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GROWTH PERFORMANCE OF BROILER RABBITS MAINTAINED ON DIETS WITH VARYING LEVELS OF ENERGY AND PROTEIN

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ABSTRACT : The growth study was conducted with nine groups of six weaner kits each maintained on three levels of energy (2585, 2778, 3043 kcal DE/kg) and protein (16.07, 19.69, 22.70 %) in nine combinations. Weaning weight o kits was similar at the initiation of the experiment and in *ad libitum* feeding regimen, irrespective of energy and protein variation the kits were able to achieve 2 kg finishing weight at 12 weeks of age, with total gain of 1.5 to 1.8 kg and average daily gain of 27 to 32 g. Total feed consumed during the experiment and DMI (g/d) was higher (P<0.01) in low energy (6.83 kg, 114.9 g/d) followed by medium (6.58 kg, 113.3 g/d) and was lowest in high energy (5.5 kg, 95.1 g/d) regimens. Digestibilities of DM, CP and energy increased (P<0.01) with increase in energy content of the diets whereas on expression in terms of protein variation only digestibility of protein increased with increase of protein content. All the kits were in positive N balance and it was higher (P<0.05) in high protein (2.17 g) followed by medium (1.99 g) and low (1.68 g) protein regimen, whereas expressed in terms of energy variation the balance was found to be similar. The regression of average daily gain on the ratio of digestible energy and crude protein intake of the diets indicated non significant effects of the ratio on average daily gain. It was found that on an average the growing kits required 91 g DM, 13 g DCP and 255 Kcal DE/kg $W^{0.75}$ to gain @ of 28 g/day.

RÉSUMÉ : Performances de croissance de lapins de chair élevés avec des régimes ayant différents niveaux d'énergie et de protéines.

L'étude de la croissance a été conduite sur 9 groupes de chacun 6 lapins au sevrage maintenus à 3 niveaux d'énergie (2585, 2778, 3043 kcal/kg) et de protéines (16.07, 19.69 et 22.7 %) selon 9 combinaisons. Au début de l'expérimentation le poids au sevrage des lapereaux était identique et le régime alimentaire ad libitum, *et quelque soit le niveau d'énergie ou de protéines les lapereaux ont pu atteindre un poids final de 2 kg à 12 semaines d'âge avec un gain de poids total de 1.5 à 1.8 kg et un gain de poids moyen journalier de 27 à 32 g. La quantité totale d'aliment consommé pendant l'expérimentation et la quantité de matière sèche (MS) ingérée (g/d) était plus élevés (P<0.01) dans le groupe "énergie basse" (6.83 kg, 114.9 g/j) suivie par le groupe "moyen" (6.58 kg, 113.3 g/j) et le plus bas pour le groupe "énergie haute" (5.5kg, 95.1 g/j). La digestibilité de la MS, des protéines brutes et de l'énergie augmente (P<0.01) avec l'accroissement du contenu énergétique des régimes. Par contre, seule la digestibilité des protéines augmente avec l'accroissement du contenu protéique. Tous les lapereaux ont un bilan azoté positif, plus élevé (P<0.05) pour le régime "haute protéine" (2.17 g) suivi par le "moyen protéine" (1.99 g) et le "bas protéine" (1.68 g) Par contre, les variations de la concentration énergétique de l'aliment ne modifient pas le bilan azoté. La régression du gain moyen journalier sur le ratio de l'énergie digestible et des protéines brutes ingérées des régimes indiquent un effet non significatif du ratio sur le gain moyen journalier. On peut conclure que les besoins moyens des lapereaux en croissance sont 91g MS, 13g de protéines digestibles et 255kcal ED/kg Poids vif$^{0.75}$ pour un gain journalier de 28g.*

INTRODUCTION

Energy and protein are the major nutrients in animal dietary governing the ultimate growth of the animals. Experiments have been conducted in temperate (SPEADBURY, 1978; DE BLAS *et al.*, 1981) and tropical (OMOLE, 1982; SANKHYAN et al., 1990) locations to determine nutrient requirement of rabbits in critical physiological stages. Nutrient requirement table devised for growing rabbits under semi arid conditions are based on experiments with comparatively lower gain (DESHMUKH *et al.*, 1990) whereas weaner kits posses potential of higher gain (SAHU and PRASAD, 1990) necessitating initiation of requirement studies with reasonable rate of gain.

MATERIAL AND METHODS

Fifty four kits comprising of Soviet Chinchilla and White Giant breeds weaned at 28th day of age were randomly assigned to nine groups and maintained in angle iron supported wire mesh individual cages (18"x20"x15") with provision of feeder and watering bowl. The feeding experiment was started in the first week of January and terminated by the end of 2nd week of March 1992. During experimentation the ambient temperature and RH of the animal shed was 8.0 ± 0.3°C and 43% minimum and 29.0 ± 0.6°C and 80% maximum respectively. The kits were offered *ad libitum* prepared pelleted feed once daily during morning hours and refusal, of the previous day was weighed and discarded before offering fresh feed. Kits had free access to clean drinking water in individual bowls fixed in the cages. Daily records of feed intake were maintained throughout the experiment whereas water intake were recorded during the metabolism trial. The kits were weighed in weekly intervals to assess their growth pattern. The experiment continued for 8 weeks. On termination of the experiment the kits were slaughtered after stunning followed by deskining and evisceration. The dressing percentage was expressed in terms of carcass weight excluding edible offals.

Table 1 : Ingredients, physical and chemical composition of diets.

Ingredients %	LELP	LEMP	LEHP	MELP	MEMP	MEHP	HELP	HEMP	HEHP
Barley	20	13	6	40	33	26	64	53	41
Ground nut cake	10	24	38	10	24	38	8	19	31
Wheat bran	20	13	6	20	13	6	6	5	5
Ground cowpea hay	35	35	35	15	15	15	5	5	5
Fish meal	5	5	5	5	5	5	8	8	8
Molasses	8	8	8	8	8	8	8	8	8
Mineral mixture	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Salt	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Chemical composition (% DM)									
Dry matter	93.7	93.5	93.2	93.7	92.0	92.2	93.0	93.9	93.5
Crude protein	15.86	19.80	22.14	16.96	19.14	23.02	15.41	20.13	22.95
DCP %	10.31	14.28	16.20	11.80	14.08	18.24	11.49	15.77	18.10
Gross energy (Kcal/kg)	3900	3900	3930	3940	3900	3940	3900	3940	3900
DE (Kcal/kg)	2556	2564	2636	2769	2769	2798	3117	2082	2932
ADF %	24.3	25.5	27.2	15.6	15.9	16.4	14.5	14.2	15.6
Digestible ADF %	9.30	7.64	10.02	3.98	4.46	5.01	6.50	5.28	4.51

Complete pelleted diets were prepared with three levels each of protein (15, 18 and 21%) and energy (2200, 2500 and 2800 Kcal DE/kg) in nine combinations. The treatments were designated as LELP, LEMP, LEHP, MELP, MEMP, MEHP and HELP, HEMP, HEHP. Physical and chemical composition of the experimental diets are presented in Table 1. The feed pellets were prepared using ground ingredients treated with 8 kg molasses dissolved in 40 litres of water/quintal of feed. The prepared feed mix was passed through 4 mm die cast in a laboratory model pelleting machine. The extruded pellets were sun dried and stored in gunny bags for use in the feeding experiment.

During the middle of the feeding experiment a metabolism trial was conducted on all the kits in the metabolic cages with facility for quantitative collection of faeces and urine. During metabolism trial the kits had attained eight weeks of age with average body weight of 1.214 ± 0.093 to 1.41 ± 0.065 kg in different groups. The pooled representative samples of faeces and urine from five days collection period were later analysed for chemical composition (AOAC, 1984) and calculation of digestibility coefficients. There was no mortality of kits during the feeding experiment.

The data on voluntary feed intake, growth rate, feed efficiency and digestibility coefficient of nutrients were subjected to analysis of variance considering energy and protein levels as two factor with two way interaction in 3x3 factorial arrangement (GOMEZ and GOMEZ, 1976) and significant group means were compared using Duncan's Multiple Range test (DUNCAN, 1955). The data of growth was subjected to simple linear regression analysis with average daily gain as dependent variable and energy protein ratio as independent variable. Statistical analysis indicated non

Table 2 : Performance of broiler rabbits maintained on different energy protein diets

	Energy			Protein		
Parameters	**LE**	**ME**	**HE**	**LP**	**MP**	**HP**
Four week weight (kg)	0.36	0.37	0.40	0.38	0.37	0.38
Twelve week weight (kg)	1.93	2.03	1.94	1.98	1.97	1.95
Total gain in Expt.	1.56	1.66	1.54	1.60	1.59	1.57
ADG (g)	27.80	29.63	27.52	28.54	28.38	28.02
Total feed consumed (kg)	6.83^{B}	6.59^{B}	5.50^{A}	6.63	6.04	6.25
Dressing percentage (live weight basis)	45.01	45.32	46.27	45.27	45.70	45.64
Edible meat yield (kg)	0.87	0.92	0.90	0.90	0.90	0.89
Feed efficiency ratio	4.41^{B}	4.04^{AB}	3.56^{A}	4.14	3.82	4.01
Efficiency of meat yield (ratio)	7.94^{B}	7.33^{B}	6.11^{A}	7.42	6.77	7.17

Values bearing unlike superscripts in a sub row differ significantly ($P<0.01$) from each other.

Table 3 : Intake, digestibility and balance of nutrients in broiler rabbits maintained on different energy protein diets.

Parameters	Energy			Protein		
	LE	ME	HE	LP	ME	HP
DMI ((g/d)	114.89^{b}	113.33^{b}	95.08^{a}	112.50	104.66	106.13
DMI (g/kg BW)	100.49^{B}	89.52^{B}	69.39^{A}	93.76	82.89	82.76
Digestibility coefficients (%)						
Dry matter	63.74^{A}	70.10^{B}	76.06^{C}	70.17	69.72	70.01
Crude protein	70.08^{A}	74.12^{AB}	77.25^{B}	69.69^{A}	74.62^{B}	77.13^{B}
ADF	35.04	28.08	37.00	36.25	31.25	32.12
Energy	66.17^{A}	70.78^{B}	77.79^{C}	71.93	71.67	71.15
DCP intake (g/d)	15.40	16.60	14.30	12.47^{A}	15.29^{A}	18.54^{B}
DCP intake (g/kg BW)	13.47^{B}	13.28^{B}	10.44^{A}	10.41^{A}	12.28^{B}	14.50^{B}
DE intake (Kcal/d)	296.29	318.67	287.66	312.45	289.98	300.19
DE intake (Kcal/kg BW)	259.96^{b}	253.78^{b}	211.00^{a}	260.23	229.28	235.23
N intake (g/d)	3.51^{b}	3.56^{b}	2.97^{a}	2.89^{A}	3.29^{AB}	3.85^{B}
N voided in faeces (g/d)	1.05^{B}	0.91^{AB}	0.68^{A}	0.90	0.84	0.88
N voided in urine (g/d)	0.54	0.56	0.47	0.31^{A}	0.46^{A}	0.80^{B}
N balance (g/d)	1.92	2.10	1.82	1.68^{a}	1.99^{ab}	2.17^{b}

Values bearing unlike superscripts in a sub row differ significantly from each other (Capital letters : P<0.01 ; small letters : P<0.05)

significant interactions in energy and protein levels for all the parameters hence the data were pooled and presented on the basis of energy and protein variations.

RESULTS AND DISCUSSION

The initial average weight of weaner (4 weeks old) kits were similar in all energy and protein based groups and ranged between 0.36 to 0.40 kg and the final average weight (12 weeks of age) were also similar and ranged from 1.93 to 2.03 kg. The total gain and average daily gain (ADG) of the broiler kits during the experiment followed similar pattern and ranged between 1.56 to 1.66 kg and 27.8 to 29.6 g respectively in different energy and protein based groups (Table 2). Irrespective of energy and protein levels the broiler kits in the growth study could attain average body weight of 2.00 kg at 12 weeks of age. The growth response of the finisher kits obtained in the present study was similar and comparable to studies conducted under tropical conditions (OMOLE, 1982 ; SAHU and PRASAD, 1990).

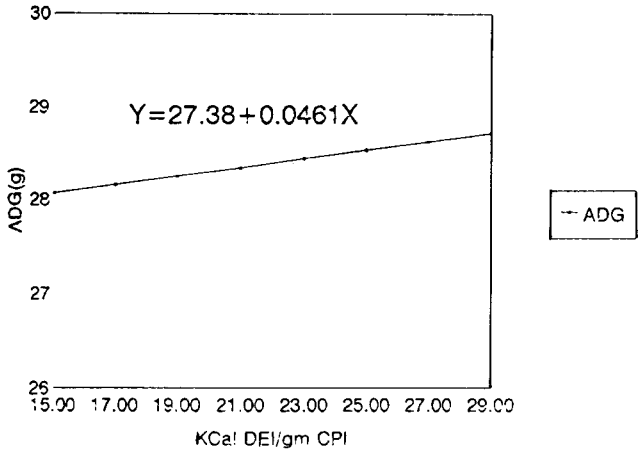
Total feed consumption during the experimental period was higher in low energy (6.83 kg) followed by medium (6.59 kg) and lowest (P<0.01) to high energy (5.5 kg) diets. The DMI expressed in terms of unit weight during metabolic trial followed similar trends (Table 3). Energy density in the dietary and feed consumption are inversely related and it is known that rabbits regulate their feed intake in accordance with the energy density of diet (LEBAS, 1975 ; POTE *et al.*, 1980). Therefore the observed changes in feed consumption during the experiment could be ascribed to variation in the energy content of experimental diets. Higher feed consumption in the low energy fed group was associated with higher (P<0.01) feed to gain ratio (LE 4.41, ME 4.04, HE 3.5). Dressing percentage of slaughtered finisher kits ranged between 44 to 47 % with 0.83 to 0.99 kg edible meat yield. Efficiency of meat yield (ratio) followed similar trends as the feed to gain ratio and was higher in low and medium energy groups (P<0.01) compared to high energy groups whereas these parameters assessed in terms of variation in protein levels were found to be similar.

Dry matter digestibility was influenced by energy contents of the diet and was lower (P<0.01) on low energy diet and increased progressively on medium and high energy regimen. Digestibility of crude protein was influenced both by energy as well as protein contents of the diets and was lower on low energy and low protein diets (70.08 and 69.69 %) and increased (P<0.01) on medium energy, medium protein diet (74.12 and 74.62 %) and more so on high energy and high protein diets (77.25 and 77.13 %).

The energy digestibility also followed similar trend and was lower (P<0.01) in low energy followed by medium and high energy regimen (Table 3). Such changes in digestibilities of nutrients were due to variable levels of roughage used in the diet formulation (Table 1) and it is established that increase in roughage component of the diet will have decreasing effect on its energy digestibility.

The actual intake of DCP followed the expected trend of variation based on the protein levels, whereas DE intake expressed in terms of unit weight was significantly (P<0.01) lower in high energy fed group

Figure 1 : Growth response of weaner kits fed diets with varying DE/CP ratio.



compared to medium and low energy regimes due to their lower DMI. The nitrogen intake followed expected treatment variation and was higher on high protein (3.85 g/d) followed by medium (3.29 g/d) and low protein (2.89 g/d) diets. The excretion of nitrogen in urine increased with increase in nitrogen intake while nitrogen intake did not have significant effect on its excretion pattern in faeces. The nitrogen balance increased ($P<0.05$) with the increase in nitrogen intake by the animals whereas the energy intake of the dietary didn't change the nitrogen balance. The increased nitrogen balance from low to high protein diets was however not reflected in average daily gain by the animals indicating that even on low protein diets the animals were able to meet their protein requirement for growth.

The regression of average daily gain on the ratio of digestible energy and crude protein intake of the diets indicated non significant effects of the ratio on average daily gain (Fig. 1)

It was evident from the experiment that on an average the growing kits required 91 g DM, 13 g DCP and 255 Kcal DE per kg metabolic body size to gain at the rate of 28 g/day (Table 4). In vogue feeding standards of rabbits (NRC, 1977 ; LEBAS, 1980) are based on nutrient density of the diets and as such are not comparable whereas the proposed feeding standard by DESHMUKH *et al.*, 1990 appears to be on lower side (74 g DM, 8.2 g DCP and 192 Kcal DE/kg W0.75 for 30 g ADG) as the table was devised on data with comparatively lower growth rate (5 to 18 g ADG) in actual experimentation.

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Table 4 : DM, DCP and DE intake (per kg metabolic weight) of growing rabbit for different gains

Feeding regimen	DMI (g)	DCPI (g)	DEI (Kcal/d)	Average daily gain (g)
LELP	112.88	11.60	288.13	20.20
LEMP	104.68	16.20	272.60	26.81
LEHP	92.01	14.89	243.27	27.39
MELP	106.28	12.35	289.82	28.88
MEMP	84.48	11.87	233.67	31.63
MEHP	95.23	17.43	280.96	28.37
HELP	76.14	8.63	237.04	27.54
HEMP	72.57	11.41	222.71	26.70
HEHP	76.33	13.81	223.93	28.30
Average	*91.17*	*13.02*	*254.68*	*28.31*
	± 4.91	*± 0.87*	*± 9.29*	*± 0.51*

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