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Effects of Dietary Levels of Energy and Protein at the Finishing Stage. 1. Performance and Pelt Production of Rex Rabbits

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ABSTRACT: Unlike meat-type rabbits [Flemish Giant, New Zealand White or Californian] which are slaughtered at 10 - 12 weeks old, Rex rabbit, a fine fur-producing rabbit, are harvested at 6 - 8 monthold. The nutrient requirement at the 'finisher stage' and for fur production purpose may be different from those of starter stage or meat production purpose. Ninetysix Rex rabbits of 3,5 to 4 months old were used in a 3 x 4 factorial experiment to study the effect of levels of protein [14, 16 and 18%] and levels of digestible energy [DE - 2000, 2250, 2500 and 2750 kcal/kg] on the performance and fur production Rex rabbits. Each treatment combination consisted of 8 unsexed rabbits. Animal performance and fur production were observed. Differences among treatment means of each parameter tested were analysed by LSD. In general, results indicated that there were no significant interaction occured between levels of energy and protein on the parameters measured. Feed intake [FI], dry matter digestibility [DMD], percentage of carcass [PC], edible meat [PEM], fat [PF], bone [PB] and skin [PS], and weight [RPW] and area [RPA] of raw pelt were not significantly different among treatments. Higher dietary level of DE and protein, however significantly increased bodyweight gain [BWG] and feed efficiency [FCR], and dried weight [DPW] and area [DPA] of pelt. Ranges of values for the tested parameters were 104 - 121 g/rabbit/d for FI, 12 - 16 g/rabbit/d for BWG, 6.9 - 9.7 for FCR, and 53 - 62% for DMD. Values for PC, PEM, PF, PB and PS ranged from 51 to 54%, 67 to 71%, 3.7 to 6.4%, 23 to 29% and from 7.4 to 8.0, respectively. Pelt production, in terms of pelt weight and pelt area were 172 - 205 g/pelt and 1136 - 1223 cm^2/pelt, respectively for raw pelts. Corresponding values for dried pelt were 89 - 110g and 1485 - 1728 cm^2.

Key Words: Energy, Protein, Performance, Pelt Production, Rex Rabbits

Introduction

Unlike meat-type rabbits [Flemish Giant, New Zealand White, Californian, etc.], which are slaughtered at 12 week-old, Rex rabbit, a fine fur-producing rabbit, is harvested at 6 - 8 month-old [Stewart, 1984; Petersen, 1992]. The nutrient requirement for growing animals, especially of crude protein [CP] and digestible energy [DE], is 16% and 2500 kcal, respectively [NRC, 1977]. The requirement for older animals, for maintenance or reproduction, or for specific production purpose [e.g. for fur] may be different accordingly, especially when environment and feed ingredients used are different [Cheeke et al., 1987]. The present experiment studied the effect of various levels of dietary energy and protein on the performance and pelt production of Rex rabbits.

Experimental Procedures

Ninety six Rex rabbits of 3.5 to 4 month-old were distributed randomly into a 3 x 4 factorial experiment. Treatments were 3 levels of CP [14, 16 and 18%] and 4 levels of DE [2000, 2250, 2500 and 2750 kcal/kg]. Rabbits were caged individualy and were slaughtered at 6 months old. Performance and pelt production, including feed intake [FI], bodyweight gain [BWG], feed conversion ratio [FCR], dry matter digestibility [DMD], percentage of carcass [PC], edible meat [EM], fat [PF], bone [PB], and skin [PS], and weight [RPW] and area [RPA] were measured. A one way ANOVA followed by LSD test for mean differences were applied.

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Results and Discussion

Unless otherwise indicated specifically, there were no significant interaction between levels of energy and protein on the measured parameters [P>0.05].

Feed intake [FI], bodyweight gain [BWG] and feed conversion ratio [FCR = FI/BWG] of rabbits fed various levels of energy and protein are shown in Table 1, 2 and 3, respectively. Results indicated that increasing levels of dietary DE had decreased FI and FCR stepwisely, but not significantly, and had increased BWG statistically.

Level of dietary CP, however, did not give a similar pattern although lowest dietary CP level tended to produce poorer growth of animals. Previous results on growing Rex rabbits [6 - 14 weeks old] were similar [Raharjo et al., 1992]. For FI, this is somewhat interesting, because theoretically the animals tend to satisfy their FI through total DE intake, hence higher dietary DE level will decrease FI significantly, or vice versa [ARC., 1975].

Within the frame of dietary CP treatments, BWG and FCR were best from rabbits fed 16% CP. At 18% CP level, BWG was slightly less and FCR was poorer as well, although the difference was not significant. Comparing the effect of dietary DE vs dietary CP, it was apparent that dietary DE had more profound effect than that of dietary CP on FI, BWG and FCR; and the results of feeding 14% dietary CP showed poorest performance.

Compared with the results from other experiment [e.g. Raharjo et al.,1994 - control diet feeding], present results indicated less BWG [13-16 vs 18-23 g/rabbit/d] and poorer feed efficiency [6.86-9.69 vs 4.35-5.88]. This could be attributed to the age, in which older animals [3.5 - 6 month] were used.

Dry matter digestibility [DMD] values of the treatment diets is shown in Table 4. Similar pattern to the three previous parameters was also obtained from DMD results; that was higher DE levels increased DMD stepwisely [P>0.05], but was not so with the effect of CP. Highest DMD value

Table 1. Feed Intake of rabbits fed various levels of CP and DE. [g/rabbit/dietary]

	Levels of crude protein			
Kcal/kg	14	16	18	Mean
2000	122	111	128	121 ± 7
2250	116	108	107	110 ± 4
2500	119	104	102	109 ± 8
2750	116	102	95	104 ± 9
Mean	118 ± 3	107 ± 4	108 ± 12	

Table 2. Bodyweight gain of rabbits fed various levels of CP and DE [g/rabbit/dietary]

	Levels of crude protein			
Kcal/kg	14	16	18	Mean
2000	12	14	14	13 ± 0.9^{a}
2250	12	15	13	13 ± 1.5^{ab}
2500	13	16	14	14 ± 1.3^{ab}
2750	14	18	15	16 ± 1.5^{b}
Mean	13 ± 1.2^{a}	16 ± 1.5^{b}	14 ± 0.6^{ab}	

^{a,b} within the same column or row differs significantly [P<0.05]

Table 3. Feed Conversion Ratio of rabbits fed various levels of CP and DE.

	Levels of crude protein			
Kcal/kg	14	16	18	Mean
2000	10.81	8.63	9.63	9.69 ± 0.89
2250	10.00	7.34	7.65	8.33 ± 1.19
2500	9.50	7.13	7.04	7.89 ± 1.14
2750	8.27	6.07	6.23	6.86 ± 1.00
Mean	9.65 ± 0.92	7.29 ± 0.91	7.64 ± 1.26	

Table 4. Dry matter digestiblity of rabbits fed various levels of CP and DE [%]

	Levels of crude protein			
Kcal/kg	14	16	18	Mean
2000	53.5	53.8	52.1	53.1 ± 0.8
2250	55.0	57.7	55.1	55.9 ± 1.3
2500	57.6	58.1	59.5	58.4 ± 0.8
2750	56.9	65.2	62.8	61.7 ± 3.5
Mean	55.7±1.6	58.7±4.1	57.4±4.1	

among the protein treatments was also found in rabbits fed 16% dietary CP level. Digestibility values obtained in this experiment [53 - 62%] were much lower that those of reported from the temperate countries [>70% - Cheeke et al., 1987]. The differences, perhaps due to the composition of ingredients used especially that contain high fiber content. In the temperate countries, alfalfa, which contain moderate level of protein and good quality fiber [Harris et al., 1981] was used as the main ingredients. In this experiment, elephant grass and sugar cane bagasse, whose fibers are not well digested [Raharjo et al., 1986] were used.

In addition, most nutrient digestibility negatively correlalated in a linear pattern with the dietary fiber content [Raharjo et al., 1986]. In the present experiment, higher DE level had lower fiber content [Table 1], hence increased DMD values, meaning better utilization of the nutrients and higher BWG and better feed efficiency were obtained as shown in Table 2 and 3, respectively.

Percentage of carcass [PC], edible meat [PEM], bone [PB] and fat [PF] are indicated in Table 5, 6, 7 and 8, respectively. Carcass weight was equal to the sum of edible meat and bone weight. Percentage of carcass was neither influenced by DE nor by CP level [P>0.05]. Range of the values for PC was 51 - 55%. These results were slightly higher than those of reported by Rao et al., [1978] and Abdella et al.,[1988] [45 - 51%], but similar to those found by Coan et al., [1988] and Sartika and Raharjo [1992] [48 - 55%].

Unlike PC, percentage of edible meat [PEM] and of bone [PB] were significantly affected by level of dietary energy [P<0.05], but not by level of CP. Higher DE level tended to produce higher PEM and lower PB, although between levels of 2000 and 2250 or 2500 and 2750 kcal/kg within each parameter, the difference was not significant [P>0.05]. Sartika and Raharjo [1991] reported similar range of results.

Percentage of lipids [petroleum ether extraction] increased slightly, but not significantly with the increasing levels of DE. This is understandable as higher dietary energy content may be deposited as body fat especially in the older animals. Moreover, the increase was not substantial as the animals were still growing [BWG = 13 - 16 g/rabbit/d].

Table 5. Percentage of carcass of rabbits fed various levels of CP and DE.

	Levels of crude protein			
Kcal/kg	14	16	18	Mean
2000	50.3	54.2	53.0	51.8 ± 1.7
2250	53.1	54.4	53.7	53.7 ± 0.5
2500	53.1	55.4	53.7	54.2 ± 0.9
2750	52.2	54.8	54.0	53.7 ± 1.1
Mean	52.3±1.2	54.7±0.5	53.1±1.2	

Table 6. Percentage of edible meat of rabbits fed various levels of CP and DE.

	Levels of crude protein			
Kcal/kg	14	16	18	Mean
2000	66.9	69.1	66.1	67.3 ± 1.3^{a}
2250	68.2	71.1	67.5	68.9 ± 1.5^{ab}
2500	69.8	72.9	70.8	71.1 ± 1.3^{b}
2750	67.4	70.8	70.6	69.6 ± 1.6^{ab}
Mean	68.1±1.1	70.8±1.3	68.7±2.0	

^{a,b} within the same column or row differs significantly [P<0.05]

Table 7. Percentage of bone of rabbits fed various levels of CP and DE.

	Levels of crude protein			
Kcal/kg	14	16	18	Mean
2000	30.2	26.4	30.1	28.9 ± 1.8^{a}
2250	27.7	24.0	27.9	26.7 ± 1.8^{a}
2500	24.3	21.2	24.1	23.2 ± 1.4^{b}
2750	26.3	23.1	22.6	24.0 ± 1.6^{b}
Mean	27.1±2.2	23.7±1.9	26.2±3.0	

^{a,b} within the same column or row differs significantly [P<0.05]

Responses of skin production, in term of percentage [to total bodyweight], weight and size area of pelt, to feeding of various levels of DE and CP are presented in Table 9, 10 and 11, respectively. Except for dried pelt area [DPA], percentage [PS] of raw skin [PS] and raw pelt weight [RPW] were not affected by levels of DE nor by CP. Reddy et al.,[1979] reported a value of 11% PS for NZW rabbits, which is a bigger breed of rabbits than the Rex.

Table 8. Percentage of fat of rabbits fed various levels of CP and DE.

	Levels of crude protein			
Kcal/kg	14	16	18	Mean
2000	2.88	4.46	3.87	3.74 ± 0.65
2250	4.09	4.91	4.60	4.43 ± 0.34
2500	5.92	5.93	5.09	5.65 ± 0.39
2750	6.37	6.08	6.83	6.43 ± 0.31
Mean	4.81±1.41	5.35±0.68	5.10±1.09	

Table 9. Percentage of raw skin of rabbits fed various levels of CP and DE.

	Levels of crude protein			
Kcal/kg	14	16	18	Mean
2000	7.5	7.3	7.4	7.4 ± 0.1
2250	7.7	7.1	7.6	7.5 ± 0.3
2500	7.7	7.3	7.3	7.4 ± 0.2
2750	7.7	8.1	8.1	8.0 ± 0.2
Mean	7.6 ± 0.1	7.4 ± 0.4	7.6 ± 0.3	

Table 10. Raw pelt weight of rabbits fed various levels of CP and DE [g/pelt].

	Levels of crude protein			
Kcal/kg	14	16	18	Mean
2000	170	175	173	173 ± 2
2250	172	177	182	177 ± 4
2500	178	185	184	182 ± 3
2750	201	201	214	205 ± 6
Mean	180 ± 12	184 ± 10	188 ± 15	

Raw pelt weight [RPW] seemed to correspond with BWG as well as with PF, in which higher DE level produced higher BWG and PF and also heavier pelt weight. Fat is commonly found and deposited underneath the cutis of skin. Higher dietary DE level could lead to higher content of subcutaneous fat. This to some extent limitsthe penetration of chemical tanning agents during tanning process hence reduces the product quality [Kanagy, 1977].

Size of dry pelt area [DPA] has commonly been used as a measure of pelt quality. Larger DPA increases price of pelt. In this trial, higher dietary DE level increased the size of DPA, although the statistical difference was applied only to level 2000 vs 2750 kcal/kg.

Table 11. Dry raw pelt area of rabbits fed various levels of CP and DE [cm^2/pelt].

	Levels of crude protein			
Kcal/kg	14	16	18	Mean
2000	1479	1490	1487	1485 ± 5^{a}
2250	1615	1608	1611	1611 ± 3^{ab}
2500	1627	1616	1647	1630 ± 13^{ab}
2750	1724	1670	1790	1728 ± 50^{b}
Mean	1611 ± 87	1596 ± 66	1634 ± 108	

^{a,b} within the same column or row differs significantly [P<0.05]

Table 12. Percentage of prime of rabbits fed various levels of CP and DE.

	Levels of crude protein			
Kcal/kg	14	16	18	Mean
2000	77.2	73.7	65.4	72.1 ± 5.0
2250	59.6	71.7	77.9	69.7 ± 7.6
2500	83.6	79.2	70.0	77.6 ± 5.7
2750	77.8	70.0	69.5	72.4 ± 3.8
Mean	74.6±8.9	73.6±3.5	70.7±4.5	

The prime rate of a pelt is a very important measure for quality determination. The prime rate of rabbits were measured through the pigmented area caused by e.g. melanin and/or pheomelanin [Wehr et al., 1982] on the meat part of the skin. Higher pigmented area indicated less prime of the pelt, hence poorer quality [Stewart, 1984]. Primeness of the rabbit pelts treated with various combination of DE and CP level is shown in Table 12. Similar to other measured parameters, percentage of prime [PP] was not influenced by levels of dietary DE and CP. These results were somewhat in contrast to those reported by Taylor and Johnston [1984], who indicated that good quality feed in *ad libitum* feeding depressed prime rate of the pelts. Present results, however were better than those produced by Raharjo et al[1994], in which the prime rate ranged from 61.9 to 67.9%.

Results of the experiment suggested that [i] higher dietary DE level increased BWG, FCR and dry weight and area of pelt significanty [ii] significant CP effect was found only on FCR, in which higher level of CP increased FCR and [iii] recommended CP and DE level for finishing stage of Rex rabbit are 16% and 2500 kcal/kg diet.

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