

# THE USE OF *LATHYRUS CICERA* IN RABBIT DIETS : EFFECT ON GROWTH, DIGESTIBILITY AND CAECOTROPHY

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**Abstract** - Four isonitrogen diets with the same NDF content, including 0, 10, 20 and 40% of *Lathyrus cicera* as substitute for soybean meal and oats were distributed to growing rabbits and female adult rabbits in two separate experiments. In the first experiment the diets were fed to 36 New Zealand young male rabbits, 5 week old, during 5 consecutive periods of 7 days. Growth performance and digestibility were determined through the whole period and in the first, third and fifth periods, respectively. The incorporation of *Lathyrus cicera* in amounts larger than 20% led to a decrease in intake and weight gain accompanied by an increase in feed conversion ratio. Dry and organic matter digestibility were not affected by the regime but digestibility of crude protein decreased significantly (81.1 on 0% diet vs. 74.5 on 40% diet). Age affected negatively the digestibility of the diet. This decreased of digestibility increased with the level of *Lathyrus cicera* in the regime: the CP digestibility was 85.1% (first period) and 77.1% (fifth period) on diet 0 % and 82.7 (first period) and 65.9% (fifth period) with diet 40%.

In the second experiment, diets with 0, 20 and 40% of *Lathyrus cicera* were fed to adult female rabbits under a maintenance regime. Digestibility and the intensity of caecotrophy were evaluated. The effect of the regime was only noticeable on NDF and hemicelulose (NDF-ADF) digestibility. The influence of the diet was not significant in the measurement of caecotrophy both in absolute and relative terms.

The use of *Lathyrus cicera* as replacement for soybean meal in diets for growing rabbits is possible and carries no problem if the content in the diet is smaller than 10%. For adult and restricted animals in maintenance its inclusion can go up to 40% with no sensible effects on the digestibility and caecotrophy.

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## INTRODUCTION

The policy of the European Union to improve its self-sufficiency in protein-rich feedstuffs, has had the result of an increase in legumes seed production that contributed to 18 % of the EU protein production in 1993 (GATEL, 1994).

Although the largest increase has been on peas and field beans, essentially in the northern European countries, other legume seeds adapted to the particular environmental conditions of the Mediterranean region, such as *Lathyrus cicera* may contribute to the protein and energy requirement of animals.

Some experiments have been carried out, in order to study the potential of legume seeds as nitrogen source in rabbits (COLIN and LEBAS, 1976; LEBAS, 1988; JOHNSTON *et al.*, 1989; BERCHICHE *et al.*, 1995). The results suggest that these feeds are well utilized by rabbits. GIDENNE *et al.* (1990) have also demonstrated that the carbohydrate fraction is well digested by young rabbits.

However, the presence in these feedstuffs of several antinutritional factors (ANFs) with negative effects on growth, feed conversion efficiency and/or in animal health (LIENER, 1990) limits their inclusion in monogastric animals diets. As the sensitivity to ANFs depends on animal species and varies with age within the same species (HUISMAN, 1989) the studies of the ability of different legumes seeds have to be carried out for each species.

The purpose of this study was to determine the effects of replacement of soybean meal by *Lathyrus cicera* in the diet (i), in the performance and digestibility on young rabbits and (ii) in the digestibility and caecotrophy on adults rabbits at maintenance.

## MATERIAL AND METHODS

To study the effect of *Lathyrus cicera* utilization in rabbit feeding, four diets were formulated, in order to provide similar crude protein and neutral detergent fibre content with 0, 10, 20 e 40% of *Lathyrus* by replacement of soybean meal and oats (Table 1). The experimental diets were fed to growing rabbits and to female adults in two experiments:

**Table 1 : Raw material (%) and chemical (%DM) composition of the experimental diets**

Centesimal (p.100)	<i>Lathyrus cicera</i>			
	0 %	10%	20%	40%
Oats	45	40	36	24
Maize	5	5	5	5
Soybean meal	22	18	13	4
<i>Lathyrus cicera</i>	–	10	20	40
Alfafa hay	15	15	15	17
Wheat Straw	5	5	5	5
Molasses	6	5	4	3
Bentonite	0.8	0.8	0.8	0.8
Dibasic calcium phosphate	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5
Trace minerals/vitamins (1)	0.2	0.2	0.2	0.2
<i>Chemical Composition</i> (p. 100 DM)				
Dry matter (%)	89.9	88.8	90.0	89.6
Ash	7.5	7.6	7.0	6.7
Crude Protein (Nx6.25)	18.4	19.6	19.5	19.8
Crude fibre	15.4	15.2	15.2	15.6
Neutral detergent fibre	31.6	30.6	29.9	29.2
Acid detergent fibre	18.9	19.5	18.1	19.3
Acid detergent lignin	2.9	3.0	3.3	3.4

*Lathyrus cicera* chemical composition

DM 89.4%; Ash 3.1%; CP 25.8%; CF 7.9%; NDF 27.2%; ADF 10.9%; Ether Extract 1.8%;

Gross Energy 4371 kcal/kg DM

Total Phenolic<sup>(2)</sup> 5.8 mg/g DM; Condensed tannins (BuOH/HCl) 5.8mg /g DM  
(vanillin) 3.6mg /g DM

(1) Mineral and Vitamin Supplement for the composition FALCÃO-E-CUNHA and FREIRE (1993)

(2) Total phenolics (as catechin equivalent) as condensed tannins (as catechin equivalent for vanillin test and mg/g according the E 1%=150 given by Bate-Smith for BuOH/HCl)

**Experiment 1** - 36 young New Zealand White male rabbits, about 5 weeks of age, homogeneous with respect to live weight were housed in individual cages. The rabbits were caged by blocks of 4 animals according the litter origin. After three days of adaptation to the experimental conditions, feed intake (daily) and live weight (weekly) were measured during 5 consecutive periods of 7 days, during which each group of animals received *ad libitum* one of the four experimental regimes. During the first, third and fifth period the faeces were collected daily in order to measure the apparent digestibility.

**Experiment 2** - Simultaneously, the experimental diets with 0, 20 and 40% of *Lathyrus cicera* were given to 24 female adult rabbits distributed into 3 equivalent groups with respect to live weight and kept in individual cages. After a 15 day adaptation period to the diet and to the restriction of 150 g of feed intake, the faeces were collected daily for seven days to measure the apparent digestibility. Twenty one days after this period, a collar was put during 20 hours on the rabbits and the hard faeces and the caecotrophes produced during 24 hours were collected. This was done 5 times with 6 days interval. During this last phase, only 100 g of feed were given during a daily period of 4 hours. The light-dark schedule was the 12 hours.

In both experiments, feed, faeces and caecotrophes dry matter (DM) was determined by heating at 103° C for 24 h and organic matter (OM) was determined by ashing at 550°C overnight. Nitrogen was measured by the Kjeldhal procedure and converted to crude protein (CP) using the factor 6.25. Crude fibre (CF) was determined by the Weende method and neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were determined according to the Van Soest procedure.

The software SAS (1989) procedure GLM were used for the statistical analysis. Growth performances of young rabbits and the digestibility and caecotrophy results of adult rabbit were compared by analysis of variance according a complete block design. The digestibility values of growing rabbits were analysed in a split-plot design using the residual error associated to the blocks for testing the diet effects. The means were compared by the Duncan's multiple range test when F value of the analysis of variance was significant (P<0.05).

## RESULTS

*Experiment 1* - The effects of including *Lathyrus cicera* in the regimes of young rabbits on their performance is included in Table 2. Negative effects on daily ingestion (25%), daily weight gain (30%) and consumption index (15%) can be detected ( $P < 0.01$ ) when the level of inclusion of *Lathyrus cicera* was greater than 20%.

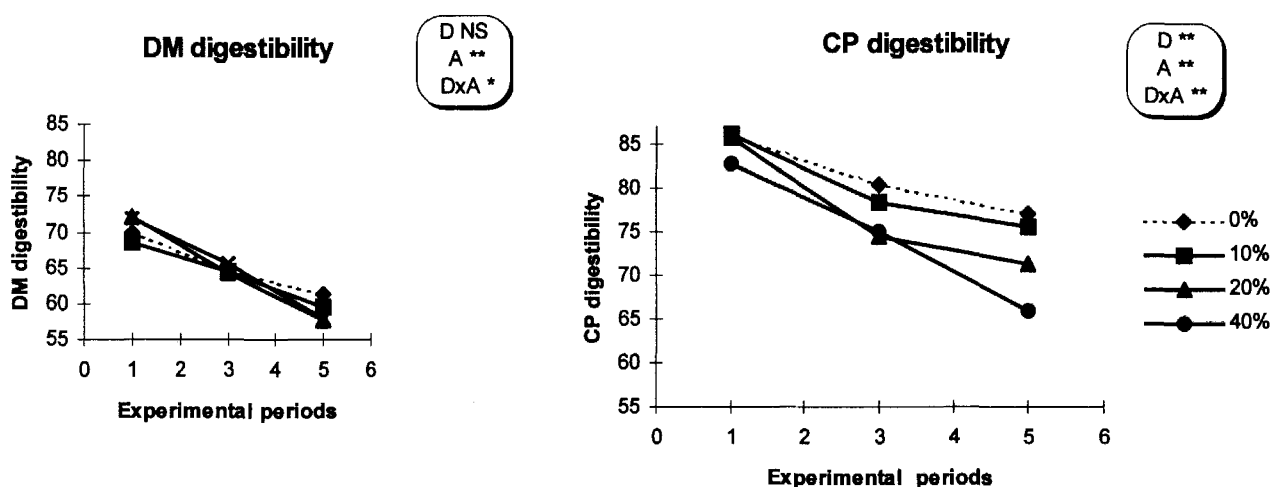
**Table 2 : Effect of *Lathyrus cicera* on average performances of rabbits**

	<i>Lathyrus cicera</i>				Statistical significance (1)		
	0 %	10 %	20 %	40 %	L	D	RSD
Initial weight (g)	821	906	921	900	NS	NS	161
Daily food intake (g/d)	135 <sup>a</sup>	128 <sup>a</sup>	105 <sup>b</sup>	101 <sup>b</sup>	NS	**	19.0
Weight daily gain (g/d)	46.3 <sup>a</sup>	40.9 <sup>a</sup>	31.7 <sup>b</sup>	27.2 <sup>b</sup>	NS	**	6.8
Feed/gain (g/g)	2.92 <sup>a</sup>	3.14 <sup>ab</sup>	3.38 <sup>b</sup>	3.85 <sup>c</sup>	NS	**	0.33

(1) Effets: L litter; D diet; \*\*:  $P < 0.01$ ; NS :not significant; RSD residual standard deviation; different letters on the same line indicate that means differ significantly ( $P < 0.05$ )

Observed apparent digestibility in young rabbits is presented in Table 3. Feed regime did not affected dry or organic matter digestibility, but nitrogen apparent digestibility decreased 3.9 and 6.6 points with the inclusion of 20 and 40% of *Lathyrus cicera* ( $P < 0.01$ ). Apparent digestibility decreased with animal age. DM, OM and N digestibility decreased linearly between the ages of 6 and 10 weeks ( $P < 0.01$ ). There was a significant interaction between diet and age: the decrease of digestibility with the age increased with the 40% of *Lathyrus cicera* inclusion in the diet. This interaction was more important on N digestibility ( $P < 0.01$ ) (Figure 1).

**Figure 1 : Effect of diet and age on DM and CP digestibility on growing rabbits**  
D: diet, A: age, DxA: interaction diet x age, \*\*:  $P < 0.01$



The litter had no effect on the rabbits performances and diet digestibility except on N digestibility.

**Table 3 : Effect of *Lathyrus cicera* on the digestibilities of dry matter, ash, organic matter and protein in growing rabbits (%)**

	<i>Lathyrus cicera</i>				age weeks			Statistical significance (1)				
	0 %	10 %	20 %	40 %	6	8	10	L	D	A	DxA	RSD
Digestibility coefficient												
Dry matter	65.3	64.1	64.7	65.2	70.6 <sup>a</sup>	64.7 <sup>b</sup>	59.1 <sup>c</sup>	NS	NS	**	*	3.1
Ash	58.7 <sup>a</sup>	54.3 <sup>b</sup>	54.5 <sup>b</sup>	54.1 <sup>b</sup>	62.9 <sup>a</sup>	55.5 <sup>b</sup>	47.9 <sup>c</sup>	NS	*	**	**	4.2
Organic matter	65.8	64.9	65.4	66.0	71.2 <sup>a</sup>	65.4 <sup>b</sup>	60.0 <sup>c</sup>	NS	NS	**	*	3.1
Crude protein	81.1 <sup>a</sup>	80.0 <sup>a</sup>	77.2 <sup>b</sup>	74.5 <sup>c</sup>	85.1 <sup>a</sup>	77.0 <sup>b</sup>	72.4 <sup>c</sup>	**	**	**	**	3.6

(1) Effets: L litter; D diet; A age; NS: not significant; \* : significant ( $0.01 < P < 0.05$ ) ; \*\* : significant ( $P < 0.01$ ); residual standard deviation.

*Experiment 2* - Apparent digestibility in female adult rabbits was not affected by *Lathyrus cicera* inclusion, except for the NDF and NDF-ADF fractions (Table 4). The inclusion of *Lathyrus cicera* as 40% of the regime reduced 8 and 13 points the NDF and NDF-ADF digestibility coefficients.

**Table 4 : Effect of *Lathyrus cicera* on the apparent digestibility of diet on adult rabbits (%)**

	<i>Lathyrus cicera</i>			Statistical significance <sup>(1)</sup>	
	0 %	20 %	40 %	D	RSD
<i>Digestibility coefficient</i>					
Dry matter	66.5	67.0	66.6	NS	3.0
Ash	52.0	50.7	50.5	NS	6.0
Organic matter	67.7	68.2	67.5	NS	1.7
Crude protein	79.9	77.2	76.6	NS	4.1
Crude fibre	19.6	20.4	16.9	NS	6.7
Neutral detergent fibre	19.4	17.5	11.3	+	7.1
Acid detergent fibre	16.5	14.4	11.6	NS	6.9
Hemicellulose (NDF-ADF)	23.7 <sup>a</sup>	22.2 <sup>a</sup>	10.7 <sup>b</sup>	*	8.3
Cellulose (ADF-ADL)	18.6	15.0	15.0	NS	5.6

(1) Effets: D diet ; NS : Not significant; + : 0.10 > P > 0.05; \*: P<0.05; RSD residual standard deviation; different letters on the same line indicate that means differ significantly (P<0.05)

The soft faeces production by adult female rabbits was expressed both in absolute and relative quantities in Tables 5 and 6, respectively. As one can see, none of the parameters used to study caecotrophy intensity was significantly affected by regime composition.

**Table 5 : Effect of *Lathyrus cicera* on dry matter (DM), organic matter (OM) and crude protein (CP) daily intake and daily excretion by hard and soft faeces on adult rabbits (g)**

diet	<i>Lathyrus cicera</i>			Statistical significance <sup>(1)</sup>	
	0 %	20 %	40 %	D	RSD
<i>Intake</i>					
DM	86.8	83.8	88.0	NS	9.4
OM	80.2	78.0	82.2	NS	8.6
CP	16.0	16.4	17.4	NS	1.8
<i>Faeces</i>					
DM	42.2	40.8	40.8	NS	7.4
OM	38.0	36.6	36.8	NS	6.6
C P	4.2	4.7	5.1	NS	0.8
<i>Caecotrophes</i>					
DM	10.4	10.8	12.6	NS	4.0
OM	9.2	9.4	11.2	NS	3.4
CP	3.1	3.3	4.0	NS	1.2

(1) Effect: D: diet; NS: not significant (P>0.05); RSD residual standard deviation

**Table 6 : Effect of *Lathyrus cicera* on the ratios: caecotrophes: intake (C/I), caecotrophes : faeces (C/F) and caecotrophes : total excretion on adult rabbits (%)**

diet	<i>Lathyrus cicera</i>			Statistical significance <sup>(1)</sup>	
	0 %	20 %	40 %	D	RSD
<i>Dry matter</i>					
C/I	12.3	13.7	14.1	NS	5.2
C/F	26.3	28.7	30.7	NS	10.2
C/T	20.4	21.6	22.9	NS	6.0
<i>Organic matter</i>					
C/I	11.8	13.0	13.3	NS	5.0
C/F	25.8	28.2	30.1	NS	10.0
C/T	20.1	21.3	22.6	NS	5.9
<i>Crude Protein</i>					
C/I	20.0	21.3	22.7	NS	8.0
C/F	78.4	74.4	77.5	NS	25.7
C/T	42.7	40.8	42.7	NS	8.3

(1) Effect: D: diet; NS: not significant (P>0.05); RSD residual standard deviation

## DISCUSSION

Our results point out clearly to a decrease in young rabbit performance with incorporation rates of *Lathyrus cicera* larger than 20% of the feed regime.

The presence of antinutritional factors, that are normally present in legume seeds (LIENER, 1990) may contribute to the observed decrease in performance. The condensed tannin content in the *Lathyrus cicera* (580 mg/100g MS) may probably contribute to this effect. MARQUARDT and BELL (1986) reported a depressive effect of the phenolic compounds present favabeans in chicks appetite and growth rates. SEROUX (1984) found no effect of field beans tannin on the rabbit growth. Differences in nature or/and level of the phenolic compounds existent in legume seeds may explain these contradictory results. Thus, the decrease in protein digestibility with the increase in *Lathyrus cicera* in the regime, may be attribute not only to the lower digestibility of the legume protein but also to the presence of ANF, namely, tannins. The decrease in protein digestibility in young rabbits was more pronounced with increasing age and with increase rate of *Lathyrus cicera* in the regime (Figure 1). This indicates that the digestive system of the young animals had difficulty in adapting to regimes with an high proportion of these legume and lead us to think that there is a negative effect due to the presence of anti-nutritional factors with depressive effects in the digestion of the nitrogen fraction.

The negative age effect on digestibility, even for the control diet, was also observed for others authors as MAERTENS and DE GROOTE (1982), GIDENNE *et al.*, (1990). These results had not a logical explanation as the caecum and colon growing occur up to eleven weeks (LEBAS and LAPLACE, 1972). Only the N digestibility apparent decreased must be justified for the increase of endogenous N.

Nevertheless, these effects were not observed in adult female rabbits: both the protein digestibility and caecotrophy were not significantly affected by the introduction of the legume. The hypothesis that an unaltered protein digestibility was a result of the possibility of adaptation of the caecotrophy intensity was not supported by our results. Although there was a non significant increase in the quantity of nitrogen excreted in soft faeces, this was not so, when reported in relation to the total amount of excreted faeces. One can hypothesize that the restriction in the total amount ingested did not allow the manifestation of the deleterious effects of *Lathyrus cicera* on the regime digestibility.

The decrease in NDF digestibility as a consequence of a smaller hemicellulose digestibility, observed in female adult rabbits subjected to a regime incorporating 40% of *Lathyrus cicera* contradicts what is generally accepted. As a matter of fact, the cell wall components in legume seeds are considered to be relatively digestible to rabbits (LEBAS, 1988; GIDENNE *et al.*, 1990). In the regime with 40% *Lathyrus cicera*, about 35% of NDF was supplied by this legume seed, suggesting a particularly low digestibility of this fraction.

The fact that the digestibility of the cellulose was not affected indicates that the conditions of microbial activity in the caecum were not greatly affected by the presence of antinutritional factors.

The effects observed in young rabbits with the regimes higher in *Lathyrus cicera*, may be attributed to an imbalance in aminoacids. Sulphur aminoacids content in legumes is particularly low (INRA,1984), relative to soybean meal and it is possible that regimes with a higher *Lathyrus cicera* content may have a methionine+cystine content below the dietary allowances.

## CONCLUSION

It is possible to include up to 10% of *Lathyrus cicera* in the diet of young rabbits as substitute for soybean meal, with no problems. Higher levels may affect growth performance and nitrogen digestibility. In adult animals, in a maintenance regime, the inclusion of up to 40% of *Lathyrus cicera* in the diet had no remarkable deleterious effects. Detailed studies of the aminoacid composition of the protein fraction and the research of antinutritional factors might contribute to a better understanding of the obtained results.

## REFERENCES

- BERCHICHE M., LEBAS F., OUHAYOUN J., 1995. Utilization of field beans by growing rabbits. 1. Effect of supplementation aimed at improving the sulfur amino acids supply. *World Rabbit Sci.*, 3(1), 35-40.
- COLIN M., LEBAS F., 1976. Emploi du tourteau de colza, de la féverole et du pois dans les aliments pour lapins en croissance. *1<sup>er</sup> Congrès International Cunicole*, Dijon mars 1976, France, *Comm. n°24*, 1-4.
- FALCÃO-E-CUNHA L., FREIRE J.P.B., 1993. Effet de la substitution totale ou partielle du tourteau de soja par *Vicia benghalensis* sur la digestibilité, la caecotrophie et le bilan azoté chez le lapin adulte. *World Rabbit Sci.*, 1(1), 31-36.
- GATEL F., 1994. Protein quality of legume seeds for non-ruminant animals: a literature review. *Anim. Feed Sci. Technol.* 45, 317-348.

- GIDENNE T., PEREZ J.M., VIUDES P., BLAS E., 1990. Utilisation digestive de la ration chez le lapin au cours de la croissance: effet de la nature de l'amidon. *41<sup>e</sup> Réunion annuelle de la Fédération Européenne de Zootechnie, Toulouse juil. 1990, France.*
- HUISMAN J., 1989. Antinutritional factors (ANFs) in the nutrition of monogastric farm animals. *Nutrition and digestive physiology in monogastric animals*, 17-35, Pudoc, Wageningen, Netherlands.
- INRA, 1984. L'alimentation des animaux monogastriques: Porc, Lapin, Volailles, *INRA, Paris ed.*, 282 pp.
- JOHNSTON N.P., UZCATEGUI M.E., 1988. The effect of soybean meal, soybeans, bitter lupine, fava bean and peas on the growth and lactation of rabbits. *J. Appl. Rabbit Res.*, **10**, 42-44.
- LEBAS F., 1988. First attempt to study chick-peas utilization in growing rabbits feeding. *4th World Rabbit Congr., Budapest oct. 1988*, vol 3, 244-248.
- LEBAS F., LAPLACE J.P., 1972. Mensurations viscérales chez le lapin. I. Croissance du foie, des reins et des divers segments intestinaux entre 3 et 11 semaines d'âge. *Ann. Zootech.*, **21(1)**, 37-47.
- LIENER, I. E., 1990. Naturally occurring toxic factors in animal feedstuffs. In: *Wiseman, J., Cole, D.J.A., (ed) Feedstuff evaluation. University Press, Cambridge, UK.*, 377-394.
- MARQUARDT R.R., BELL J.M., 1986. Future Potential for use of pulses in animal feeds. *International Conference on Pea Lentils Chickpeas and Faba beans to be Spokane, Washington, July 1986*
- MAERTENS L., DE GROOTE G., 1982. Étude de la variabilité des coefficients de digestibilité des lapins suite aux différences d'âge, de sexe, de race et d'origine. *Rev. Agric.*, **35**, 2747-2757.
- SAS, 1989. *SAS/STAT User's Guide*, 4th edition, vol II., SAS Inst. Inc., Cary NC, USA.
- SEROUX M., 1984. Utilisation des protéagineux par le lapin à l'engraissement : pois, lupin feverole. *4th World Rabbit Congr., Roma*, vol 1, 391-398.