WORLD RABBIT SCIENCE 1995, 3 (2), 63-67.

UTILIZATION OF FIELD BEANS BY GROWING RABBITS 2 - EFFECTS OF VARIOUS PLANT SUPPLEMENTATIONS

BERCHICHE M.*, LEBAS F.**, OUHAYOUN J.**

* Université de Tizi-Ouzou, Institut d'Agronomie, TIZI OUZOU - Algérie
** INRA, Station de Recherches Cunicoles, BP 27, 31326 CASTANET TOLOSAN Cedex - France

ABSTRACT : Eighty New Zealand White rabbits distributed into four dietary groups were fattened between 35 and 77 days in individual cages. The diets were SOJ (soybean control), FEVL (field bean meal + lucerne as the main plant supplementation), FEVSO (field bean meal + wheat bran and barley) and FEVT (field bean meal + sunflower meal). The mean protein content of the diets (14.6 % to 15.1 %) and protein digestibility (69 to 70.9 %) did not differ between diets, but the digestible energy content varied from 2076 (FEVT diet) to 2301 kcal DE / kg. The growth rate was smaller under the field bean based diets than under the SOJ diet (42.7 g / d with SOJ, 39.5, 38.9, 37.4 g / d with FEVL, FEVSO and FEVT, respectively). Dressing percentage (mean : 57 %), perirenal fat weight and liver weight did not differ between dietary treatments. The weight of a hind leg and of the amount of meat on it, as well as its meat to bone ratio were all significantly higher under the FEVSO and FEVT diets. This study shows that field beans are a good source of proteins for growing rabbits but production performance depends on appropriate plant supplementation, which changes the sulfur amino acid and threonine balances of the proteins.

RÉSUMÉ : Valorisation de la feverole par le lapin en croissance. 2 - Effets de diverses complémentations végétales

Quatre-vingt lapins de race Néozélandaise blanche, répartis en 4 lots, ont été engraissés entre 35 et 77 j, en cages individuelles, avec l'un des aliments expérimentaux SOJ (témoin soja), FEVL (féverole + luzerne en complément végétal principal), FEVSO (féverole + son et orge) ou FEVT (féverole + tourteau de tournesol). Les aliments ne différaient pas par la teneur en protéines (de 14,6 à 15,1 %) ni la digestibilité de ces dernières (de 69 à 70,9 %), alors que leur teneur en énergie digestible variait de 2076 (aliment FEVT) à 2301 kcal ED / kg. Les trois aliments à base de féverole, moins consommés que l'aliment SOJ, ont permis une vitesse de croissance plus faible (42,7 g / j pour l'aliment SOJ, 39,5, 38,9 et 37,4 g / j, pour les aliments FEVL, FEVSO et FEVT, respectivement). Le rendement à l'abattage (57 %, en moyenne), le poids du tissu adipeux périrénal et du foie n'ont pas subi d'influence significative des traitements alimentaires. Le poids d'un membre postérieur et de la viande qui y attachée, ainsi que le rapport muscle/os ont été significativement plus élevés avec les aliments FEVSO et FEVT. Cette étude montre que la féverole est une bonne source principale de protéines pour le lapin en croissance mais que les performances productives dépendent de sa complémentation végétale, qui joue sur l'équilibre en acides aminés soufrés et en thréonine des protéines.

INTRODUCTION

In a previous study, BERCHICHE *et al.* (1995) indicated that field beans could be used usefully by feeding growing rabbits provided that supplementation was appropriate. The aim of this study was to compare several plant supplemented diets, with as additional constraints that the protein content should be low and that dehydrated lucerne should be avoided if possible. Although the latter is usually present in diets used in France (LEBAS *et al.*, 1981), this legume forage is not available in all rabbit-producing countries.

MATERIALS AND METHODS

Animals and rearing conditions

Four equivalent groups, each containing 20 New Zealand White rabbits belonging to both sexes that had been weaned one week previously were established on the grounds of live weight and genetic origin. One week after weaning, the 35 day old rabbits were housed in individual wire cages within the same rearing cell at the Station de Recherches Cunicoles at the INRA research centre in Toulouse. They were fed the experimental diets *ad libitum* up to the age of 77 days, when they were slaughtered.

Experimental diets

Three field bean based diets (Ascott variety, protein content = 24.4 %) were compared to a soybean meal based control diet. All four diets were formulated with a crude fibre content that matched the requirements of growing rabbits (LEBAS, 1989).

- SOJ diet : 45 % of the proteins in this diet, which has been used previously (BERCHICHE *et al.*, 1995), were provided by soybean meal. Its

calculated sulfur amino acid (SAA) content after supplementation with *dl* methionine was 0.55 %.

- FEVL diet : Field beans contributed to 50.7 % of the protein content of this diet. It was supplemented mainly by lucerne. It was not supplemented with *dl* methionine and its calculated total SAA content was 0.43 %.

- FEVSO diet : Field beans provided 59.4 % of the proteins. This diet was supplemented mainly with bran and barley. No lucerne was provided.. The *dl* methionine content was made similar to that of the SOJ diet at 0.55 %.

- FEVT diet : Field beans contributed to 43.3 % of the total protein content. This diet was mainly supplemented by sunflower meal. The SAA content (0.47 %) was intermediate between those of the SOJ and FEVL diets.

Recorded variables

Apparent nutrient digestibility.

This parameter was measured *in vivo* under the same conditions as previously (BERCHICHE *et al.*, 1995).

Growth and feed efficiency.

Growth and feeding performance were recorded every week during the six-week fattening period. These values and apparent nutrient digestibility were used for calculating the feed conversion ratio between 35 and 77 days, and energy efficiency (kcal DE per g gained) and protein efficiency (g DP per g gained) during the same period.

Slaughter traits.

All rabbits were slaughtered when 77 days old. Slaughter and carcass traits, recorded as recommended in BLASCO *et al.* (1993), included commercial skin weight, full gastrointestinal tract weight and hot and commercial carcass weights. These were completed with the following measurements recorded on a sample of ten rabbits per experimental group chosen according to the distribution of their live weights : liver weight, perirenal fat weight, weight of a hind leg and of its meat and bone constituents (OUHAYOUN and CHERIET, 1983).

Statistical analysis

The variables describing production performance and slaughter traits of the rabbits were analysed with single-factor analysis of variance, with or without introducing as a covariable the initial live weight (35 d) or the final live weight (77 d) (SAS/ Stat., 1990).

RESULTS

Nutritional characteristics of the diets (Table 1)

All four experimental diets had the same crude and digestible protein contents. The FEVT diet, which

Table 1 : Constituents of the experimental diets

	SOJ	FEVL	FEVSO	FEVT
Constituents (%)				
Soybean meal	15	–	–	–
Field beans	–	30	35	26
Sunflower meal	–	–	–	9
Lucerne	15	18	–	–
Barley	12	–	–	–
Oats	29	27	22	19
Wheat bran	10	13	25	25
Wheat straw	16	9	15	18
Minerals and vitamins	2.93	3	2.86	3
dl methionine	0.07	–	0.14	–
Composition (% as fed):				
Dry matter	88.3	89.5	87.6	87.8
Crude protein	14.6	14.9	14.7	15.1
Crude fibre	14.3	13.1	11.7	14.7
Crude energy (kcal / kg)	3850	3831	3771	3793
Digestible energy (kcal DE / kg)	2256	2301	2217	2076
Digestible proteins (g DP / 100 g)	10.3	10.5	10.2	10.4
DP / DE (g / 1000 kcal)	45.7	45.6	46.0	50.1
Calculated AA (% as fed)				
SAA	0.55	0.43	0.55	0.47
Lysine	0.69	0.72	0.73	0.69
Threonine	0.51	0.50	0.47	0.49

Table 2 : Weight at specific ages (g), daily intake and daily gain (g / d). Mean values adjusted so that initial live weight was 778 g.

	SOJ	FEVL	FEVSO	FEVT	σ_r	F(1)
Weight 35 d	790	765	773	753	127.5	NS
Weight 77 d	2529a	2396ab	2310b	2375b	214	*
MDI 35-77 d	128.8a	115.2b	108.9b	115.8b	12.9	**
MDG 35-77 d	42.7a	39.5ab	37.4b	38.9b	5.2	*
FCR 35-77 d	3.03	2.92	2.92	3.0	0.26	NS

(1) NS : not significant ($P > 0.05$); * : significant ($0.01 < P < 0.05$); ** : significant ($P < 0.01$); σ_r : standard error of residues; different letters on the same line indicate that means differ significantly ($P < 0.05$).

had a particularly low energy content, had the highest DP / DE ratio.

Growth and feed efficiency (Table 2)

Under constant initial live weight, the intake of all three field bean based diets was significantly less than that of the SOJ control diet (108.9 to 115.8 *vs* 128.8 g / d). Growth rate was better under the SOJ diet (42.7 g / d) than under the field bean based diets, which did not differ from each other (mean : 38.6 g / d). Nevertheless, the diet supplemented with lucerne (FEVL) was special among the field bean based diets. The feed conversion ratio and protein efficiency did not differ significantly between diets (30 to 31 g DP per 100 g gained). However, the field bean based diets resulted in a significantly ($P < 0.05$) higher energy efficiency than the SOJ diet (mean : 6.48 *vs* 6.83 kcal DE per g gained). Among the field bean based diets, the diet supplemented with sunflower-meal (FEVT), which had the lowest energy content (2076 kcal DE / kg), was the most efficient : 6.23 kcal DE / g gained versus 6.47 under the diet supplemented with bran and barley (FEVSO) and 6.73 under the diet supplemented with lucerne (FEVL).

Slaughter value (Table 3)

The slaughter and carcass composition variables were analysed under constant final (77 d) live weight. Dressing percentage (weight of the commercial carcass divided by live weight at the time of slaughter) and its components (skin weight and full gastrointestinal tract weight) did not differ between dietary treatments. The only carcass composition variables that differed significantly between dietary treatments were the total weight and meat weight of the hind leg. These were higher in the rabbits fed the FEVSO and FEVT diets than in those fed the SOJ and FEVL diets. Because the bone weight of the hind leg did not differ between treatments, the meat to bone ratio was highest in the rabbits fed the diets supplemented with bran and barley

Table 3 : Slaughter performance and carcass composition. Weights (g) adjusted so that slaughtering weight is 2400 g

	SOJ	FEVL	FEVSO	FEVT	σ_r	F(1)
Skin	333	329	331	335	25	NS
Full gastroint. tract	446	462	463	457	43	NS
Hot carcass	1493	1491	1492	1494	39	NS
Commercial carcass	1369	1383	1386	1380	44	NS
Hind leg						
Total	180.6a	181.3a	192.3b	191.9b	10.7	*
Muscle	149.2ab	147.8a	160.7b	159.8b	10.3	*
Bone	31.4	33.5	31.6	32.1	3.0	NS
Muscle / bone	4.81	4.43	5.12	5.02	0.57	NS
Perirenal fat	24.4	26.3	23.1	21.3	5.5	NS
Liver	104	109	99	97	21	NS

(1) NS : not significant ($P > 0.05$); * : significant ($0.01 < P < 0.05$); σ_r : standard error of residues; different letters on the same line indicate that means differ significantly ($P < 0.05$).

(FEVSO) or sunflower (FEVT) and was lowest in the rabbits fed the diet supplemented with lucerne (FEVL). However, differences between diets for this trait were at the limit of statistical significance ($P < 0.1$).

DISCUSSION

Growth performance obtained with supplemented field bean diets was not as good (–9.6 %) as with the control soybean meal diet. However, the feed conversion ratio was the same under the field bean diets, whose intake was less than that of the control diet (–12 %). Growth performance was similar with all three forms of supplementation. Although the 2 diets had the same crude protein and energy contents, performance differed between the soybean control (SOJ) and the field bean based diet supplemented with bran and barley (FEVSO), which had the same SAA content. The FEVSO diet, which resulted in the weakest performance, had a threonine content (0.47 %) that only covered 86 % of requirements, and its leucine, isoleucine and combined tyrosine + phenylalanine only covered 92 % of requirements (INRA, 1989). The low performance obtained using the diets supplemented with lucerne (FEVL) or with sunflower meal (FEVT), compared to the control diet (SOJ), was attributed to an SAA deficiency.

Previous results (BERCHICHE and LEBAS, 1994 ; BERCHICHE *et al.*, 1995) showed that a field bean based diet supplemented with *dl* methionine could provide the same growth performance as a soybean control diet. This did not occur here, although the FEVSO diet was balanced with respect to SAA. Therefore, an appropriate complementarity between the raw materials used, which determines the overall balance of the ration, was just as important as the SAA supplementation that was required because the field beans were deficient. In the present study, the sunflower supplemented diet (FEVT) resulted in a lower performance than the SOJ control diet, unlike what was observed in BERCHICHE *et al.* (1995). This may be due to a deficiency of the present formulation with respect to some essential amino acids.

In both the previous study and in the present study, the feed conversion ratio between 35 and 77 d did not differ between diets. This was due on the one hand to the low variability of growth rate between different diets, and on the other hand to a very strong interaction between feed intake and growth rate in the age group under consideration. In practice, this means that the cost price of each weight gain was virtually independent of the diet. Matters would be completely different if the duration of the fattening period had been adapted to each diet in order to obtain a fixed slaughtering weight (KOEHL, 1993). As regards slaughter traits, carcass yield varied little between treatments, which is hardly surprising when one considers that growth rate remains fairly constant (OUHAYOUN *et al.*, 1991). Interestingly, the meat to bone ratio, and on closer scrutiny the meat weight of the hind leg, which are both good indicators of the fleshiness of the whole carcass (VAREWYCK and BOUQUET, 1982), were sensitive to the dietary treatment : field bean based diets supplemented with methionine and sunflower (BERCHICHE *et al.*, 1995), sunflower or bran + barley (this study) resulted in better fleshiness than the SOJ control diet without improving the growth rate.

CONCLUSION

It was perfectly possible to completely substitute field beans for soybean meal as the main source of proteins in the diet of growing rabbits. Field beans could contribute to over 50 % of the total protein content in diets with a moderate crude protein content (14.5–15.0 %) and a DP / DE ratio of 43 to 45 g / 1000 kcal DE. The resulting production performance and slaughter traits were very satisfactory. But these were strongly affected by which plant supplementation was used in the formulation.

Received : December 15, 1994.
Accepted : January 26, 1995.

REFERENCES

BERCHICHE M., LEBAS F., 1994. Supplementation en méthionine d'un aliment à base de féverole : effets sur la croissance, le rendement à l'abattage et la composition de la carcasse chez le lapin. *World Rabbit Sci., 2 (4), 135-140.*

BERCHICHE M., LEBAS F., OUHAYOUN J., 1995. Utilisation of field beans by growing rabbits. 1 - Effects of supplementations aimed at improving the sulfur amino acid supply. *World Rabbit Sci., 3 (1), 35-40.*

BLASCO A., OUHAYOUN J., MASOERO G., 1993. Harmonization of criteria and terminology in rabbit meat research. *World Rabbit Sci., 1 (1), 3-10.*

KOEHL P.F., 1993. GTE 1992 : une lapine produit 46 lapins ou 62 kg de viande/an. *Cuniculture, 113, 247-251.*

LEBAS F., 1989. Besoins nutritionnels des lapins, revue bibliographique et perspectives. *Cuni. Sci., 5,* 1-28.

LEBAS F., TINEL B., LOUPIAC B., 1981. Enquête sur les aliments commerciaux pour lapins. 1-

Composition de 101 échantillons. *Cuniculture, 8, 109-113.*

OUHAYOUN J., CHERIET S., 1983. Valorisation comparée d'aliments à niveaux protéiques différents, par des lapins sélectionnés sur la vitesse de croissance et des lapins provenant d'élevages traditionnels. 1 - Etude des performances de croissance et de la composition du gain de poids. *Ann. Zootech., 32 , 257-276.*

OUHAYOUN J., LEBAS F., DELMAS D., 1991. La croissance et la composition corporelle du lapin. 1 - Influence des facteurs alimentaires. *Cunisciences, 3,*

SAS/Stat., 1990. User's guide, version 6, Cary, NC.

VAREWYCK H., BOUQUET Y., 1982. Relations entre la composition tissulaire de la carcasse de lapins de boucherie et celle des principaux morceaux. *Ann. Zootech., 31, 257-268.*