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EFFECT OF DIETARY PROTEIN AND THREONINE LEVEL ON PERFORMANCES OF GROWING RABBITS

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ABSTRACT

Five groups of 90 rabbits weaned at 28 days of age, with an average weight of 723g, were used to measure the effect of dietary protein and threonine level on the zootechnical performances of growing rabbits. The batch A received a diet containing 16.2% of crude protein (CP) and 0.58% threonine during the entire 41-d fattening period. The 4 other batches were fed a 14.5% CP diet containing 0.50%, 0.50%, 0.58%, 0.58% of threonine during the starter period (0 - 19 d) respectively for batch B, C, D and E; and a level of 0.50%, 0.58%, 0.50% and 0.58% during the finishing period (19 - 41d), respectively for the same batches. The reduction of the dietary CP level from 16.2% (diet A) to 14.5% (diet B) without additive threonine did not damage the growing performances for the overall period (DWG 39.3g versus 40.1g, respectively for A and B). The feed:gain ratio was significantly higher with diet B compared to diet A, during the overall period of 41 days (2.94 versus 2.88) but also between 0 and 19 d (2.25 versus 2.17).The addition of threonine in the finishing period permited to increase significantly the feed:gain ratio between 19-41 days and 0-41 days (2.857 and 2.870 for diets E and C versus 2.935 and 2.905 for diets B and D).

INTRODUCTION

Feeding programs usually practised do not let protein level vary during the fattening period. However the protein requirements of growing rabbits are age dependant and vary according to growing speed, fattening duration and slaughtering weight (DE BLAS et al., 1996 MAERTENS and LUZI, 1996).). The interest for a drop of the dietary protein level in the finishing period was demonstrated to reduce the nitrogenous excretion without affecting the zootechnical performances (MAERTENS and LUZI, 1996).

Nevertheless, below 14.7% of CP, a drop of the performances could be explained by a deficiency in amino acids. A minimum rate of 0.58% of threonine at the beginning of the fattening period is required (LEBAS, 1989; DE BLAS and WISEMAN, 1998).

The aim of this trial was to compare (1) different dietary CP levels (16.2 and 14.5%) (2) for a given CP level (14.5%) the effect of supplementing with synthetic threonine and (3) to measure the effect of the threonine level during the starter (0 - 19 days) and finishing period (19 - 41 days).

MATERIAL AND METHODS

Rabbits and housing

This trial was realized with 450 young male hybrid rabbits from a female line (Hycole), weaned at 28 days of age. Fattening period lasted in total 41 days. The rabbits were housed in collective cages (6/cage) in a conventional rabbit house.

At their arrival, groups of 30 rabbits with the same weight were selected to constitute the 15 homogeneous blocks (replicates). Thus, each block was constituted of 5 cages of 6 animals and cages were ad random assigned to one of the 5 treatments.

Experimental diets and treatments
The pelleted diets (2.5mm diameter) were fed ad libitum. The characteristics of the 3 diets (2 levels of CP and 2 levels of threonine at low CP level) are presented in Table 1. Formulas were made based on the analysed nutritive values of the raw materials.

Table 1 : Characteristics of the experimental diets.

FEED	1	2	3
DE (kcal/kg)	2600	2600	2600
Crude protein (%)	16.2	14.5	14.5
Crude fiber (%)	14.5	14.3	14.3
Methionin + Cystin (%)	0.62	0.62	0.62
Lysine (%)	0.80	0.80	0.80
Threonine (%)	0.575	0.50	0.58

Diets were fed during 2 periods: a starter (0-19d) and a finishing (19-41d) period. With the 3 diets and the phase feeding, 5 different treatments were compared (Table 2)

Table 2 : Feeding plan according to diet and age

	Treatment A	**Treatment B**	**Treatment C**	**Treatment D**	**Treatment E**
0 – 19 days	Diet 1 16.2% CP 0.575% thr	Diet 2 14.5% CP 0.50% thr	Diet 2 14.5% CP 0.50% thr	Diet 3 14.5% CP 0.58% thr	Diet 3 14.5% CP 0.58% thr
19 – 41 days	Diet 1 16.2% CP 0.575% thr	Diet 2 14.5% CP 0.50% thr	Diet 3 14.5% CP 0.58% thr	Diet 2 14.5% CP 0.50% thr	Diet 3 14.5 % CP 0.58% thr

Recordings and analyses
The dietary crude protein and the crude fiber were analysed in the CCPA laboratory. Feed intake and live weight in each cage were determined at the beginning and after 19 and 41 days in order to calculate the average daily weight gain (DWG), the average daily feed intake (DFI) and the feed:gain ratio. Mortality, reason of the death and the lesions were noticed (in particular, record of the death by diarrhea).

Statistical treatment
The recorded data have been subjected to an analysis of variance, following *a mechanism in complete well balanced block ;* and treated by the ANOVA procedure from SPSS.

RESULTS

Feed analyses
The crude protein is in accordance with the expected values (Table 3). The difference for dietary crude fibre level between calculated and analysed was -0.95 to -1.5 points. However,

the analysed values were homogeneous according to the diets (13% mini and 13.3% maximum).

Table 3 : Feed analyses

FEED	CRUDE PROTEIN			CRUDE FIBRE		
	Expected (%)	Analysed (%)	Difference	Expected (%)	Analysed (%)	Difference
1	16.2	16.2	0	14.49	13	-1.49
2	14.49	14.7	0.21	14.25	13.3	-0.95
3	14.5	15	0.5	14.26	13.3	-0.96

Daily Weight Gain (DWG)

All along the trial, DWG had almost the same level (Table 4). The lowest DWG was 39.3g (treatment A: 16.2% CP and 0.575% of threonine), the highest DWG was 40.8g for the treatment E with 14.2% CP and 0.58% of threonine (significant difference $P<0.10$). Notice that all the batches with 14% CP had a higher DWG than the control batch (16.2% CP), but the difference was not significant.

During the starting period (0 to 19 days), the DWG was also at about the same level. The DWG varies from 43.2g to 44.9g respectively for the treatments D and E (not significantly different).

During the finishing period (19 to 41 days), DWG of treatment A (34.9g/d) containing CP: 16.2% and threonine:0.575%, was 1.4g lower ($P<0.10$) compared to treatment B (36.3g/d) containing CP: 14.5% and threonine: 0.50, and was 2.4g lower ($P<0.10$) compared to the DWG of treatment E (37.3g/d) with 14.5% CP and 0.58% threonine.

Daily Feed Intake (DFI)

The animals that received the diet with 16.2% of dietary protein ate less feed than the animals that had 14.5% of dietary protein during the overall period. The DFI varied from 113.1g/d (treatment A) to 117.6g/d (treatment B) (significant difference: $P<0.05$). The DFI of treatment A (113.1g/d) was also lower ($P<0.10$) than the one of t treatment E (116.5g/d).

The DFI of the starter period can be compared between the 3 diets. They vary from 96.5g (for the treatments A and D) to 99.9g (treatment B).

During the finishing period, the DFI of treatment A fed 16.2% CP (127.4g) was significally lower than diet B fed 14.5% CP without threonine (132.9g).

Feed gain ratio

Table 4 shows that for the overall growing period, the best feed:gain ratio was obtained with treatment E and the worse with treatment B, 2.857 and 2.935 respectively. The treatment B at 14.5% CP without added threonine is significally penalized of 0.06 points compared to diet A with 16.2% CP ($P<0.10$). This difference is also found during the first period 0-19d with 2.173 and 2.245 for treatment A and B, respectively. Treatment B has also the worsed feed:gain ratio during the finishing period, even thought the best result is obtained with treatment C (14.5% CP with hight level of threonine). During the finishing period, the feed gain ratio varies from 3.558 (treatment C) to 3.678 (treatment B)

Mortality

Mortality levels were very low: 5 animals died during the 19 - 41 days period: 3 in the batch D, 1 in the batch B, 1 in the batch C.

DISCUSSION

Effect of the dietary protein level on zootechnical results

A drop of the dietary protein from 16.2% to 14.5%, with or without synthetic threonine supplementation, did not damage the DWG of the growing rabbits. The slaughtering weight obtained for treatment B (14.5% CP) and treatment E (14.5% CP with threonine) were even higher than the one of the control diet A (16.2% CP): 31 and 59g more, respectively. During the finishing period, DWG of treatments with low level in CP was almost the same: 36.3g and 37.3g, respectively for treatments B and E but they are above the DWG of control diet A: 34.9g (16.2% CP). These results are in line with trials already published (MAERTENS L. and LUZI F.; 1996 and BRIENS C., 1996) or not (EURONUTRITION, 1998 and 1999).

Effect of the threonine level

Comparison B - C versus D – E in the starter period and B and D versus C and E in the finishing period.

The reduction of the dietary protein from 16.2% (diet A) to 14.5% without synthetic threonine (diet B) involves a significant increase of feed:gain ration during the overall period.

During the starter period 0-19 d, the consumption tends to decrease when threonine is added (97.1g/d for D and E with 0.58% of threonine and 98.7g/d on average for B and C with 0.50% of threonine). According to C. BRIENS (1996) during the same period, the daily consumption is not affected by the threonine level. The animals were a little bit lighter on diets with added threonine : 1565g on average without threonine versus 1559g in average with threonine.

During the finishing period (19-41d), a threonine effect was only clear on the feed:gain ratio, on diets with added synthetic threonine during the finishing period. Feed:gain ratio was 3.661 for the diet B and D with 0.50% of threonine versus 3.564 for the diet C and E with 0.58% of threonine. These results fit with BRIENS' (1996) and with earlier Euronutrition experiments that have not been published. The slaughtering weights were slighly improved when threonine was added in the finishing period: +30g on average.

CONCLUSION

On the whole set of trials conducted on the theme: dietary protein and/or threonine level, some conclusions can be drawn :

A dietary protein lower than usually practised can be fed, particulary during the finishing period, without deterioating results. The addition of synthetic threonine to a diet of 14.5% CP during the finishing period seems to be very interesting and seems to favour the feed:gain ratio. The drop of the dietary protein has also the advantage to decrease the nitrogen excretion (MAERTENS L, 1996). Further trials with very low level in dietary protein would show the real interest of threonine in respecting the amino acids balance with lysine, methionine and cystine.

RESUME

Influence du niveau azoté et du taux de threonine sur les performances zootechniques des lapins à l'engraissement. Cinq lots de 90 lapins sevrés à 28 jours, d'un poids moyen de 723g ont servi à mesurer l'influence des niveaux azotés et de threonine dans l'aliment sur les performances zootechniques des lapins à l'engraissement. Le lot A a reçu un aliment à 16.2% de protéines et 0.58%

de thréonine sur toute la période d'engraissement; les quatre autres lots ont eu un régime à 14.5% de protéines, un niveau de 0.50%, 0.50%, 0.58%, 0.58% de thréonine sur la période 0-19jours ; et un niveau de 0.50%, 0.58%, 0.50% et 0.58% sur la période 19-41 jours respectivement pour les mêmes lots. La réduction du niveau de protéines de 16.2% (lot A) à 14.5% (lot B) sans réajustement de thréonine n'a pas détérioré les performances de croissance sur l'ensemble de la période d'engraissement (GMQ 39.3g contre 40.1g respectivement pour A et B). L'indice de consommation était par contre significativement plus élevé avec le lot B par rapport au lot A sur l'ensemble de la période 0-41 jours (2.935 contre 2.876) et sur la phase 0-19jours (2.245 contre 2.173). L'ajout de thréonine en finition permet une amélioration significative des indices de consommation entre 19-41jours et 0-41 jours (2.857 et 2.870 pour les lots E et C contre 2.935 et 2.905 pour les lots B et D).

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Table 4. Effect of dietary protein and threonine level on the performances suring the starter and finishing period.

		0 - 19 dayss						19 - 41 days						0 - 41 days					
		Initial weight	final weight	DWG	DFI	feed:gain ratio	dead	initial weight	final weight	DWG	DFI	feed:gain ratio	dead	initial weight	final weight	DWG	DFI	feed:gain ratio	dead
A (16.2 % CP)	n	15	15	15	15	15	0	15	15	15	15	15	0	15	15	15	15	15	0
	av.	725	1568	44.4	96.5	2.173 [a]		1568	2336	34.9	127.4	3.653		725	2336	39.3	113.1	2.876	
	s.d	83	115	2.3	8.5	0.113		115	149	2.7	11.5	0.220		83	149	2.1	9.8	0.145	
B 14.5 % CP treonine - / -	n	15	15	15	15	15	0	15	15	15	15	15	1	15	15	15	15	15	1
	av.	723	1569	44.5	99.9	2.245 [b]		1569	2367	36.3	132.9	3.678		723	2367	40.1	117.6	2.935	
	s.d	81	98	2.1	5.4	0.094		98	123	3.0	7.4	0.214		81	123	2.0	5.8	0.101	
C 14.5 % CP threonine - / +	n	15	15	15	15	15	0	15	15	15	15	15	1	15	15	15	15	15	1
	av	724	1560	44.0	97.4	2.211		1560	2367	36.7	130.2	3.558		724	2367	40.1	115.0	2.870	
	s.d	84	121	2.4	8.1	0.093		121	153	2.3	9.7	0.274		84	153	2.0	8.5	0.158	
D 14.5% CP threonine + / -	n[1]	14	14	14	14	14	0	14	14	14	14	14	3	14	14	14	14	14	3
	av	720	1541	43.2	96.5	2.233		1541	2339	36.3	130.7	3.607		720	2339	39.5	114.8	2.905	
	s.d	82	127	2.6	5.9	0.064		127	142	2.2	9.5	0.262		82	142	1.6	7.5	0.111	
E 14.5% CP threonine + / +	n	15	15	15	15	15	0	15	15	15	15	15	0	15	15	15	15	15	0
	av	723	1576	44.9	97.7	2.177		1576	2395	37.3	132.8	3.569		723	2395	40.8	116.5	2.857	
	s.d	81	92	1.9	5.4	0.102		92	112	1.9	7.2	0.147		81	112	1.6	6.1	0.104	
average	av	723	1563	44.2	97.6	2.207		1563	2361	36.3	130.8	3.613		723	2361	40.0	115.4	2.888	
	s.d	80	109	2.3	6.7	0.097		109	135	2.5	9.2	0.226		80	135	1.9	7.6	0.126	
Statistical interpretation																			
protein effect		0.937	0.847	0.091	0.018	ns		0.194	0.052	0.012	0.702	ns		0.194	0.107	0.022	0.092	ns	
threonine effect		0.848	0.810	0.188	0.294														
in growing period								0.766	0.577	0.576	0.821			0.808	0.808	0.690	0.438		
in finishing period								0.155	0.278	0.552	0.085			0.147	0.147	0.597	0.021		
interaction growing/finishing								0.133	0.672	0.303	0.652			0.120	0.120	0.067	0.753		
residual variation coefficient (%)		2.5	4.6	4.5	3.5			3.0	6.7	5.7	5.8			3.0	4.2	4.6	3.5		
efficacity (%)		7973	123	236	150			385	102	162	125			382	120	207	160		

[1] : a cage was eliminated because of wasting feed. [a, b] : $P<0.05$