	0.98a
		±3.25	±2.32	±1.11	±0.21	±0.01	±0.07	±0.45	±0.33	±0.31	±0.03
2800	**16%**	316.57^{a}	91.90^{d}	72.15^{b}	6.85^{a}	3.70^{a}	3.15^{b}	22.86^{ab}	14.63^{cd}	14.77^{bcd}	0.93b
		^{b} ±2.88	±1.16	±1.51	±0.30	±0.10	±0.03	±0.42	±0.30	±0.27	±0.02
	18%	287.51^{c}	101.17^{b}	72.25^{b}	7.02^{a}	3.55^{ab}	3.47^{a}	22.47^{ab}	15.26^{bc}	15.54^{a}	0.95ab
		±3.41	^{c} ±1.93	±1.11	±0.21	±0.05	±0.03	±0.58	±0.27	±0.31	±0.06
	19%	311.83^{b}	102.24^{b}	72.00^{b}	7.13^{a}	3.50b	3.63^{a}	22.14^{bc}	13.26^{e}	15.35^{abc}	0.96ab
		±3.42	^{c} ±1.81	±1.03	±0.22	±0.05	±0.01	±0.55	±0.24	±0.30	±0.05
	20%	321.32^{a}	100.96^{c}	74.32^{ab}	7.05^{a}	3.53^{ab}	3.52^{a}	22.67^{ab}	12.28^{f}	15.61^{a}	0.98a
		±2.91	±1.73	±1.00	±0.18	±0.03	±0.05	±0.61	±0.33	±0.29	±0.03
3000	**16%**	318.83^{a}	109.00^{a}	76.53^{a}	6.86^{a}	3.69^{a}	3.17^{b}	21.29^{c}	15.40^{ab}	14.34^{d}	0.96ab
		^{b} ±4.00	^{b} ±2.00	±0.89	±0.21	±0.13	±0.11	±0.68	±0.30	±0.27	±0.09
	18%	311.52^{b}	106.32^{b}	74.23^{ab}	7.15^{a}	3.50^{b}	3.65^{a}	21.28^{c}	11.30^{g}	14.97^{abcc}	0.98a
		±4.11	±2.10	±0.71	±0.21	±0.07	±0.05	±0.55	±0.25	±0.22	±0.08
	19%	219.77^{d}	104.33^{b}	76.33^{a}	7.10^{a}	3.55^{ab}	3.55^{a}	22.65^{ab}	16.14^{a}	15.18^{abc}	0.99a
		±3.12	±1.69	±1.11	±0.16	±0.03	±0.06	±0.53	±0.29	±0.30	±0.11
	20%	330.65^{a}	112.05^{a}	77.04^{a}	7.01^{a}	3.54^{ab}	3.47^{a}	23.50^{a}	12.62^{f}	15.61^{a}	0.98a
		±3.11	±2.05	±1.51	±0.31	±0.01	±0.08	±0.63	±0.21	±0.32	±0.06
Sig.		**	**	*	**	**	**	*	**	*	*

Means in the same column having different letters, differ significantly.

**: P≤0.01, *: P≤0.05, NS: Not significant, Sig. = Significant.

On the other hand, rabbits fed 19% CP gave the lowest value (P≤ 0.05) of total lipids among treatments. While the values of triglycerids and cholesterol did not differ significantly as a result to different dietary protein levels. Onward, the highest values (P≤ 0.05) of total protein and globulin were observed for rabbits fed 19% CP, being 6.74 and 3.40 mg/100 ml., respectively. However, no significant differences were detected between treatments for albumin due to different dietary protein levels (Table 5).

Data illustrated in Table (5) define that, urea and creatinin were increased with increasing dietary protein level. The highest values were recorded for rabbits fed 20% CP, being 15.60 and 0.98 mg/100 ml., respectively. This increment in plasma urea and creatinin may be due to the breakdown of elevated protein level during the metabolism (Murray *et al.*, 1991). The cleavage of an amino group from an amino acid leads to the production of ammonia which successively combine with carbonic acid to form urea (Stroev, 1989). These results coincide with that obtained by Abdel-Malak (2000) who found a significant increase in serum urea and creatinin with increasing dietary protein level (form 14 to 18%).

Concerning , energy and protein levels interaction, it is clear that (Table 5), the highest values of plasma triglycerids and cholesterol were recorded with rabbits fed 20% CP and 3000 kcal DE/kg diet. While the lowest values were observed for those fed the control diet. Hereaway, the best values for plasma total protein and liver function (AST and ALT enzymes) were observed with rabbits fed 18% CP and 3000 kcal DE/kg diet, subject to all values within the normal range. Analysis of variance showed significant differences between dietary treatments for all blood parameter due to the interaction between the energy and protein levels. In agreement with obtained results, Ayyat *et al.* (2002) indicated that, serum total protein increased significantly with increasing the levels of energy and protein in rabbit diets.

5. Economic efficiency:

Obtained results (Table 6) showed that, the price of one kilogram (kg) diet increased by increasing either protein or energy level. However, feed cost/kg weight gain decreased-approximately-with elevated dietary protein under each level of the three mentioned successive energy levels. This decrement of feed cost/kg weight gain may be due to the improvement of weight gain and feed conversion which occurred with increasing dietary protein and energy levels in rabbit diets. Concerning this, Ayyat *et al.*(2002) showed that, feed cost decreased by increasing dietary protein and energy levels.

Table 6. Input-output analysis and economic efficiency of different treatments.

Items	Energy 2500 kcal DE/kg diet				Energy 2800 kcal DE/kg diet				Energy 3000 kcal DE/kg diet			
	Crude protein (%)				Crude protein (%)				Crude protein (%)			
	16	18	19	20	16	18	19	20	16	18	19	20
Average feed consumption (kg/rabbit)	4.671	4.628	4.589	4.595	4.491	4.507	4.558	4.406	4.363	4.383	4.390	4.360
Price/kg food (LE.)	1.310	1.349	1.370	1.377	1.488	1.485	1.498	1.503	1.563	1.569	1.575	1.583
Total feed cost (LE.)	6.12	6.24	6.29	6.33	6.68	6.69	6.83	6.62	6.82	6.88	6.91	6.90
Average weight gain (kg/rabbit)	1.055	1.074	1.129	1.089	1.120	1.146	1.248	1.187	1.181	1.247	1.230	1.234
Fed cost/kg weight gain (LE.)	5.80	5.81	5.57	5.81	5.96	5.84	5.47	5.58	5.77	5.52	5.62	5.59
Total return* (LE.)	21.10	21.48	22.58	21.78	22.40	22.92	24.96	23.74	23.62	24.94	24.60	24.68
Net return (LE.)	14.98	15.24	16.29	15.45	15.72	16.23	18.13	17.12	16.80	18.06	17.69	17.78
Ecoaomical efficiency	2.45	2.44	2.59	2.44	2.35	2.43	2.65	2.59	2.46	2.63	2.56	2.58
Relative economic efficiency (%)	100	99.59	105.71	99.59	95.92	99.18	108.16	105.71	100.41	107.35	104.49	105.31

* Total return was calculated according to the local market price which was 20 LE./kg rabbit live body weight.

Assuming that, the control diet (16% CP and 2500 kcal DE/kg diet) had a value of 100% as relative economic efficiency (Table 6), the best value of relative economic efficiency was observed for rabbits fed 19% CP and 2800 kcal DE/ kg diet followed by those fed 18% CP and 3000 kcal DE/ kg diet, being 108.16 and 107.35%, respectively. This may be scientifically logic since these mentioned two treatments had the lesser values of feed cost/kg weight gain, being 5.47 and 5.52 LE, respectively (Table 6). These results coincide with those obtained by Ayyat *et al.* (2002) who observed that, rabbits fed 18% CP recorded higher final margin when compared with those fed 16% CP. They added that, increasing the levels of energy and protein in rabbit diets increased final margin.

Once more, obtained data (Table 2) revealed that, rabbits fed 19 and 18% CP with 2800 and 3000 kcal DE/ kg diet in the first and second periods, respectively gave the best values of weight gain and feed conversion, as mentioned elsewhere, so to verify this commendation, Table (7) define the relative economic efficiency for each previously period as two interval periods thus, relative economic efficiency was increased to be 111.02%.

It was clearly noted that, a new lesser value for feed cost/kg weight gain was obtained, being 5.38 LE, (Table 7), comparable to the lowest value in Table (6), being 5.47 LE. This decrement in feed cost produce an effect upon more improvement for relative economic efficiency, being 111.02 (Table 7) comparable to 108.16% in Table 6.

Thus, from the economic point of view, it could be stated that, for growing NZW rabbits it is preferable to portioning out the growth period into two periods with feeding rabbits the previously mentioned two commendation levels of energy and protein in each period to be more efficient and more economic.

Conclusion

Increasing energy and protein levels in NZW growing rabbit diets lead to significant improvevement in growth performance. It is preferable to portioning out the growth period into two interval periods. During the first period rabbits should be fed 19% CP and 2800 kcal DE/kg diet, while in the second period they should fed 18% CP and 3000 kcal DE/kg diet to maximize growth performance, thus improving economical efficiency and increased final margin without any adverse effect on rabbits performance.

Table 7. **Input-output analysis and economic efficiency of the best treatment within the two interval periods (first and second).**

Items	During the first period for rabbits fed 19% CP and 2800 kcal DE/kg diet	During the second period for rabbits fed 18% CP and 3000 kcal DE/kg diet	Total for two periods	Rabbits fed the control diet 16% CP and 2500 kcal DE/kg diet
Average feed consumption (kg/rabbit)	1.762	2.628	4.390	4.671
Price/kg food (LE.)	1.498	1.569		1.310
Total feed cost (LE.)	2.64	4.12	6.76	6.12
Average weight gain (kg/rabbit)	0.550	0.707	1.257	1.055
Feed cost/kg weight gain (LE.)	-	-	5.28	5.80
Total return (LE.)*	-	-	25.14	21.10
Net return (LE.)	-	-	18.38	14.98
Economical efficiency	-	-	2.72	2.45
Relative economic efficiency (%)	-	-	111.02	100

* Total return was calculated according to the local market price which was 20 LE/kg rabbit live body weight.

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اتجاه جديد لتغذية الأرانب وعلاقته باحتياجات الطاقة والبروتين.

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تم استخدام أربع مستويات من البروتين ١٦ ، ١٨ ، ١٩ ، ٢٠% وتحت ثلاث مستويات من الطاقة المهضومة ٢٥٠٠ ، ٢٨٠٠ ، ٣٠٠٠ كيلو كالورى / كيلو جرام عليقة في تغذية الأرانب النامية حيث استخدم ١٨٠ أرنب نامي حوالي ٥ أسابيع من العمر ومتقاربة في الوزن لتقسيمها على ١٢ معاملة بمعدل ١٥ أرنب / معاملة. تم تقسيم فترة التجربة إلى فترتين كل فترة ٤ أسابيع ودلت النتائج على ما يلي:

في خلال الفترة الأولى سجلت الأرانب التي تغذت على ١٩% بروتين و ٢٨٠٠ كيلو كالورى أفضل معدل للزيادة الوزنية وكفاءة التحويل الغذائي بينما في الفترة الثانية سجلت الأرانب هذا التفوق مع مستوى ١٨% بروتين و ٣٠٠٠ كيلوكالوري.

كما أعطت هاتان المعاملتان أحسن كفاءة اقتصادية خلال فترة النمو. بينما كانت نتائج معاملات هضم المادة الجافة والمادة العضوية وصفات الذبيحة ووزنها وبروتينات الدم وكل من وظائف الكبد أحسن ما تكون في الأرانب التي تغذت على ١٨% بروتين و ٣٠٠٠ كيلوكالوري طاقة مهضوم.