



## THE EFFECT OF HEAT TREATMENT ON PROTEIN QUALITY OF SOYBEAN

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### INTRODUCTION

The soybean is currently the most important source of edible oil and high – quality plant protein for inclusion in diets for animals. However this potential can be achieved only after heat treatment because of high content of some antinutritional compounds and high crude protein solubility. Heat treatment substantially decreased urease activity and solubility of protein and degradation of protein in the rumen. Furthermore heat treatment caused a higher flow of total amino acids to the intestine while minimizing the activity of antinutritional factors.

The main purpose of our experiment was to determine the quality of protein in native and heat treated soybeans by chemical and biological tests by using animals.

### MATERIAL AND METHODS

In this study were used untreated and treated (by flaking, roasting and toasting) samples of soybean. Chemical composition was determined by the Weende analyze, crude protein (CP) degradability by using in sacco technique and intestinal digestibility by mobile bag technique on three cows provided with a large rumen cannula and T-cannula in the

duodenum behind the pancreas. For CP effective degradability calculation was used passage rate 0.06/h.

The results were evaluated by statistical programme Statistics, by One-way analysis of variance and significant differences were declared at  $P<0.01$  and  $P<0.05$ .

### RESULTS

- The heat treatment had no significant effect on chemical composition of tested samples.
- The urease activity, which is the indicator of heat inactivation of antinutritional substances, was marked decrease by toasted and roasted soybean.
- Significant decrease of CP solubility by flaked soybean (from 54.9 % to 16.7 %), roasted soybean (from 51 % to 15 %) and toasted soybean (from 58.8 % to 17.6 %).
- The content of methionine was 5.97 g.kg<sup>-1</sup> and 5.75 g.kg<sup>-1</sup> resp.
- The content of arginine was 21.66 g.kg<sup>-1</sup> and 25.13 g.kg<sup>-1</sup>, resp. and leucine was 18.56 g.kg<sup>-1</sup>.
- The heat treated soybean has high energy and protein value.

- The heat treatment (all used methods) reduce effective CP degradability (Edg) ( $P<0.05$ ), the most significant decrease – by toasted soybean (from 83.4 % to 66.7 %).
- The toasting had significant effect on decrease of soluble fraction "a" (from 56.9 % to 21.4 %) and on increase of insoluble fraction "b" (from 43.1 % to 78.6 %) ( $P<0.05$ ).
- The heat treatment by flaking had similar effect on decrease of soluble fraction "a" and increase of insoluble "b" fraction.
- The effective CP degradation decreased as temperature of treatment increased and the differences were found between temperatures of roasting too.
- The most differences were determined between untreated and roasted soybean by 140 °C.
- These changes were reflected on the parameters of CP degradation.
- The heat treatment did not damage proteins and intestinal digestibility of by-pass protein was kept high (97.6 % - 98.4 %).

Table 1  
Chemical composition of untreated and treated soybean (g.kg<sup>-1</sup> DM)

Soybean	Nutrients					Urease activity*
	Dry matter	Crude protein	Fiber	Fat	Organic matter	
untreated	904.3	393.4	57.7	215.1	950.2	7.98
roasted						
120 °C	926.1	403.0	65.7	220.6	946.7	0.69
130 °C	927.8	392.5	69.5	216.4	947.5	0.58
140 °C	930.2	401.2	65.7	222.4	946.6	0.55
untreated	942.8	426.2	65.7	205.5	948.6	-
flaked	931.1	422.1	84.3	208.0	949.3	-
untreated	889.3	361.1	91.4	210.0	949.3	6.16
toasted	885.0	349.3	107.3	215.8	946.9	0.65

\*Urease activity (mg N/ g sample/ min)

Table 2  
Parameters of crude protein degradability in untreated and treated soybean

Soybean	Parameters				
	a (%)	b (%)	c (%.h <sup>-1</sup> )	a+b (%)	Edg (%)
untreated	42.9	57.1	0.0211	100.0	69.1
flaked	24.8	75.2	0.0893	100.0	68.2
comparison	1:2	1:2	1:2	n.s.	1:2
untreated	56.9	43.1	0.034	100.0	83.36
toasted	21.4	78.6	0.015	100.0	66.65
comparison	1:2	1:2	1:2	n.s.	1:2
untreated	56.5	43.5	0.0613	100.0	79.4
roasted					
120 °C	46.8	53.2	0.0154	100.0	73.4
130 °C	41.6	58.4	0.0468	100.0	66.9
140 °C	34.8	65.2	0.0263	100.0	66.4
comparison	1:2,3,4 2:3,4 3:4	1:2,3,4 2:3,4 3:4	2:1,3	n.s.	1:2,3,4 2:3,4

Significant differences between tested feeds are declared at  $P<0.05$  and \* $P<0.01$

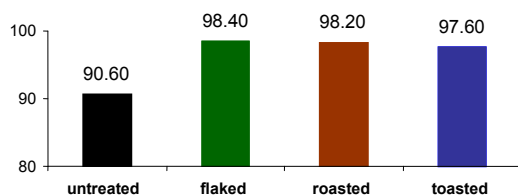


Fig. 1 Intestinal digestibility of by-pass protein (%)

### CONCLUSION

The results of this study demonstrate positive effect of heat treatment on CP solubility and ruminal CP degradability of soybean. The properly treated soybeans significantly reduced its ruminal protein degradation without affecting its intestinal protein digestibility.

However the estimation of suitable temperature for heat treatment is very important in term of prevention of decrease nutritive value together with energy saving.

