FIELD BEAN (Vicia faba minor) AS PROTEIN SOURCE FOR RABBIT : EFFECTS ON GROWTH AND CARCASS QUALITY

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INTRODUCTION

Possibilities of field bean utilization in rabbit feeding have already been demonstrated, but the protein level of diets was very high (COLIN and LEBAS, 1976 ; LEBAS, 1981 ; SEROUX, 1984). The object of the present experiment is to study the possibilities of field bean utilization in diets with a medium to low protein concentration (14.5 %), in which some aminoacids may be limiting factors, such as sulfur aminoacids (SAA) (BERCHICHE and LEBAS, 1984) and probably threonine (BERCHICHE, 1985). In this study, SAA level were increased by three ways. In one diet, a better SAA level was obtained by addition of pure industrial methionine. But, pure methionine is not always available in the factories, particularly in developping countries, then for two other diets, a higher SAA amount was obtained by increasing the protein level through a larger amount of field bean (37 %) or, more efficiently, by addition of 14 % sunflower meal.

MATERIAL AND METHODS

One hundred, 35 day old rabbits of both sexes weaned a week ago were caged individually. The mothers were of the commercial hybrid type INRA 1067 (NewZealand White x Californian) and the fathers of a New-Zealand White strain selected for growth and reproduction. In addition 5x6 young rabbits of the same type were placed in digestibility cages. All animals were fed ad libitum with one of the 5 experimental diets (table 1). Diet 1 was the reference diet without field bean, soya meal being the main protein source. Diets 2 and 3 had the same formula with 26.5 % field bean, diet 3 was added 0.12 % dl methionine to obtain a SAA proportion of 3.3 % of the proteins. In diets 4 and 5, the level of crude proteins were increased up to 16.2-16.5 % with field bean (diet 4) or with field bean and sunflower meal (diet 5 : same level of SAA % diet as in diet 3).

Food intake and live weight of rabbits were controlled weekly during the 6 experimental weeks. All rabbits were endly slaughtered, and skin, full digestive tract and commercial carcass weighted. In addition some controls were performed on 10 carcasses sampled per experimental group : weight of liver, kidneys, kidney fat, hindleg, muscle (soft tissues) and bone of the hindleg, anatomic part used as estimator of carcass composition (VAREWYCK et BOUQUET, 1982).

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TABLE 1
Composition of experimental diets

DIETS	1	2	3	4	5
Formula (p.100)					
. Soya meal	15	-	-	-	-
. Field bean	-	26.5	26.5	37.0	20.0
. Sunflower meal	-	-	-	-	14.0
. Oats	12	10	10	10	10
. Barley	29	16.5	16.5	8	17
. Wheat bran	10	11	11	11	11
. Alfalfa dehydrated	15	25	25	25	20
. Wheat straw	16	8	8	6	5
. Minerals and vitamins	2.93	3.0	2.88	3.0	3.0
. dl methionine	0.07	-	0.12	-	-
Composition (% as fed)					
. Dry matter	88.3	89.3	89.4	88.0	88.2
. Crude proteins	14.6	14.3	14.4	16.2	16.5
. Crude fiber	14.3	14.7	14.7	14.1	14.8
. S.A.A. (calculated)	0.52	0.36	0.48	0.38	0.49
. Threonine (calculated)	0.62	0.58	0.58	0.64	0.63
. Gross energy kcal/kg	3850	3859	3863	3809	3868

Digestibility of dry matter, energy, nitrogen and crude fiber were estimated from the collection of feces during 2 x 4 days, after a 2 weeks period of habituation to diets.

Statistical analysis were performed with variance analysis (growth performance) or with covariance analysis (covariate live weight for slaugter performances, and covariate carcass weight for carcass cuts). Results are presented as means and residual coefficient of variation (CV %).

RESULTS AND DISCUSSION

Digestibility

Digestibility of dry matter, energy and crude fiber are not different from one diet to the other (table 2). Digestibility of nitrogen is lower (66.2 %) for diet 4 which contain the highest level of field bean (37 %). This low nitrogen digestibility was not observed in our previous experiments with such a high proportion of field bean : 35 or 36 % (BERCHICHE and LEBAS, 1984 ; BERCHICHE, 1985). It is also of some interest to consider the moderate nitrogen digestibility of diet 1, in which soya bean proteins represents one half of the total proteins. This digestibility level is the same with diets 2 and 3. Thus, the low nitrogen digestibility observed for diet 4 is probably not related to a deleterious effect of trypsin inhibitors contained in field bean as suggested by WILSON et al. (1972).

According to the published digestible energy concentration of ingredients (INRA, 1984) and with an energy concentration of 1900 kcal/kg for the alfalfa employed, our proposition for the corresponding digestible energy of field bean is 2800 kcal DE/kg.

TABLE 2
Digestibility of the 5 experimental diets and digestible components

DIETS	1	2	3	4	5	CV %	Statistical significance (F)
Digestibility coefficient							
. Dry matter	58.5	59.7	60.3	58.6	59.3	2.7	< 1 NS
. Energy	58.6	59.3	60.1	59.0	59.8	2.6	< 1 NS
. Nitrogen	70.9b	68.9b	70.0b	66.2a	73.3c	2.6	9.5 P<0.001
. Crude fiber	8.5	10.5	10.8	9.9	9.3	-	- (1)
Digestible components (% diet as fed)							
. Dig. energy (DE) kcal/kg	2256	2288	2324	2245	2312	-	-
. Dig. crude proteins (DP)	10.3	9.8	10.1	10.4	12.1	-	-
. g DP/1000 kcal DE	45.7	42.8	43.5	46.3	52.3	-	-

(1) estimated only on 1 pooled sample per diet
a, b, c : with different letter : $P < 0.05$

Growth and feed efficiency

Daily food intake does not differ from one diet to the other : on average 146.7 g/day. The average daily gain in this experience is high : 41.7 g/day. Some differences are observed according to treatment (table 3).

TABLE 3
Average performances between 5 and 11 weeks of age of the rabbit receiving 5 diets with or without field beans

DIETS	1	2	3	4	5	CV %	Statistical significance (F)
- Initial weight (g)	784	779	765	773	768	18	< 1 NS
- Daily food intake (g/d)	150	141	147	146	151	13	1.7 NS
- Weight daily gain (g/d)	42.3ab	39.2a	42.7ab	40.7ab	43.8b	13	3.28 P<0.05
- Feed/gain (g/g)	3.58	3.61	3.44	3.59	3.45	9	2.11 P<0.10

The lowest daily weight gain (39.2 g/d) was observed with diet 2 (low level of SAA) and the highest (43.8 g/d) with diet 5 (field bean and sunflower meal as protein sources) ; growth performances are also high for the reference diet 1 with soya meal and diet 3 including 26.5 % field bean supplemented with methionine. The best feed efficiencies and growth rates are observed with diet 3 and 5 ; then the increasing of SAA obtained by addition of pure methionine or by increasing the protein level with sunflower meal, are equivalent.

Slaughter and carcass cuts

According to the growth rate differences, live weights at slaughter are different. But after covariance analysis, the live weight being the covariate, no effects of diets are observed for carcass, skin or full digestive tract weights (table 4). The same absence of significant effects is observed for weight of kidneys, kidney fat, muscles and bones of hind leg, after covariance analysis with carcass weight as covariate. The only effect concerns liver which is relatively lighter with diets 5 (90.3 g) and 3 (105.7). This may be related to the higher maturity of the rabbits of these groups (CANTIER et al., 1969) as a consequence of their high growth rate. But care must be taken about the great variability of situations observed for the proportion of liver in the carcass from one experiments to the other (OUHAYOUN et al., 1986). However, these relative liver modifications are without any relation with the field bean proportion in the diets.

TABLE 4
Slaughter results : fitted means (g) for a common live weight 2482 g ; and carcass cuts of 10 sampled rabbits/group : fitted means (g) for a common carcass weight 1403 g.

DIETS	1	2	3	4	5	CV %	Statistical significance (F)	
Slaughter								
Live weight (g)	2517b	2386a	2514b	2441ab	2563b	12	3.18	P<0.05
Skin (g)	347	346	348	344	353	16	<1	NS
Full dig. tract (g)	444	468	460	474	440	12	1.6	NS
Carcass (g)	1424	1407	1406	1392	1442	13	1.4	NS
(slaughter rate %)	(57.4)	(56.7)	(56.6)	(56.1)	(58.1)	-	-	-
Carcass cuts (n=10) (g)								
Carcass weight	1408	1379	1423	1349	1466	-	-	-
Hind leg total	187	187	194	193	193	10	<1	NS
- Muscle	153	151	161	157	160	11	1.3	NS
- Bones	34	36	32	36	34	12	1.6	NS
Kidney fat	25.1	28.9	28.4	27.3	25.7	28	<1	NS
Kidneys	16.7	16.5	15.8	17.4	16.7	12	1.5	NS
Liver	110.1b	117.5b	105.7ab	123.6c	90.3a	20	3.9	P<0.05

CONCLUSION

Field bean may be employed very efficiently for growing rabbit even with low protein diets. This experience is also a confirmation of the possibility to obtain very high growth rates with low protein diets (14.5 %) and a digestible protein to digestible energy ratio near 43-45 g/1000 kcal DE (OUHAYOUN and CHERIET, 1983). In this conditions, field bean may be a suitable protein source for rabbits, and the SAA deficiency is not a great problem for practical production.

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From 5 to 11 weeks of age 5 group of 20 rabbits each caged individually, received ad libitum one of the following diets : 1 (reference diet with soya meal), 2 (26.5 % field bean), 3 (= 2 + dl methionine), 4 (37 % field bean) and 5 (field bean 20 % + sunflower meal 14 %). The average crude protein level was 14.5 for the diets 1 to 3 and 16.3 for the 2 others ; the common crude fiber level was 14.5 %. The dry matter digestibility was the same for all diets (58.9 to 60.3). But digestibiliy of nitrogen was significantly lower for diet 4 (66.2) than for diets 1, 3 and 5 (70.9 - 70.0 -73.2). The digestibility of crude fiber was very low (8.5 to 10.8) but not different between diets. The mesured digestible energy concentration varies from 2256 to 2324 kcal/kg. When compared to the reference diet 1, growth rate of the 4 other groups with field beans was equivalent or slightly lower : in the order 42.3 -39.2 - 42.7 -40.7 - 43.8 g/day. Feed efficiency was not affected significantly by the type of diet. The slaughter rate was not affected by the diet (mean 57.0 %). The skin and full digestive tract weights were also not different according to the experimental group. The same situation was observed for kidney fat, muscle and bones of one hindleg, or for kidneys. But liver weight was small for diets 5 (90.3 g) and 3 (105.7) and high for diet 4 with the highest proportion of field beans (123.6 g). The conclusion is that field bean is able to replace completely soya oil meal as a protein source in complete pelleted feeds for growing rabbits and the proposed digestible energy value is 2800 kcal/kg.

LA FEVEROLE (Vicia faba minor) SOURCE PROTEIQUE POUR LE LAPIN : EFFETS SUR LA CROISSANCE ET LA QUALITE DES CARCASSES

Entre 5 et 11 semaines d'âge, 5 groupes de 20 lapins logés individuellement ont reçu à volonté l'un des aliments suivant : 1 (témoin tourteau de soja), 2 (féverole 26,5 %), 3 (= 2 + dl méthionine), 4 (féverole 37 %), 5 (féverole 20 % + t. tournesol 14 %). La teneur moyenne en protéines était de 14,5 % pour les aliments 1 à 3 et de 16,3 pour 4 et 5. La teneur commune en cellulose brute était de 14,5 %. La digestibilité de la matière sèche était comparable pour les 5 régimes (58,9 à 60,3). Le CUD de l'azote était plus faible pour l'aliment 4 (66,2) que pour les aliments 1, 3 et 5 (70,9 - 70,0 - 73,2). Le CUD de la cellulose brute était faible pour l'ensemble des aliments (8,5 à 10,8). La teneur en énergie digestible variait de 2256 à 2324 kcal ED/kg. Par rapport à l'aliment témoin (1), les 4 autres aliments avaient des vitesses de croissance égales ou légèrement inférieures, soit dans l'ordre 1 à 5 : 42,3 - 39,2 - 42,7 - 40,7 - 43,8 g/jour. L'indice de consommation n'était pas affecté, de même que le rendement à l'abattage (moyenne 57,0 %). Il n'y avait pas de différence entre lots pour les poids relatifs (covariance) de la peau, du tube digestif plein, des reins, du tissu adipeux périrénal et des muscles et os d'une patte arrière. Par contre, pour un poids de carcasse (1403 g), le foie était plus léger dans les lots 5 et 3 (90,3 et 105,7 g) et plus lourd avec le lot 4 (123,6 g) contenant la plus forte proportion de féverole. En conclusion, la féverole est un bon protéagineux pour le lapin, qui permet le remplacement total du tourteau de soja. La valeur énergétique proposée est de 2800 kcal/kg.