

## APPARENT IDEAL AMINO ACIDS DIGESTIBILITY OF RAW FULL-FAT SOYBEAN IN BROILER DIETS

### ZDÁNlivÁ IDEÁLNÍ STRAVITELNOST AMINOKYSELIN SUROVÉ PLNOTUČNÉ SÓJE VE VÝŽIVĚ BROJLERŮ

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#### ABSTRACT

The aim of this study was to attempt to influence of soybean meal (SBM) replacement by multiple levels of raw full-fat soybean (RFFS) in broiler diets on the apparent ileal amino acids digestibility (AIAAD). In the experiment in total 208 ROSS 308 male chickens were used to examine the effect of RFFS on AIAAD and fat digestibility when four dietary treatments were used; Control group (without RFFS) and groups containing 4%, 8% and 12% of RFFS. The experiment lasted from 10th to 38th day of age. The AIAAD was lower when diets contained RFFS in all observed amino acids except methionine. Higher AIAAD was obtained in RFFS12 in comparison with RFFS8 and RFFS4.

**Key words:** raw full-fat soybean, soybean meal, broiler, apparent ileal amino acids digestibility

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## INTRODUCTION

Currently, the most soybeans in poultry diets are used in the form of soybean meal and extruded soybeans (Karr-Lilienthal et al. 2005). Both of these soybean forms are treated through its process by heat and pressure in order to reduce the effect of antinutritional substances (trypsin inhibitor, antigenic proteins, estrogens, lectins, saponins and non-starch polysaccharides), which are present in soybean (Liener and Kakade, 1980) and limiting its use. But the thermal treatment process could also destroy other essential nutrients (Chunmei et al. 2010). For the most problematic antinutritional compounds are considered a trypsin inhibitors (TI) that consists in two types Bowman-Birker's and Kunitz's. TI reduces the proteolytic action of the pancreatic enzyme trypsin (Rackis et al. 1986) in the digestive tract of animals and thereby reduces the digestibility of feed protein and it is associated with a growth reduction. Earlier studies have dealt with the use of raw full-fat soybean, but the with negative results linked to TI impact, especially Kunitz's trypsin inhibitors (Han et al., 1991; Zhang et al., 1991; Chohan et al., 1993). Limited data are available on the lower TI soybean hybrids less-required treatment for optimally inclusion full-fat soybeans in to the broilers diets. In recent years, there has been progress in soybean breeding with lower TI content in soybean hybrids as outcome (Bernard and Hymowitz, 1986; Han et al., 2005; Hymowitz, 1986). These hybrids can be used by omit the energy and costly intensive operation for soybean treatment and get better use of its nutrients.

The aim of this study was to attempt to influence of soybean meal (SBM) replacement by multiple levels of raw full-fat soybean (RFFS) in broiler diets on the apparent ileal amino acids digestibility.

## MATERIAL AND METHODS

The experiment was conducted to determine the ileal amino acids digestibility and fat digestibility of diets with improving content of EFFSB when four treatments that differed in the percentage of RFFS were used. The broilers were fed diets formulated to resemble industry ingredient and nutrient specifications. Diets were offered in 2 feeding phase, starter from 0 to 10th day and grower from 10th to 38th day, both in grout. Starter diet had for all treatment same composition (21,5 % CP; 12,2 MJ MEN/kg). Grower diets were the experimental and based primarily on wheat, SBM, and corn and contained 0, 4, 8 or 12% RFFS (20,5 % CP; 12,7 MJ MEN/kg). Diets were formulated to be isocaloric and similar in limiting and other nutrients (Table 1) and were formulated to meet or exceed NRC nutrient recommendations (NRC, 1994). Broilers consumed feed and water on an ad libitum basis.

Table 1. Composition of the diets (%)

Ingredient	Experimental diets			
	C	RFFS4	RFFS8	RFFS12
Wheat	39.08	39.08	39.08	39.08
Maize	25.00	25.00	25.00	25.00
Soybean meal	27.3	24.02	20.74	17.46
<b>Raw full-fat soybean</b>	<b>0</b>	<b>4</b>	<b>8</b>	<b>12</b>
Soybean oil	4.5	3.78	3.06	2.34
Complex of minerals and vitamins*	4.12	4.12	4.12	4.12

\* One kilogram of premix contained : Retinol: 75.75 mg, Vit. D3: 1 mg ; 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

Experiment was executed at the Mendel University Brno, Czech Republic. The cage technology with collecting belt for excreta was used. In total of 208 x ROSS 308 male broiler chicks were obtained from a commercial hatchery and were kept according to the principles referred to breeding instructions for this hybrid. At the beginning of the experimnet broilers were individually labeled by wing makrs and distributed equally across 16 cages so that each treatment was replicated 4 times with 13 broilers each. Chicks were vaccinated at the hatchery for Marek's disease and Infectious Bronchitis. Each cage was equipped with a lying feeder and a nipple drinker line. Target temperature were 32, 29, 27, 26, 24, 23, and 21 C for d 0 to 2, d 3 to 4, d 5 to 9 d 10 to 14, d 15 to 21, d 22 to 33, and d 34 to 38 respectively. The broiler house was completely enclosed, and fluorescent bulbs provided the lighting. Photoperiods was 23L:1D and followed a continuous schedule with lighting intensities of 30 lx from 0 to 7 d of age, 10 lx from 7 to 22 d of age, and 3 lx from 22 to 38 d of age, and light intensity was verified at bird level (30 cm) using a photometric sensor.

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:

$$\text{AIAAD} = 100 - (100 \times \text{Id} \times \text{AAdc} / \text{Idc} \times \text{AAAd}) (\%)$$

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 (AAAd).

### Statistical Analysis

Observed characteristics were expressed as mean and standard error of the mean and were analyzed using the single factor analysis of variation. Data of ileal amino acid and fat digestibility were followed by the Kruskal-Wallis analysis. For a statistical analysis was used software UNISTAT 5.1 (UNISTAT Ltd., England).

## RESULTS AND DISCUSSION

The effect of feeding RFFS on AIAAD for each amino acid was expressed by polynomial function (Figure 1):

$$y = ax^2 + bx + c,$$

where a, b, c are parameters of the polynomial function, x is level of EFFSB and y is coefficient of digestibility.

The AIAAD, expressed as coefficient of AIAAD showed in Table 2, decreased at most observed amino acids (Thr, Ile, Leu, Phe, His, Arg and Lys) with increasing level of RFFS in the experimental diets. Only methionine AIAAD decreased in group RFFS4, but increased in groups RFFS8 and RFFS12 without significant difference ( $P < 0.05$ ) between experimental groups. Markedly ( $P < 0.05$ ) lower AIAAD in all groups fed with RFFS in diets have been observed for Ile and His compare to group fed with basal diet. The AIAAD for Thr, Leu, Phe, Arg and Lys were significantly ( $P < 0.05$ ) lower in groups RFFS4 and RFFS8, but not in group RFFS12. Significantly ( $P < 0.05$ ) higher AIAAD for Phe and Lys compare to RFFS4 and for Ile and His compare to RFFS8 were obtained when 12 % of RFFS were in diet. No significant differences were reached at Thr, Leu and Arg in comparison between group RFFS12 to RFFS4 and RFFS8, even the values for RFFS12 were higher. For all experimental groups fed RFFS in the diets were observed significantly ( $P < 0.05$ ) lower fat digestibility.

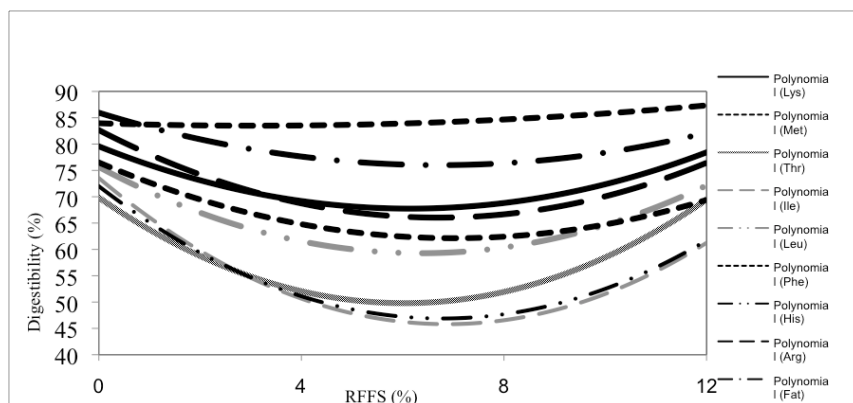
Table 2. Coefficients of apparent ileal amino acid digestibility and fat digestibility

	C	RFFS4	RFFS8	RFFS12
Lysine	0.803 <sup>a,c</sup>	0.670 <sup>b</sup>	0.710 <sup>b,c</sup>	0.777 <sup>a,c</sup>
Methionine	0.841 <sup>a</sup>	0.831 <sup>a</sup>	0.851 <sup>a</sup>	0.872 <sup>a</sup>
Threonine	0.696 <sup>a</sup>	0.528 <sup>b</sup>	0.512 <sup>b</sup>	0.697 <sup>a</sup>
Isoleucine	0.734 <sup>a,c</sup>	0.511 <sup>b,c</sup>	0.461 <sup>b</sup>	0.614 <sup>b,c</sup>
Leucine	0.758 <sup>a</sup>	0.611 <sup>b</sup>	0.608 <sup>b</sup>	0.720 <sup>a</sup>
Fenylalanine	0.760 <sup>a,c</sup>	0.663 <sup>b,c</sup>	0.609 <sup>b</sup>	0.699 <sup>a,c</sup>
Histidine	0.717 <sup>a,c</sup>	0.520 <sup>b</sup>	0.468 <sup>b</sup>	0.620 <sup>b,c</sup>
Arginine	0.826 <sup>a</sup>	0.689 <sup>b</sup>	0.665 <sup>b</sup>	0.765 <sup>a</sup>
Fat digestibility	0.873 <sup>a</sup>	0.736 <sup>b</sup>	0.804 <sup>b</sup>	0.808 <sup>b</sup>

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

Many studies have found that protein digestibility was decreased by 20-40 % in animal fed with diets containing raw soybean or high level of trypsin inhibitor compared with those fed with diets containing heated soybean or soybean meal (Qin, G.X. 1996; Li et al. 1998; Caine et al. 1998). Likewise, Herkelman et al. (1992) showed that low-trypsin inhibitor soybean had significant greater amino acid and nitrogen digestibility compared with conventional SB when fed to growing pigs. Contrary to these authors, Batal and Parsons (2003) showed that the AA digestibility values of the Williams 82 soybeans (Kunitz-free and lectin-free soybeans) diets were much lower than those for the SBM diet.

Figure 1. Effect of RFFS on AIAAD and fat digestibility



In the present study, raw full-fat soybean was used as the source of crude protein, and the results showed that amino acids digestibility was decreased by its presence. On the other hand, many scholars considered that thermal treatment improving digestibility and nutritional value of soybean (Wuersch et al., 1986; Bengala Freire et al. 1991). Our result showed, that RFFS in diets depressed broiler fat digestibility. In contrast with Chunmei et al. (2010), which discovered that fat digestibility in rats fed by raw full-fat soybean was significantly higher than control group fed by common diet.

## CONCLUSION

The present study has shown that the addition of RFFS to the broiler diets decreased AIAAD. The AIAAD was lower when diets contained RFFS in all observed amino acids except methionine. Higher AIAAD was obtained in RFFS12 in comparison with RFFS8

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