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EFFECTS OF ENVIRONMENTAL TEMPERATURES AND RESTRICTED FEEDING ON THE PERFORMANCE, CARCASS PERCENTAGE AND FUR QUALITY OF THE REX RABBITS

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SUMMARY

Rabbits has a tremendous potential as a meat and skin producer, even in the small scale farming system. Rex, in particular, is a breed of rabbit raised mainly for fur production. An experiment was conducted to study the effects of different environmental temperatures and feed restriction on the performance, carcass percentage and fur quality of the Rex rabbits. Nintysix rabbits of 3,5 month old were allocated randomly into 3 environmental temperatures (ET), i.e. 16 - 18° C (air conditioned room; T1), 16 - 26°C (Cisarua, 900 m above sea level; T2) and 20 - 28°C (Ciawi, 350 a.s.l.; T3). Rabbits in each environment were divided into 3 feeding system groups, i.e. 60, 80 and 100 g/rabbit/day feeding. Replicates of each feeding group were 10 for T1 and T3, and 12 for T2 of rabbits caged individually. Measurements were made on slaughter weight (SW), bodyweight gain (BWG), percentage of carcass and edible meat, nutrient digestibility, pelt area, and fur quality in term of hair length, density, luster, hair loss, and overall fur appearance.

In most cases, environmental temperature and restricted feeding significantly affected the parameters measured. No interaction, however, was detected between the two factors, except in some fur quality measurements. Lower environmental temperatures produced higher SW, BWG and better fur quality, but did not affect percentage of carcass and its component, pelt area or nutrient digestibility, except for dry matter. Feed restriction reduced SW, BWG, percentage of carcass and edible meat and pelt area significantly. Nutrient diigestibility and fur quality were, however, improved by feed restriction especially the luster and reduction of hair loss. Lowest ET (T3) and highest feeding (100g/rabbit/d) produced heaviest SW and BWG; while lowest ET(T3) and lowest feeding (60 g/rabbit/d) produced better digestibility and fur quality.

INTRODUCTION

Potential of rabbits as a meat-producing livestock in a small scale, backyard farming, particularly in the tropical countries is known elsewhere (Owen, 1976; Lebas, 1983). In Mexico, for example, 70 % of 300,000 does (female rabbits) are raised by backyard producers (Leach and Barret, 1984). Similarly, in Indonesia, rabbits are raised in a backyard farming system with mostly less than 5 does reared by each family (Sitorus et al. 1982).

The most obvious limitation to rabbit production in the tropics is that rabbits are susceptible to heat stress. At temperature about or above 30°C production can be severely limited (Cheeke, 1986; Raharjo et al, 1991). The effect can be worse, in term offur quality, when applied to the Rex rabbits, a breed of rabbit raised mainly to produce good quality and expensive fur (Raharjo, 1988). Nevertheless, in many tropical countries, there are highlands and high elevation areas, where temperatures are moderate or cool. Other factor that can affect the performance and quality of fur is feed consumption. Less feed consumption is reported to improve fur quality, yet reduces the slaughter weight and size of pelt area (Taylor and Johnston, 1984).

MATERIALS AND METHODS

Management of animals

Nintysix Rex rabbits of 3.5 month old were used in a 3 x 3 factorial experiment. Rabbits were distributed randomly into three environments differed in temperature, i.e. 16 - 18° C [air conditioned room; designated as T1], 16 - 26° C [at Cisarua, 900 above sea level; T2] and 20 - 28° C [Ciawi, 350 a.s.l.; T3]. Rabbits in each environment were divided into 3 feeding system groups, i.e. 100 [F1], 80 [F2] and 60 [F3] g/rabbit/day feeding. Replicates for each feeding group were 10 for T1 and T3, and 12 for T2 of rabbits raised in individual cages. Diet composition is presented in Table 1. Rabbits were slaughtered at 6 months old.

Table 1. Diet composition.

Nutrient	% dry basis
[Dry matter	87.89]
Crude protein	23.30
Acid detergent fibre	14.60
Ash	9.90
Calcium	1.33
Phosphorus	0.98
Gross Energy	4727 kcal/kg

Measurements

Measurements were made on slaughter weight [SW], bodyweight gain [BWG], percentage of carcass [PCs] and edible meat [PEM], nutrient digestibility [only between T1 and T3], pelt area and fur quality, in terms of density, luster, fur length, hair loss [degree of moult] and overall fur appearance. Fur quality was analysed by a sensory evaluation method [Larmond, 1973].

Statistical analyses

Results were subjected to analysis of variance and differences between means were tested using an LSD (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Growth performance

Bodyweight gain [BWG], Slaughter weight [SW], Percentage of carcass [PCs] and edible meat [PEM] was significantly affected by levels of temperature and feed restriction [Table 2]. No interaction [P>0.05] was detected between the two factors on the responses measured.

In general, increasing levels of temperature and decreasing levels of feed intake depressed BWG. Bodyweight gain was significantly higher in rabbits raised at T1 [16-18°C]. Similar results were observed in different trial, but when temperature is further dropped to 13-16° BWG declined although feed intake was increased (Raharjo et al., 1991). Cheeke et al.(1987) reported that 'comfort zone' for rabbits to grow ranges from 16° to 20° C. At temperature above or below the comfort zone the animal had to spend more energy to maintain body temperature. Bodyweight gain was apparently low [± 14 % or 3.9 g/rabbit/d] during 2,5 months period of observation and this was mainly due to the animalsare in the finisher phase. A 60 g/day consumption was obviously used only for maintenance.

Response of SW to the effects of environment temperature and levels of feeding followed the pattern observed in BWG. Higher temperature of environment and less feed consumption decreased SW. Slaughter weight was heavier [2518 g] in rabbits fed F1 [100 g/day] than those from two other feeding levels. Taylor and Johnston (1984) reported similar results. It is clear that higher feed intake produced more bodyweight, hence SW. Lower SW of rabbits raised at T2 was apparently due to some of the rabbits underwent enteritis. This may also explained the negative gain observed in growth response.

Carcass percentage [PCs] was influenced (P<0.)5) by levels of feeding, but not by temperature of environment. Higher levels of intake produce better PCs and linear correlation was observed between mean values of SW and PCs [r = 0.87]. The PCs values of Rex obtained in this experiment [45.9 - 52.1 %] were similar to those of crossbred of New Zealand White x Flemish Giant [47-51 %] [Sudaryanto et al.,1985] but higher than those from Flemish Giant [39.7 - 49.1 %] [Diwyanto et al., 1985]. Percentage of edible meat [PEM] followed the pattern of PCs. A 74 % value of PEM from the rabbits raised at F1 was higher (P<0.05) than that of F3. Interesting to note that PEM at T3 (higher temperature) was

significantly higher than that of T1. Percentage of bone from rabbits at T3 was apparently less than that of T1.

Table 2. Effects of environmental temperature and feed restriction on the performance of Rex rabbits.

	T1 [16-18°]	T2 [16-26°]	T3 [20-28°]	Means	SEM
1. Bodyweight Gain [%]					
F1 [100 g]	31	25	25	27[c]	0.52
F2 [80 g]	20	14	14	16[b]	0.57
F3 [60 g]	1	- 3	2	- 1[a]	0.50
Means	17[b]	12[a]	13[a]		
SEM	0.51	0.50	0.60		
2. Slaughter Weight [g/rabbit]					
F1	2682	2324	2613	2518[b]	20
F2	2589	2288	2523	2456[b]	23
F3	2510	1785	2241	2152[a]	20
Means	2594[b]	2127[a]	2447[b]		
SEM	20	24	20		
3. Carcass Percentage [%][1]					
F1	51.8	49.9	52.1	51.3[b]	0.26
F2	48.4	46.4	51.5	48.8[a]	0.31
F3	45.9	48.7	47.3	47.3[a]	0.26
Means	48.7	48.3	50.3		
SEM	0.26	0.27	0.31		
4. Edible Meat Percentage [%][2]					
F1	74.3	74.2	73.0	74.0[b]	0.33
F2	73.0	74.1	74.1	73.7[b]	0.38
F3	69.0	64.5	74.8	69.6[a]	0.33
Means	72.1[ab]	71.3[a]	74.0[b]		
SEM	0.39	0.32	0.33		

Initial weight ranged from 1889 - 2356 [2069 ± 142] g/rabbit.
[1] Percentage from slaughter weight.
[2] Percentage from carcass weight.
[a,b] within the same column or line are significantly different ($P<0.05$).

Digestibility of nutrients

Digestibility of nutrient was, in most cases, influenced by levels of feeding, but not by temperature of environment, except for dry matter [Table 3]. Increasing levels of intake significantly decreased the digestibility values. This is understandable since high level of consumption increases rate of passage and caused shorter time of ingesta to be digested/absorbed in the intestine.

Table 3. Nutrient digestibility as affected by environmental temperature and feed restriction in Rex rabbits [%].

Nutrient	T1 [16-18°]	T3 [20-28°]	Means	SEM
1. Dry matter				
F1 [100 g]	71.7	68.0	69.8[a]	
F2 [80 g]	72.2	69.5	70.8[ab]	
F3 [60 g]	75.9	71.8	73.3[b]	
Means [SEM]	73.3[b]	69.8[a]		0.40
2. Crude Protein				
F1	83.4	81.9	82.7[a]	
F2	84.4	84.2	84.3[ab]	
F3	87.0	84.3	85.7[b]	
Means [SEM]	84.9	83.5		0.24
3. Acid Detergent Fibre				
F1	33.4	28.2	30.8	
F2	35.0	28.4	31.7	
F3	41.1	32.9	37.0	
Means [SEM]	36.5	29.8		1.00
4. Gross Energy				
F1	75.0	72.1	73.6[a]	
F2	75.9	73.6	74.8[ab]	
F3	80.0	77.2	78.3[b]	
Means [SEM]	76.6	74.3		0.46

[a,b] within the same line or column are significantly different ($P<0.05$).

Higher digestibility values for crude protein [82 - 89 %] over other nutrients was because of the practise of cecotrophy, in which undigested protein in the foregut was redigested in the caecum and together with some microbial proteins were directly reconsumed by the rabbits. This beneficial effect of cecotrophy on the protein digestibility has also been reported (Robinson et al., 1985; Raharjo et al., 1986). Substantial difference occurred in the digestibility values of ADF, but no significant level was detected. This could be the high variability of digestibility values obtained in fibre. Similar results found from by-product feeds and legumes products have been reported (Raharjo et al., 1986; 1988). Possible cause of this high variability involves the role of hind gut, particularly cecal retention, cecal impaction and motility, and movement of reverse peristalsis and contraction of haustra (Cheeke, 1986). Digestibility values of more than 70 % obtained in this experiment was considered high, this in part may indicate the ability of rabbits to efficiently utilize nutrients, in spite of the fact that feed is high in quality (CP = 22 % and DE > 3000 kcal/kg).

Fur quality

Responses of skin and fur quality to different environmental temperature and feeding levels is presented in Table 4. A significant and stepwise decrease of pelt area due to the reduction of feed intake was observed. Taylor and Johnston (1984) also reported a decrease of 5 and 12 % of pelt area by the reduction of 25 and 50 % of feed intake, respectively. Linear correlation of slaughter weight and pelt area [r^2 = 0.64] was observed; heavier SW produced bigger pelt area. Pelt area is considered important since bigger pelt area increases the value of skin.

Fur density, but not fur [hair] length was affected significantly by both treatment factors. Significant interaction occurred between environmental temperature and levels of feeding on fur density, luster of fur and degree of moult. Increasing levels of temperature caused a consistent decrease on the fur density, but the change was not consistent within levels of feeding. At T1F1, fur density was valued 3.82. As the consumption was reduced to F2 [80 g] density value increased to 4.25. Further restriction [F3] within the same environment decreased the value to 3.62. When similar feeding treatments were applied to T2, the effect was reversed. The effects of temperature change, however, more pronounced and lower temperature produced denser fur. Anggo- rodi (1979) and Martawijaya et al. (1986) also reported that high environmental temperature and excessive sunlight reduced wool production.

Luster or shineness of fur was also better in rabbits raised at lower temperature, e.g. at T1. On the other hand, high level of feed intake did not warrant better results. In fact, best luster, as also occurred with the density, was found in T1F2, meaning from rabbits raised at 16-18° C and receiving 80 g diet/day. Hair loss, which was measured by the degree of fur moult, was highest in rabbits from T3F3, i.e. from the highest temperature and lowest feed intake. This could be related with the insufficient nutrient requirements plus the effect of hot temperature. Overall fur appearance was also found to be best from rabbits raised at low temperature, but not affected by levels of feeding.

Density, luster, hair loss and fur appearance of the tanned fur were also influenced by method and/or chemical used for tanning [Raharjo et al., 1990]. Chrom tanning, which is a common method used for fur tanning, gave better and more stable skin quality, and denser fur, but may reduce luster and overall fur appearance. On the other hand, Formaline tanning produced less stable and less physical quality of skin, but performed better luster and appearance, particularly to white colour fur.

Table 4. Effect of environmental temperature and feed restriction on the size of pelt area and fur quality.

	T1 [16-18°]	T2 [16-26°]	T3 [20-28°]	Means	SEM
1. Pelt area [cm^2]					
F1 [100 g]	979	889	1043	970^{b}	12
F2 [80 g]	903	860	913	892^{ab}	12
F3 [60 g]	818	828	868	838^{a}	12
Means	900^{ab}	859^{a}	942^{b}		
SEM	10	17	11		
2. Fur length, shoulder part [mm]					
F1	20.6	20.9	20.8	20.8	
F2	21.1	20.2	20.2	20.6	
F3	21.6	20.7	20.1	20.9	
Means	21.1	20.6	20.4		1.00
3. Density [score 1 - 5, less dense to very dense]					
F1	3.82^{de}	3.30^{abc}	3.13^{ab}	3.42	
F2	4.25^{e}	3.22^{abc}	3.00^{a}	3.49	
F3	3.60^{de}	3.48^{bcd}	3.20^{abc}	3.43	
Means [SEM]	3.89	3.33	3.11		0.07
4. Luster [score 1 - 5, dull to shine]					
F1	3.60^{c}	3.38^{bc}	2.83^{a}	3.27	
F2	3.73^{c}	3.43^{bc}	3.28^{b}	3.48	
F3	3.53^{bc}	3.68^{c}	3.52^{bc}	3.58	
Means [SEM]	3.62	3.50	3.21	0.07	
5. Hair loss [score 1 - 5, easily moult to not moult]					
F1	2.75^{a}	3.13^{ab}	2.75^{a}	2.88	
F2	3.35^{b}	2.78^{a}	3.28^{b}	3.14	
F3	3.48^{b}	3.22^{b}	3.52^{b}	3.41	
Means [SEM]	3.19	3.05	3.18		0.08
6. Overall fur appearance [score 1 - 5, not attractive to attractive]					
F1	3.73	3.65	3.55	3.64	
F2	3.80	3.62	3.32	3.58	
F3	3.80	3.55	3.08	3.48	
Means [SEM]	3.78^{b}	3.61^{b}	3.32^{a}		0.08

a,b,c,d within column[s] and/or line[s] differed significantly ($P<0.05$).

Conclusion

Increasing environmental temperature and decreasing feed intake depressed growth, meat production and pelt area. Feed restriction however, improved nutrient digestibility although might give less feed efficiency due to inadequate supply of nutrients for growth. Increasing temperature also decreased the quality of fur, although in most cases the effect was also dependent on the level of feeding. Low temperature and feed restriction to 80 g/day seemed to give best fur quality. Interesting to see if the tempe- rature is further dropped to a level less than 16° C, as it could cause cold stress, hence growth depression, but may produce better fur quality.

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