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USE OF LUCERNE-BASED DIETS ON REPRODUCTIVE RABBIT DOES.

PASCUAL, J.J., FONFRÍA, M.J., ALQEDRA, I., CERVERA, C. FERNÁNDEZ-CARMONA, J.

Departamento de Ciencia Animal, Universidad Politécnica de Valencia, P.O. Box 22012, VALENCIA 46071, Spain.
jupascu@dca.upv.es

ABSTRACT

One hundred and fifty-two lactations of 80 New Zealand × Californian rabbit does, housed in a traditional building, were used to study rabbit production on diets based on lucerne during their first 2 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. Reproductive rabbit does given L diet showed a higher DM intake throughout the reproductive cycle ($P<0.001$), but they showed a significantly lower DE intake, milk yield and litter growth than does given the C diet ($P<0.001$). The addition of fat to the lucerne diet improved the litter weight at 3rd week ($P<0.001$) because of a slight increase in milk production.

INTRODUCTION

Lucerne or alfalfa hay is the most common source of fibre in rabbit diets and it is included in a high proportion in commercial diets (30 to 50%). The most relevant drawbacks of lucerne are its low energy value, aminoacid deficiencies and mineral imbalance. The digestible energy (DE) values of lucerne varies widely (6.4 to 12.0 MJ DE kg^{-1} DM) according to the authors (Lebas, 1987; Perez, 1994; García *et al.*, 1995; Fernández-Carmona *et al.*, 1996a).

Few studies have been conducted on the use of high levels of forage crops in rabbits' diets, particularly for reproductive rabbit does. The level of crude protein in lucerne may be sufficient to cover the doe rabbit's requirements, but it does not seem to be suitable for high performance during lactation, mainly on account of the lower DE content.

Therefore, the aim of the present work was to determine the performance of reproductive rabbit does on diets based on lucerne, taking into account that some of its obvious imbalances on energy, aminoacids and minerals had been partially corrected.

MATERIAL AND METHODS

Diets

Three diets were formulated using sun-cured commercial pelleted lucerne, after milling with a 3-mm sieve. The ingredients and chemical composition of 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. They were offered *ad libitum* throughout the experimental period. Chemical analyses of diets were made according the methods of AOAC (1984) and Van Soest

et al. (1991) for ADF. Gross energy was determined by adiabatic bomb calorimetry. Apparent digestibility coefficients of diets were determined using eight 42 days old rabbits, in individual metabolism cages. Their faeces were collected individually for 4 days after a 7-day adaptation period (Perez *et al.*, 1995).

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; a-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

One hundred and fifty-two lactations from a total of 80 New Zealand × Californian crossbreed rabbit does were used to study the effect of the three experimental diets on their performance during the 1st and 2nd reproductive cycles. Nulliparous does were artificially inseminated at about 4.5 months of age (with an average live weight of 3.4 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 8 pups at partum, keeping the number constant throughout lactation, and weaned at the age of 28 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

As is shown in Table 2, type of diet affected significantly the parturition interval of does ($P<0.01$), which was higher for fibrous diets L and G than for does given C diet. Diet did not affect either the weight gain or the DE intake of gestating rabbit does. However, there were significant differences in the weight gain ($p<0.001$) and DE intake ($P<0.001$) of does during lactation, the values being higher for does given diet C than for those on diets L and G. Consequently, milk yield was significantly higher for does given diet C than for those given diets L and G.

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

	Diets				
	C	L	G	SE	Sig.
No. of observations	51	52	49		
Interval between parturitions	45[a]	57[b]	62[b]	19.2	**
Doe weight gain (g/day):					
gestation	22.7	21.8	20.6	6.57	NS
lactation	9.1[b]	4.5[a]	0.3[a]	6.52	***
Food intake (g DM $kg^{-0.75}$ day^{-1}):					
gestation	60.9[a]	83.2[b]	75.0[b]	8.93	***
lactation	115.6[a]	143.2[c]	130.5[b]	13.47	***
Energy intake (MJ DE $kg^{-0.75}$ day^{-1}):					
gestation	732	726	721	85.7	***
lactation	1390[b]	1249[a]	1245[a]	132.4	***
Milk yield (g day^{-1})	192[b]	160[a]	171[b]	12.5	***

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

Table 3 shows the effect of the experimental diets on the performance of litters. Litters on diet G showed a lower solid DM and DE intake ($p<0.001$) than litters on diets C and L, which showed differences in their DE intake. The live weight of litters on diet C was always higher ($P<0.001$) than those of litters on diets L and G. Also, there were significant differences

between L and G diets (P<0.001) during the 2nd and 3rd weeks of lactation, litters on diet G showing higher values. There were no significant differences in the replacement of pups, which was minimal (0.2 pups per lactation).

Table 3. Effect of diet on the performance of litters.

	Diets				
	C	L	G	SE	Sig.
No. of observations	51	52	49		
Size at partum	9.3	9.0	9.1	2.68	NS
Weight (g):					
at partum	552	513	511	111.7	NS
1st week	1235[b]	1056[a]	1097[b]	100.4	***
2nd week	2095[c]	1751[a]	1887[b]	158.2	***
3rd week	2893[c]	2364[a]	2529[b]	219.9	***
4th week	4575[b]	3580[a]	3676[a]	387.1	***
Solid food intake (g DM $kg^{-0.75}day^{-1}$)					
22 to 28 days of lactation	52.6[b]	54.3[b]	35.1[a]	14.25	***
Solid energy intake (MJ DE $kg^{-0.75}day^{-1}$)					
22 to 28 days of lactation	632[c]	473[b]	337[a]	139.4	***

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

DISCUSSION

The results obtained in the present work indicate that the use of diets with an high level of lucerne did not affect the performance of rabbit does during gestation, giving an adequate DE intake and live weight gain, and a similar litter size and weight at partum to a commercial diet.

However, lactating rabbit does given diet L showed a lower DE intake than those given diet C, and this was not improved by the addition of fat. Although lactating rabbit does given L and G diets increased their DM intake in order to cover their high requirements, voluntary food intake of fibrous diets was limited by physical factors (Maertens and De Groote, 1988). Consequently, does given L and G diets showed lower milk yield and their litters presented a worse live weight gain with respect to that showed by those on the control diet. Lactating does on both lucerne diets showed a similar DE intake, but the addition of fat slightly improved the milk yield and the litter weight, which could be related to the higher efficiency of the energy coming from the fat fraction, as suggested by several authors (Fraga *et al.*, 1989; Xiccato *et al.*, 1995; Pascual *et al.*, 1999), who also obtained greater milk production from diets rich in fat.

Moreover, the lower DE intake of does on L and G diets could also have affected the energy balance of does that presented a worse live weight gain and a higher interval between parturition with these diets. Sabater *et al.* (1997) suggested that the time in which the

reproductive rabbit doe is not pregnant is used to recover the corporal reserves that may be lost during lactation.

CONCLUSION

The use of all-lucerne diets on reproductive rabbit does permits successful gestation and lactation, but does presented lower productivity, showing a greater interval between parturition and lower litter weight at weaning.

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