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EFFECT OF LUCERNE- BASED DIETS ON THE REPRODUCTIVE PERFORMANCE OF RABBIT DOES AT HIGH ENVIRONMENTAL TEMPERATURES

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ABSTRACT

Ninety one lactations of 33 New Zealand × Californian rabbit does, housed in a climatic chamber at 30ºC, were used to study rabbit production on diets based on lucerne at high environmental temperatures during their first 3 reproductive cycles. Three diets were formulated: diet C a commercial diet having 12.0 MJ DE kg^{-1} DM and 12.2 g DP kg^{-1} DM; diet L a 96% lucerne diet having 8.7 MJ DE kg^{-1} DM and 10.8 g DP kg^{-1} DM; and diet G a fat-added lucerne diet having 9.6 MJ DE kg^{-1} DM and 10.5 g DP kg^{-1} DM. Rabbit does given L and G diets showed higher DM intake than those given C diet through the whole reproductive cycle ($P<0.001$). There were no differences in the DE intake of does throughout the reproductive cycle, although lactating does given L diet showed a slightly lower value. In consequence, lactating does on L diet showed a lower milk yield ($p<0.05$) and litter weight gain than does on C and G diets. Litters on lucerne diets showed lower kit mortality than litters on C diet ($P<0.05$).

INTRODUCTION

As has been stated in previous work, lucerne is the most common source of fibre in rabbit diets. Lucerne inclusion in commercial diets is always lower than 50%, because its drawbacks may affect productivity and conversion rate. However, animal production in some tropical and semiarid countries, characterised by high environmental temperatures, is mainly based on the use of forages. Under hot stress conditions, the performance of reproductive rabbit does decreases (Cervera and Fernández-Carmona, 1997), especially with fibrous diets. Simplicio *et al.* (1991) found that the use of high lucerne diets may not be advisable at high environmental temperatures.

Few studies have been conducted on the use of high forage crops levels in rabbit diets, especially at high environmental temperatures and during several reproductive cycles. The aim of the present work was to determine performance of reproductive rabbit does on lucerne diets under hot stress conditions, taking into account that some of the obvious imbalances of energy, aminoacids and minerals in these diets had been partially corrected.

MATERIAL AND METHODS

Diets

The three diets used in this work have been previously described by Pascual *et al.* (2000). The ingredients and chemical composition of the diets are summarised in Table 1. Diet C was

similar to a typical commercial diet having 12.0 MJ DE kg^{-1} DM and 12.2 g DP kg^{-1} DM; diet L a 96% lucerne diet having 8.7 MJ DE kg^{-1} DM and 10.8 g DP kg^{-1} DM; and diet G was a 92% lucerne diet, enriched by the addition of 5% fat, having 9.6 MJ DE kg^{-1} DM and 10.5 g DP kg^{-1} DM.

Table 1. Ingredients (g kg^{-1}) and chemical composition (g kg^{-1} DM) of diets.

	Diets		
	C	L	G
Ingredients			
Lucerne hay	480	960	920
Barley	350	-	-
Soya (44%)	120	-	-
Animal fat	20	10	50
Methionine	1	1.5	1.7
Lysine	-	1.5	1.7
Arginine	-	1	1.2
Monosodium phosphate	-	22	22
Calcium hydrogen phosphate	23	-	-
Sodium chloride	3	1	1
Magnesium sulphate	0.1	0.1	0.1
Robenidine	0.8	0.8	0.8
BHT	0.05	0.05	0.1
Vitamin E	0.05	0.05	0.1
Vitamin/mineral mixture[1]	2	2	2
Chemical composition			
Dry matter (DM; g kg^{-1})	902	904	906
Ash	102	140	136
Crude fibre (CF)	147	236	226
Acid-detergent fibre (ADF)	151	251	242
Ether extract (EE)	58	51	82
Digestible energy (DE; MJ kg^{-1} DM)	12.0	8.7	9.6
Digestible protein (DP)	122	108	105

C = control diet; L = lucerne diet; G = lucerne fat-added diet.

[1] Contains (g kg^{-1}): thiamin, 0.25; riboflavin, 1.5; calcium pantothenate, 5; pyridoxine, 0.1; nicotinic acid, 12.5; retinol, 2; cholecalciferol, 0.1; α-tocopherol, 15; phytylmenaquinone, 0.5; cyanocobalamin 0.006; choline chloride, 100; $MgSO_4 \cdot H_2O$, 7.5; ZnO, 30; $FeSO_4 \cdot 7H_2O$, 20; $CuSO_4 \cdot 5H_2O$, 3; KI, 0.5; $CoCl_2 \cdot 6H_2O$, 0.2; Na_2SeO_3, 0.03.

Animals

Ninety one lactations from 33 New Zealand × Californian rabbit does, housed in a climatic chamber at 30ºC, were used to study rabbit production on diets based on lucerne at high environmental temperatures during their first 3 reproductive cycles. Nulliparous does were artificially inseminated at about 4.5 months of age (with an average live weight of 3.5 kg).

Until insemination, all does received the L diet. Subsequently, does were housed in individual cages and had free access to one of the experimental diets. Lactating does were inseminated at 3-5 days after parturition. At twelve days after insemination, the does were tested for pregnancy by palpation. The litters were standardised to 6 kits at partum, keeping the number constant throughout lactation, and weaned at the age of 35 days. Live weight and food intake of does were recorded weekly. Milk yield was recorded daily using the weight(doe)-suckling-weight(doe) method. Weight of litters was also controlled weekly. Food intake of litters was recorded during the last week of lactation.

Statistical analysis

Statistical analysis of the performance of does and litters was carried out according to the GLM procedure of SAS (Statistical Analysis System Institute, 1990) with a model accounting for the fixed effects of the diets, and the reproductive cycle, and their interaction.

RESULTS

Data in Table 2 show that there were no significant differences in the live weight gain and DE intake of gestating and lactating rabbit does. Respect to the interval between parturitions, although not significant, does given C diet presented a lower interval than does given lucerne diets. DM intake of does given L and G diets was significantly lower ($P<0.001$) than for C diet through the whole reproductive cycle. Lactating does on L diet showed a lower milk yield ($p<0.05$) than those on C and G diets.

Table 2. Effect of diet on the reproductive performance of rabbit does at 30ºC.

	Diets				
	C	L	G	SE	Sig.
No. of observations	30	32	29		
Interval between parturitions	56	70	71	16.9	NS
Doe weight gain (g/day):					
gestation	12.3	9.7	11.4	6.37	NS
lactation	3.9	-1.8	-0.9	1.97	NS
Food intake (g DM $kg^{-0.75}$ day^{-1}):					
gestation	48.3^{a}	64.3^{b}	58.1^{b}	6.88	***
lactation	76.9^{a}	93.3^{b}	95.2^{b}	7.64	***
Energy intake (MJ DE $kg^{-0.75}$ day^{-1}):					
gestation	581	562	559	65.2	NS
lactation	924	849	915	76.1	NS
Milk yield (g day^{-1})	114^{b}	96^{a}	115^{b}	16.6	*

SE: standard error.

Sig.: statistical significance: NS, not significant; * $P<0.05$; *** $P<0.001$.

[a,b] Means within a row with different letters are significantly different at $P<0.05$.

As can be seen in Table 3, although there were no significant differences in the litter size at partum, live weight of litters on diet L was always lower than that of litters on diets C and G. Litters on diet C showed a lower solid DM and DE intake ($p<0.05$) than litters on diets L and G, during the last week of lactation. There were significant differences in the replacement of kits, showing a higher mortality in litters on diet C than in those on lucerne diets ($P<0.05$).

Table 3. Effect of diet on the performance of litters at 30ºC.

	Diets				
	C	L	G	SE	Sig.
No. of observations	30	32	29		
Size at partum	6.8	7.2	7.3	3.13	NS
Weight (g):					
at partum	350	372	357	136.7	NS
1st week	782[b]	658[a]	742[b]	105.4	**
2nd week	1290[b]	1043[a]	1261[b]	157.5	**
3rd week	1869[b]	1447[a]	1807[b]	236.4	***
4th week	2797[b]	2093[a]	2700[b]	366.5	***
5th week	4409[b]	3287[a]	4267[b]	577.8	***
Solid food intake (g DM $kg^{-0.75}day^{-1}$)					
22 to 28 days of lactation	29.6	34.3	29.8	13.99	NS
29 to 35 days of lactation	74.4[a]	97.2[b]	88.2[b]	19.12	*
Kit replacement (%)	1.97[b]	0.86[a]	0.55[a]	1.695	*

SE: standard error.
Sig.: statistical significance: NS, not significant; * $P<0.05$; ** $p<0.01$; *** $P<0.001$.
[a,b] Means within a row with different letters are significantly different at $P<0.05$.

DISCUSSION

Rabbit does given fibrous diets (L and G) showed higher food intake due to the lower DE content of these diets than those given a commercial diet. The higher fibre content of these diets could produce an increase in digestive transit speed (Lebas and Laplace, 1977), and consequently lower nutrient digestibility.

So, there were no significant differences in the DE intake of does on the different diets throughout the reproductive cycle. However, the lower litter performance of litters on diet L could be due to the slightly lower DE intake and milk yield of does on this lucerne diet with respect to those on the commercial diet (-75 kJ $kg^{-0.75}$ day^{-1}), as suggested by other authors for fibrous diets (Simplicio *et al.*, 1991). The decrease in productivity shown by reproductive does on the lucerne diet was improved by the addition of dietary fat, showing productivity values similar to C diet. These results differ from those obtained with the same diets in traditional building conditions (Pascual *et al.*, 2000), where the addition of fat to the diet did not increase the DE intake of does. At high environmental temperatures, animals decrease their food intake in order to reduce the production of heat linked to digestion, showing a

similar DM intake. However, although under normal temperature conditions, the voluntary food intake of does could also be determined by their intake capacity of does, in this case it seems to be more influenced by physical factors (Maertens and de Groote, 1988), resulting in similar DM intakes for both fibrous diets, but lower than for a less fibrous diet.

The number of kits replaced during lactation was lower for both fibrous diets, in agreement with Fernández-Carmona and Pascual (1998), who obtained similar results for high lucerne diets in reproductive rabbit does.

CONCLUSION

The use of all-lucerne diet decreases the performance of reproductive rabbit does under high environmental temperatures, showing a lower litter weight at weaning, although with a lower kit mortality. However, this decrease in productivity was improved by the addition of dietary fat, with which rabbit does showed similar reproductive performance to those given a commercial diet.

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