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HIGH FORAGE DIETS SUPPLEMENTED WITH SYNTHETIC AMINO ACIDS ON THE PERFORMANCE OF FATTENING RABBITS

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ABSTRACT

Two hundred and fifty weanling rabbits from a genetic line under development were used to analyze fattening period (FP, until 2.2 kg body weight), average daily gain (ADG), feed intake (FI), feed convertion (FC) and mortality (MT). Five diets were evaluated: FL (forage, 13% crude protein, and no synthetic amino acids), FLA (as FL but supplemented with synthetic amino acids), FH (forage, 16% crude protein, and not supplemented), and FHA (as FH but supplemented with synthetic amino acids) and control (CO). Forage diets had more than 90% of forage content (alfalfa and kikuyo grass). Treatment means were compared using contrasts: All forage diets (F) vs CO, forage diets with 13% crude protein (L) vs 16% (H), forage diets without synthetic amino acids (W) vs supplemented (A), and FLA vs CO. The inclusion of high levels of forage and low protein affected all response variables adversely ($P<.01$). Supplementing amino acids also improved performance ($P<.05$) but keeping FI at the same level. For the FLA vs CO contrast, no significance difference was observed for FP and ADG, but for FI ($P<.01$) and FC ($P<.05$).

INTRODUCTION

Since forages can be used as an important ingredient in diets for fattening rabbits, the search for adequate levels of them without reducing growth, and carcass yield and economic efficiency, as well as having low mortality levels is a great concern in situations in which grains are very expensive or scarce. However, in temperate areas alfalfa has been the predominant forage to feed rabbits. This legume could not be always the best alternative as main ingredient for rabbit rations upon its availability and price (ESPINOZA-FLORES *et al.* 1997).

MATERIAL AND METHODS

This research took place in Montecillo, Mexico. Climatic conditions and geographic location were described by ESPINOZA-FLORES *et al.* (1997).

Experimental diets

Five experimental diets were evaluated (Table 1 and 2). Diets, FL (forage, 13% crude protein, and no synthetic amino acids), FLA (as FL but supplemented with synthetic amino acids), FH (forage, 16% crude protein, and not supplemented), and FHA (as FH but supplemented with synthetic amino acids) had more than 90% of forage content (alfalfa and kikuyo grass). Diet CO was considered as control (commercial diet), containing sorghum, soybean meal and less than 60% of alfalfa. Diets were all offered *ad libitum* as pellets of 0.5 mm diameter. The chemical analysis of diets were performed according to A.O.A.C. (1980), and GOERING and VAN SOEST (1970), (Table 2). The same energy level was observed in the diets (2.34 Mcal kg^{-1}), except the control diet (2.50 Mcal kg^{-1}), which is lower than the recommended by LEBAS (1988), however all experimental diets had a high neutral detergent fiber, ranged from 31 to 38%. Diets FL and FH were deficient in the amino acid levels and diet CO met all the requirements according to LEBAS (1988).

Table 1. Composition (%) of experimental diets.

Ingredient	Diets				
	FL	FLA	FH	FHA	CO
Alfalfa meal	50.36	50.36	73.00	73.00	59.11
Kikuyo grass	40.00	40.00	19.26	19.26	--
Sorghum	--	--	--	--	28.75
Soybean meal	--	--	--	--	8.00
Tallow	5.00	5.00	3.10	3.10	--
Vegetable oil	1.50	1.50	1.50	1.50	1.00
Antioxidant	0.01	0.01	0.01	0.01	0.01
Salt	0.50	0.50	0.50	0.50	0.50
Dicalcium phosphate	1.50	1.50	1.50	1.50	1.50
Minerals premix	0.10	0.10	0.10	0.10	0.10
Vitamins premix	0.25	0.25	0.25	0.25	0.25
Sand	0.78	0.27	0.78	0.72	0.61
L-Lysine HCL	--	0.18	--	--	0.02
DL-Methionine	--	0.18	--	0.06	0.11
L-Threonine	--	0.15	--	--	0.03

FL = High forage and low protein; FLA = As FL but added with synthetic amino acids; FH = High forage and high protein; FHA = As FL but supplemented with synthetic amino acids; CO = Control.

Table2. Chemical analysis (%) of diets.

Nutrient	Diets				
	FL	FLA	FH	FHA	CO
DE (Mcal/kg-1)	2.34	2.34	2.34	2.34	2.50
Crude fiber	31.88	31.88	29.59	29.59	20.01
Neutral detergent fiber	38.31	38.31	31.74	31.74	17.92
Acid detergent fiber	23.48	23.48	22.13	22.13	13.94
Calcium	1.20	1.20	1.62	1.62	1.23
Phosphorous	0.52	0.52	0.57	0.57	0.62
Crude protein	13.00	13.00	16.00	16.00	16.50
Lysine	0.66	0.84	0.84	0.84	0.84
Methionine+Cystine	0.45	0.63	0.57	0.63	0.63
Treonine	0.53	0.68	0.68	0.68	0.68

FL = High forage and low protein; FLA = As FL but supplemented with synthetic amino acids; FH = High forage and high protein; FHA = As FH but supplemented with synthetic amino acids; CO = Control.

Experimental procedures, models and analysis

Two hundred and fifty five animals of thirty five days old of both sexes from a new genetic line under development were used. Animals were slaughtered when they reached 2.2 kg. Three rabbits from different litters were alloted randomly per cage, in a total of 85 cages. Fattening period (FP), average daily gain (ADG), feed intake (FI), feed conversion (FC) and mortality (MT) were analyzed. Measurements were recorded weekly for all variables, until animals reached slaughter weight. FI and FC were measured per cage. MT was measured as a percentage relative to the number of initial rabbits.

For the analysis of FP, ADG, FI, FC and MT a completely random experimental design including cage effect was used. The statistical model was:

$$Yijk = M + Di + Cj(i) + B(Xijk - X) + Eijk$$

were:

Yijk is the observation of the ith diet, jth cage of the kth rabbit.

M is a general constant.

Di is the fixed effect of the ith diet (i = 1,2,3,4,5).

Cj(i) is the random effect of the jth cage nested in the ith diet (j = 1, 2,.....,17).

B is the regression coefficient of Y on X.

Xijk is the initial weight of the ith diet, jth cage of the kth rabbit, used as a covariable.

X is the mean initial weight of all rabbits.

Eijk is the random residual effect.

All random effects were assumed to be normal, with zero mean and respective variance. For FI and FC the cage effect was considered as experimental unit and the average initial weight by cage as covariable. Mean comparisons were done using four contrasts as described: All forage diets (F) vs CO, forage diets with 13% crude protein (L) vs 16% (H), forage diets without synthetic amino acids (W) vs supplemented (A), and FLA vs CO. In order to consider performance trends by week and diet for ADG, FI, FC and MT, a split plot analysis of variance was used, including diet as big plot and week as small plot. Data analysis were performed using the GLM procedure of SAS (SAS INSTITUTE, 1988).

RESULTS AND DISCUSSION

For FP, ADG, FI and FC results on performance by contrasts are presented in Table 3. As observed, differences between contrast involving F vs CO and L vs H were important ($P < .01$) for all traits, meaning that the inclusion of a high level of forage and a low level of protein affected performance adversely. Also, adding synthetic amino acids resulted in an improved performance ($P < .05$), keeping FI at the same level. Interestingly, for the FLA vs CO comparison, no significance difference was observed for FP and ADG, but for FI ($P < .05$) and FC ($P < .01$).

FP was 3 days longer for rabbits fed F diets in relation to the CO diet, which observed the shortest FP (41 d). The longest FP value was observed in rabbits fed the L diets (47 d), which were 5 days longer than the H diets. Adding amino acids reduced FP in 2 days. Remarkably, rabbits fed FLA diet reached the same FP as the CO. It seems that although a large amount of forage in the diet increased FP, the most limiting factors could be the low protein level and the amino acids deficiencies.

For ADG, the biggest gain was 37 gd^{-1}, which was observed for the CO, only tied by the FLA. A 11% reduction was presented in rabbits fed the F diets in relation to the CO. Rabbits fed both, the L and W diets showed the poorest performance with only 31 gd^{-1} (Table 3). The week effect was also important ($P < .01$), with a better response before week 9. For some weeks, diets were not different implying an important interaction between these two factors ($P < .01$)

FI was only 108 gd^{-1} for the CO, a 14% reduction compared with the F diets (Table 3). Although an important difference between the L and the H diets was observed, the same FI was presented for rabbits fed the W and A diets. Despite similar results observed before for the FLA and CO diets, here the latter produced an important reduction of 9 gd^{-1} (8%), i.e. 369 g less per animal for the entire FP of rabbits fed 41 d. Rabbits tended to have a higher FI when fed with forages. The week effect was important ($P < .01$), with FI below 85 g at week 6 and over 145 g in week 13 for all diets, observing a positive trend most of the time. However, FI for the CO diet was consistently lower than the F diets, been the low protein diets, FL and FLA, the ones with highest FI ($P < .01$).

Table 3. Overall productive performance by contrasts.

	Contrast							
Trait	F vs CO		L vs H		W vs A		FLA vs CO	
FP (days)	44	41**	47	42**	45	43*	41	41NS
ADG ($g\ d^{-1}$)	33	37**	31	34**	31	34**	37	37NS
FI ($g\ d^{-1}$)	126	108**	131	121**	126	125 NS	117	108**
FC	3.9	3.1**	4.2	3.5**	4.0	3.7**	3.3	3.1*

FP = Fattening period; ADG = Average daily gain; FI = Feed intake; FC = Feed conversion ratio; F = All forage diets; CO = Control; L = 13% crude protein diets; H = 16% crude protein diets; W = No synthetic amino acids diets; A = Supplemented synthetic amino acids diets; FLA = 16% crude protein added with synthetic amino acids; NS = Non significant; * ($p < .05$); ** ($p < .01$).

Rabbits fed the CO had a better FC than the rabbits fed F diets, and required 800 g (21%) lees feed for each kilogram of weight gain; this difference was reduced to only 200 g (6%) when compared to the FLA, but still the difference was important. The higher FI showed by the FLA could have influenced in this result. Again, L and W diets resulted in the poorest FC. Through weeks FC was important ($P < .01$), with estimates as low as 2.0 at the beginning of

the fattening period and over 6.0 at week 13, observing also a positive trend for all diets. Again, the CO diet consistently observed smaller FC through weeks ($P < .01$), with the low protein diets, FL and FLA, observing the poorest FC.

The results of this experiment indicated that a diet with 92% alfalfa meal – kikuyo grass would produce similar results in FP and ADG to those obtained with a commercial type diet (with alfalfa and soybean meal, and sorghum), but a poorer FC. Feeding rabbits with high content forage diets and 16% level of protein supplemented with amino acids seems to be a realistic alternative in situations in which a shortage of grains and protein sources are present. A economic study is warranted.

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