THE EFFECT OF GRADED LEVEL EXTRUDED FULL-FAT SOYBEAN IN DIETS FOR BROILER ON APPARENT ILEAL AMINO ACIDS DIGESTIBILITY

VLIV VZRŮSTAJÍCÍ HLADINY EXTRUDOVANÉ PLNOTUČNÉ SÓJE V KRMNÉ SMĚSI PRO KUŘATA NA ZDÁNLIVOU ILEÁLNÍ STAVITELNOST AMINOKYSELIN

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ABSTRACT

The aim of this study was to determine the influence of different content of extruded full-fat soybean (EFFSB) in the diets for broilers on apparent ileal amino acids digestibility (AIAAD). In the experiment total 260 ROSS 308 female chickens were used. Five dietary treatments were used; Control group (without EFFSB) and groups containing 4%, 8%, 12% and 16% of EFFSB. The experiment lasted from 10th to 38th day of age. The addition of EFFSB to the diets for broilers decreased body weight and worsened feed efficiency ratio. AIAAD was lower when diet contained more than 4% of full-fat soybean. The AIAAD was higher in E16 in comparison with E8 and E12 due to higher weight of pancreas and higher trypsin activity.

Key words: trypsin inhibitors, broiler

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INTRODUCTION

Soybeans and soybeans products are the most important sources of protein and energy in livestock feeds for many animals. Soybeans have a good amino acids profile, with high content of lysine, tryptophan, isoleucine, valine and threonine (Larbier and Leclercq, 1994). In addition soybeans contain form 18 to 22% of oil with good quality mainly with high content of linoleic acids (Waldroup, 1982). Soybeans are used mainly as a source of oil for human consumption but thanks breeding there are more resistant varieties, which can be grow in colder climatic conditions and the area of soybeans grows. In general, full-fat soybeans may be not only good sources of protein but also of energy and it can replace soybean meal in swine and poultry diets with similar anticipated performance. However raw soybeans contain a number of antinutritional factors.

The most problematic are Bowman-Birker or Kunitz trypsin inhibitors (TI) and lectin. Other antinutritional factors are antivitamins, saponins, tanins, non starch oligosaccharides and polysaccharides and phytate (Dourado et al., 2011). These antinutrition factors depress the food intake, growth performers and digestibility of nutrients (Liener, 1994; Perilla et al., 1997, Palacios et al., 2004; Valencia et. al., 2009). The growth depression, observed when TIs are ingested, may be a combined effect of endogenous loss of essential amino acids and decreased intestinal proteolysis (Clarke and Wiseman; 2007). The TI and urease activity (UA) are correlated to body weight and feed conversion ratio (Ruiz et al., 2004). The level of 4 mg/g TI activity is assumed to have a minimum adverse effect in birds although the basis for such recommendation is questionable (Clarke and Wiseman; 2007). One of the ways how to eliminate the antinutritional factors and improve nutritional value of raw soybeans is heating treatment (Qin et al., 1996; Machado et al., 2008). Extrusion as a form of heating treatment inactivates TI and denatures it as native proteins (Perila et al., 1997).

MATERIAL AND METHODS

Birds Management and Diets

In total of 260 female chickens ROSS 308 were housed in two-floor cage technology. Each chicken had wing mark. Housing was provided according to technology guide for ROSS 308. Chickens were fed by commercial diet from 1 to 10 days of age. Ten day of age all chickens were weighed and divided into 5 groups with the same average weight. Broilers were fed by diets with different contents of soybean meal (SBM), EFFSB and soybean oil. Thirteen chickens were kept in each cage and 4 cages were used for each treatment. Chickens in the group 1 were fed by control diet (C – without EFFSB) and groups E4, E8, E12 and E16 were fed by diets with 4, 8, 12 and 16% of EFFSB respectively. Composition of diets is shown in Table 1. The content of TI in the soybean meal and EFFSB was expressed as amount of trypsin inhibited by one gram of the sample (SBM or

EFFSB) and the amount was 6.7 mg and 8.4 mg respectively. The diets were formulated to have similar energy (12 MJ AMEn/kg) and protein (21.5% CP) contents. Feed and water were available ad libitum. All birds were weighed individually from the start to the end of the experiment in regular one week period. Feed consumed per each cage was recorded; the dead chickens were weighed to calculate feed efficiency.

Table 1. Composition of the experimental diets (%)

Ingredient	Control diets	Experimental diets			
		E4	E8	E12	E16
Wheat	39.08	39.08	39.08	39.08	39.08
Corn	25.00	25.00	25.00	25.00	25.00
Soybean meal	27.30	24.02	20.74	17.46	14.18
Extruded full fat soybean	**0.00**	**4.00**	**8.00**	**12.00**	**16.00**
Soybean oil	4.50	3.78	3.06	2.34	1.62
Complex of minerals and vitamins	4.12	4.12	4.12	4.12	4.12

* One kilogram of premix contained : Vit. A: 250 000 m.j. , Vit. D3: 40 000 m.j. ; Vit. E (alfa tokoferol): 700 mg; Vit. K3: 30 mg; Vit. B1: 30 mg; Vit. B2: 60 mg; Vit. B6: 25 mg; Vit. B12: 0,2 mg; Niacinamid: 210 mg; Cholin chloride: 6 200 mg; DL-methionin: 20 g; L-lysine: 14 g; Ca: 200 g; P: 48 g; Na: 15 g; Fe: 880 mg; Cu: 100 mg; Zn: 740 mg; Mn: 1 240 mg; Co: 4,5 mg; I: 5 mg; Se: 1,4 mg

Amino Acids and Fat Digestibility

This experiment was conducted to determine the ileal amino acids digestibility of diets with improving content of EFFSB. At 38 d, birds were killed by decapitation and dissected in order to obtain the digesta content of ileum (section between Meckel's diverticulum and the 4 cm from ileocecal junction). Digesta collected from each bird was stored at –30 °C (one sample – five chickens). Samples were lyophilized, ground and analyzed for amino acids, dry matter and insoluble ash in 4 mol.l-1 HCl, which was used as indicator. The samples of the feed and ileal digesta were treated by oxidative acid hydrolysis HCl (c= 6 mol.l-1). The chromatographic analysis of the hydrolysate samples was performed in the analyser AAA 400 (f. Ingos, Prague) using Na-citrate buffers and ninhydrin detection to find the amounts of certain amino acids. The content of fat in the diets and excreta was determined according to Soxhlet. Apparent ileal amino acids digestibility (fat digestibility) was calculated with the following formula:

$$AIAAD = 100 – (100 \times Id \times AAdc / Idc \times AAd)\ (\%)$$

Apparent ileal amino acid digestibility (AIAAD), content of indicator in the diet (Id), content of amino acid in the digesta (AAdc), content of indicator in the digesta (Idc), content of amino acid in the diet (AAd).

Statistical Analysis

Data obtained from these experiments were analyzed using the single factor analysis of variation. Apparent ileal amino acid and fat digestibility the Kruskal-Wallis analysis was used using the software package Unistat 5.1 (UNISTAT Ltd, ENGLAND).

RESULTS AND DISCUSSION

Coefficients of apparent ileal amino acids digestibility are shown in Table 2. The effect of feeding EFFSB on AIAAD for each amino acid was expressed by polynomial function (Figure 1): y = ax2 + bx + c, where a, b, c are parameters of the polynomial function, x is level of EFFSB and y is coefficient of digestibility.

Table 2. Coefficients of apparent ileal amino acid digestibility

	C	E4	E8	E12	E16
Lysine	0.803^{b}	0.813^{a}	0.748^{b}	0.750^{b}	0.740^{b}
Methionine	0.841^{a}	0.878^{a}	0.858^{a}	0.859^{a}	0.866^{a}
Threonine	$0.696^{a,c}$	0.718^{a}	0.519^{b}	0.532^{b}	$0.598^{b,c}$
Isoleucine	0.734^{a}	0.721^{a}	0.517^{b}	0.554^{b}	0.603^{b}
Leucine	0.758^{a}	0.751^{a}	0.583^{b}	0.614^{b}	0.660^{b}
Fenylalanine	0.760^{a}	0.757^{a}	0.664^{b}	0.663^{b}	$0.699^{a,b}$
Histidine	0.717^{a}	$0.661^{a,c}$	0.483^{b}	0.493^{b}	$0.604^{b,c}$
Arginine	0.826^{a}	$0.794^{a,c}$	0.661^{b}	0.705^{b}	$0.753^{b,c}$
Fat digestibility	0.873^{a}	0.873^{a}	0.855^{ab}	0.799^{b}	0.823^{ab}

Different superscripts (a, b) indicate statistical significant difference between groups (P<0.05)

The AIAAD decreased with increasing level of EFFSB in the diets. Only in methionine there was not significant effect of EFFSB on AIAAD. There were significantly (P<0.05) lower AIAAD in groups E8 and E12 in comparison with C and E4 for Thr, Ile, Leu, Phe, His, Arg and Lys and also weight of these chickens was negatively affected by EFFSB. For all amino acids except methionine the AIAAD was no significantly higher in E16 in comparison with E12 (E8). The fat digestibility slightly decreased with increased level of EFFSB.)

Clarke and Wiseman (2007) noted wide variability between coefficients of digestibility for individual amino acids depending of the samples (e.g. lysine from 0.75 to 0.88 for SBM and from 0.77 to 0.84 for FFSB) but they did not find correlation with TI levels, indicating other factors also affect amino acid digestibility of FFSB and SBM. This hypothesis indicates also Batal and Parsons (2003). In their study AA digestibility values of the Williams 82 soybeans, Kunitz-free soybeans, and lectin-free soybeans diets were much lower than those for the SBM diet. Positive effect of extrusion on amino acid digestibility observed Ruitz et al. (2004). As temperature increased during wet-extrusion, the digestible amino acid coefficients increased, indicating the gradual destruction of TI and other antinutritional factors that may affect amino acid absorption. Amino acid digestibility coefficients for lecitin free soybean tended to be consistently higher than for conventional soybean but the differences were not significant (Michele et al., 1999).

CONCLUSION

The present study has shown that the addition of EFFSB to the diet for broilers to 12% had not significant negative effect on the growth but the feed conversion ratio was slightly impaired, when more than 4% of EFFSB was used.

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