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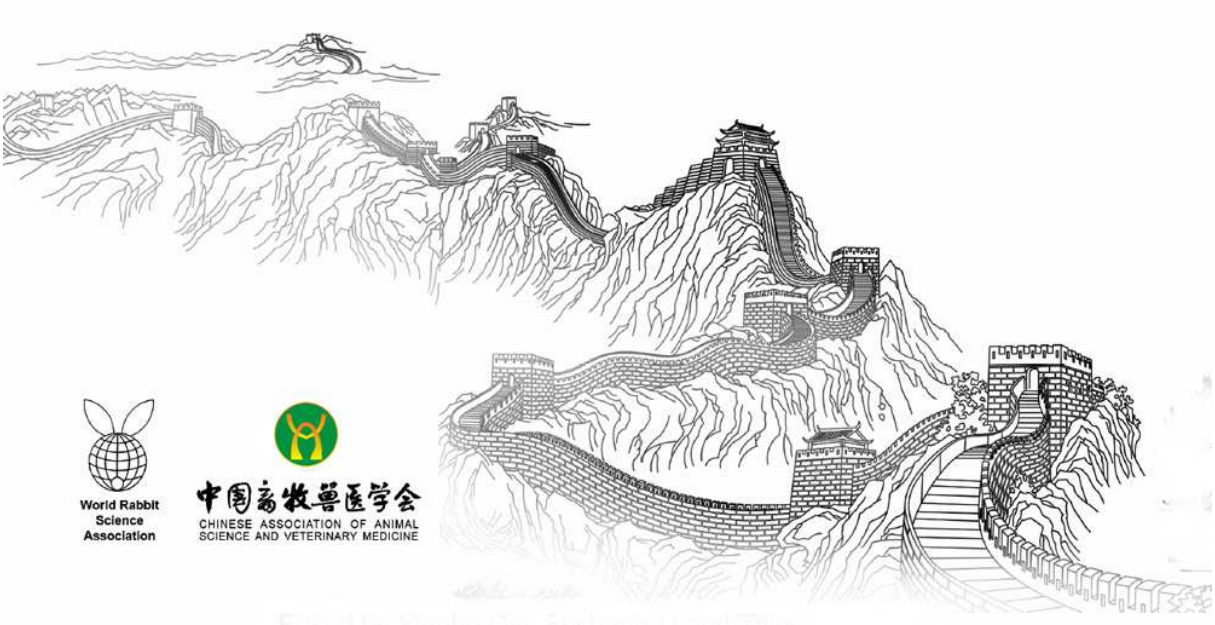

THE EFFECT OF A DIET BASED ON WHOLE LUPIN SEED (*LUPINUS ALBUS CV AMIGA*) ON SANITARY RISK INDEX AND THE GROWTH OF GROWING-FATTENING RABBITS

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ABSTRACT

The aim of this study was to evaluate the effect of a diet based on whole white lupin seed (WLS) on the sanitary risk index and the growth of growing-fattening rabbits. Two experimental diets were formulated; the first contained soybean meal (SBM: 60 g/kg) as the main crude protein (CP) source and the second contained WLS (105 g/kg) as the main CP source. A total of 260 Hyplus rabbits (weaned at 36 d old) were randomly divided into 2 experimental groups (SBM and WLS; 130 rabbits per group) and fed one of the two experimental diets (SBM or WLS diet) for 42 d. There were no significant differences among treatments with regard to weight gain (on average 46.5 g/d), feed intake (on average 150.5 g/d) or the feed conversion ratio (on average 3.24). No significant differences between the two groups in mortality or morbidity of the rabbits were observed due to a high hygiene standard of rabbit building. However, we observed a lower number of rabbits at sanitary risk in rabbits fed with the diet based on WLS compared to the rabbits fed the SBM diet (5 *vs.* 13 rabbits. P=0.085). The results of this study confirmed that regarding growth performance, WLS is fully comparable with SBM. From the digestive health of rabbit perspective, it is highly probable that feeding with the WLS diet is safer than with the SBM diet.

Key words: Rabbit, Diet, White lupin, Sanitary risk index, Growth.

INTRODUCTION

Leguminous seeds may be important for a greater self-sufficiency regarding the supply of protein to balance the diets of animals (Carrouée *et al*., 2003) and for increasing the sustainability of European crop-livestock systems (Jensen and Hauggaard-Nielsen, 2003). In this respect, lupin seed, one of the grain legumes, may be a useful European-grown source of protein (Chiofalo *et al*., 2012). With regard to rabbit nutrition, there is much evidence suggesting that whole white lupin seeds (WLS) can fully replace soybean meal in the diets of fattening rabbits (Volek and Marounek, 2009; Uhlířová *et al*., 2015). Volek *et al*. (2014) reported that WLS (*Lupinus albus* cultivar Amiga) was also a suitable dietary crude protein source (CP) for lactating rabbits. These authors observed that due to the lupin seed fatty acid (FA) composition, WLS in the lactation diet had the potential to improve milk FA composition without the need for the addition of dietary fat. Volek and Marounek (2011) showed that feeding rabbits a WLS diet affected the fatty acid profile of hind leg meat and perirenal fat in a favourable manner.

White lupin hulls can serve as a suitable by-product for rabbit feed and produce no significant reduction in the nutrient value of the diet (Volek *et al*., 2013). Importantly, the rabbits fed *ad libitum* with the diet based on the VLS showed better digestive health compared to those fed with a diet based on soybean meal (Volek and Marounek, 2009; Volek *et al*., 2014; Uhlířová *et al*., 2015). However, the sanitary risk index was assessed on a low number of rabbits per group. Thus, the aim of this study was to evaluate the effect of a diet based on WLS on the sanitary risk index and the growth of growing-fattening rabbits.

MATERIALS AND METHODS

Animals and experimental design

The experiment was conducted in the experimental rabbit unit of the Institute of Animal Science. Animals were maintained under controlled environmental conditions: room temperature between 16 and 20°C, relative humidity of approximately 65% and 12 h of light per day.

The ingredients and chemical composition of the experimental diets are shown in Table 1. The soybean meal diet (SBM) contained 60 g/kg of SBM as the main crude protein source (CP), whereas the WLS diet contained 105 g/kg of white lupin seeds as the main CP sources. No synthetic amino acids were added to the diets. The diets contained no added dietary fat. The experimental diets had similar CP, starch, neutral detergent fibre (NDF), acid detergent fibre (ADF), digestible energy and digestible protein contents and met the recommendations of De Blas and Mateos (2010) for the nutrient requirements of fattening rabbits. No antibiotics were included in the feed or drinking water. The only dietary inclusion was a coccidiostat (66 mg of robenidine hydrochloride/kg of feed). The diets were offered as 3-mm pellets that were 5 to 10 mm long.

Table 1: Ingredients and chemical composition (g/kg as-fed basis) of the experimental diets based on soybean meal (SBM) or whole white lupin seeds (WLS)

	SBM	WLS
Ingredients		
Alfalfa meal	300	300
Soybean meal, CP (440 g/kg)	60	0
White lupin seeds, CP (298 g/kg)	0	105
Wheat bran	330	310
Sugar beet pulp	70	60
Oats grain	150	125
Barley grain	60	70
Mineral and vitamin premix[1]	10	10
Dicalcium phosphate	5	5
Limestone	10	10
Salt	5	5
Determined values		
Dry matter	896	895
Crude protein	153	147
Neutral detergent fibre	385	390
Acid detergent fibre	185	195
Lignins	45	54
Ether extract	29	35
Starch	173	164
Calculated values[2]		
Digestible crude protein	120	118
Digestible energy (MJ/kg)	10.9	10.9

[1]Included per kg of feed: vitamin A, 12,000 IU; vitamin D3, 2,000 IU; vitamin E, 50 mg; vitamin K3, 2 mg; vitamin B1, 3 mg; vitamin B2, 7 mg; vitamin B6, 4 mg; niacinamide, 50 mg; Ca-pantothenate, 20 mg; folic acid, 1.7 mg; biotin, 0.2 mg; vitamin B12, 0.02 mg; choline chloride, 600 mg; Co, 1 mg; Cu, 20 mg; Fe, 50 mg; I, 1.2 mg; Mn, 47 mg; Zn, 50 mg; Se, 0.15 mg; Robenidine, 66 mg; [2]According to Maertens *et al*. (2002).

A total of 260 Hyplus rabbits, 36 d old at the beginning of the trial, were randomly allocated to 2 experimental groups (SBM and WLS; 130 rabbits per group) and fed one of the two experimental diets (SBM or WLS diet) for 42 d. The diets and water were offered *ad libitum* to all rabbits during the entire experimental period. The rabbits were housed in wire net cages (80 x 60 x 45 cm), 5 per cage. Rabbit live weight (weekly) and feed intake (daily) were recorded per cage, and the average feed

intake, average daily weight gain, and feed conversion ratios were calculated afterwards. The sanitary risk index of the rabbits was assessed according to the methodology of the European Group on Rabbit Nutrition (Fernández-Carmona *et al*., 2005); that is, as the sum of morbid and dead rabbits, given that each animal was considered only once (i.e., classed as either dead or morbid). Morbidity corresponds to sick rabbits (but still alive within a period), showing digestive troubles or severe loss of weight during a week. An animal was considered morbid only once (within period), even if diarrhoea lasted several days.

Chemical analyses

Chemical analyses of diets for ether extract, starch, dry matter, CP and ADF were performed according to the official methods of analysis 920.39, 920.40, 934.01, 954.01, and 973.18 of AOAC (AOAC, 2005). Neutral detergent fibre was assayed with heat-stable amylase (Mertens, 2002), and lignin levels were determined by solubilisation of cellulose with sulphuric acid (Robertson and Van Soest, 1981).

Statistical Analysis

Data regarding growth performance were examined using one-way analysis of variance using the GLM procedure of SAS Inst. Inc. (Cary, NC), with the type of diet as the main effect. The cage represented the experimental unit. These results were presented as the mean followed by the standard error of mean. Health status was evaluated using Fisher's Exact Test. The individual rabbit was used as the experimental unit. All differences were considered significant at $P < 0.05$, and P-values between 0.05 and 0.10 were considered to be a trend.

RESULTS AND DISCUSSION

There were no significant differences among treatments with regard to weight gain (on average 46.5 g/d), feed intake (on average 150.5 g/d), or feed conversion ratio (on average 3.24, Table 2), which confirmed our previous studies related to the comparison of the soybean meal with whole white lupin seeds as the main dietary crude protein source (e.g., Volek *et al*., 2014).

Table 2: Growth performance and sanitary risk index (d 36 to 78 of age) of rabbits fed with diets containing soybean meal (SBM diet) or white lupin seeds (WLS diet) as the main CP sources

	SBM	WLS	SEM[1]	*P*-value
Live weight (g)				
At 36 d (weaning)	913	919	18	0.798
At 78 d	2850	2886	45	0.581
Daily weight gain (g/d)	46.1	46.8	0.8	0.555
Daily feed intake (g/d)	147.9	153.0	2.8	0.208
Feed conversion ratio	3.21	3.27	0.04	0.326
Morbidity (n)	11	4	-	0.108
Mortality (n)	2	1	-	1.000
Sanitary risk index (n)[2]	13	5	-	0.085

[1]SEM=Standard error of means (n=26 cages per group). [2]Sanitary risk index=number of dead + number of morbid; (morbid animals that died was count as dead).

No differences between groups in the mortality or morbidity of the rabbits were significant, although a lower morbidity in the rabbits fed the diet based on WLS was observed (4 *vs.* 11 rabbits in the WLS group and SBM group, respectively; Table 2). In our study, the non-significant effect of dietary treatments on the mortality of rabbits was apparently due to a high hygiene standard in the rabbit experimental unit. However, we observed a lower number of rabbits at sanitary risk in rabbits fed the WLS diet compared to rabbits fed the SBM diet (5 *vs.* 13 rabbits, P=0.085), which is consistent with our previous studies, using a lower number of rabbits per group. Indeed, Volek and Marounek (2009)

observed a higher incidence of diarrhoea in rabbits fed with the SBM diet than in rabbits fed the WLS diet (8 *vs.* 2 rabbits; 30 rabbits per group. P=0.083). Volek *et al*. (2014) reported a lower sanitary risk index caused by digestive disease in rabbits fed the WLS diet than in rabbits fed the SBM diet (3.0 *vs.* 16.7%; 66 rabbits per group. P=0.016). Uhlířová *et al*. (2015) observed both a lower morbidity (1 rabbit *vs*. 9 rabbits; P=0.014) and sanitary risk index (2 rabbits *vs*. 12 rabbits; 40 rabbits per group. P=0.006) in WLS rabbits fed *ad libitum* compared with SBM rabbits fed *ad libitum*.

CONCLUSIONS

The results of this study confirmed that regarding the growth performance, WLS is fully comparable with SBM. From perspective of the digestive health of the rabbit, it is highly probably that feeding with the WLS diet is safer than with the SBM diet. Further studies should be performed to elucidate this aspect.

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