

Increase of Insoluble Nitrogen Fractions in Soybean (*Glycine max (L.) Merrill*) and Redbean (*Phaseolus vulgaris L.*) due to Higher Drying Temperatures

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Abstract – Soybean and redbean are high protein feed materials. Protein is typically determined by measuring nitrogen component and multiplied the value by 6.25. Utilization of feed protein by livestock can be determined if the amount of nitrogen bound in the cell wall is analyzed. This study was aimed to analyze cell wall nitrogen or insoluble nitrogen fractions present in soybean and redbean as influenced due to different drying temperatures. Soybean and redbean were oven-dried at different levels of temperatures for 24 h, i.e. 50, 60, 70 and 80 °C in three replicates. This research used a factorial completely randomized design (2x4). Results showed that soybean contained higher protein than that of redbean. Increasing drying temperatures increased NDICP and ADICP of both soybean and redbean, probably due to the formation of maillard compounds. Higher levels of such insoluble nitrogen fractions are not desirable due to their lower utilization efficiency in the digestive tract of animals. It can be concluded that, increasing drying temperatures increased of insoluble nitrogen fraction in soybean and redbean and the most optimal drying temperatures were at 50 and 60 °C.

1. INTRODUCTION

The quality of protein is determined by the amino acid sequence. Several types of beans a potentially serve as a source of protein are soybean and redbean. Soybean have an amino acid sequence that is relatively complete and balanced. While the redbean is the grain potential because it accounts for the largest protein *by-pass* thus more effective for ruminants [1]. Feed materials with high levels of crude protein believed to be feed with better quality compared to feed containing crude protein lower levels. Protein is typically determined by measuring nitrogen component and multiplied the value by 6.25, and in Indonesia for animal nutrition's research were still using the crude protein as an indicator of animal diet, because it was believed that high crude protein in feedstuffs could be provide the amino acids to be absorbed in the small intestine. It was not entirely true because the crude protein was composed of several factions in the rumen. Utilization of feed protein by livestock can be determined if the amount of nitrogen bound in the cell wall is analyzed. This study was aimed to analyze cell wall nitrogen or insoluble nitrogen fractions present in soybean and redbean as influenced due to different drying temperatures.

2. METHODS

2.1 Chemicals

Grain samples were analyzed for dry matter (DM). Crude protein (CP) was analyzed according to AOAC [2], whereas neutral detergent fiber (NDF) and acid detergent fiber (ADF) were analyzed by the method of Van Soest [3]. Neutral detergent insoluble crude protein (NDICP) and acid detergent insoluble crude protein (ADICP) were determined using protein fractions analyzed [4].

2.2 Procedures

The materials which used in this research are soybean and redbean. Beans were obtained from traditional markets in a fresh condition and selected based on physical rating. Soybean and redbean were oven-dried at different levels of temperatures for 24 h, i.e. 50, 60, 70 and 80 °C in three replicates. This research used a factorial completely randomized design (2x4) with two factors, in which the first factor was grain species and the second factor was various temperature levels.

Dry matter analyzed [2] :

The previous a cup has heated at oven about 1 hour at 105 °C and then cooled in eksikator and weighed heavy cup. 5 g sample is weighed and put into a cup, the cup and the sample is put into the at oven 105 °C for about 6 hours (to achieve permanent weight). Then the cup removed and cooled in eksikator. After that weighed.

Crude protein [2] :

The sample is weighed as much as 0.3 g and 1.5 g of catalyst was added selenium mixture. Then put in a Kjeldahl flask and added 20 mL of concentrated H₂SO₄. Destruction is done until the color of the solution became green-yellowish-clear, then cooled about 15 minutes, then added 300 mL of distilled water and cooled again. After it was added 100 mL 40% NaOH, then do distillation. Distilled accommodated with 10 mL of 0.1 N H₂SO₄ was added 3 drops of indicator mixture of methylene blue and methylene red. Once that is done titrate with 0.1 N NaOH until the color changes from purple to blue-green. Determination of forms by means of pipette 10 mL of 0.1 N H₂SO₄ and added two drops of indicator PP, then titrated with NaOH 0.1 N.

Neutral detergent fiber [3] :

The sample is weighed as much as 1 g (air dried and milled) and then put in a 600 mL glass beaker and added about 100 mL of neutral detergent solution and 2-3 drops of decalin. After it was heated for 5 to 6 minutes until hot start and then calculated the heating time for 60 minutes while in reflux with a water stream. After 60 minutes of boiling, the beaker was taken out of the heater and left for a while so that solids settle to the bottom. Glass filter set in place and heated with boiling water. Material solution was filtered slowly from the liquid material which was dissolved by the low power vacuum. In the solids can be incorporated into a colander while rinsing with boiling water until all samples depleted enter into a glass filter. Samples were washed about 2 times with hot water, 2 times with acetone and then be dried. Glass filters can be dried for at least 8 hours (or stored overnight if analysis followed the next day) at 105 °C in an oven equipped with a fan system. Having weighed dry weight will be obtained residue NDF.

Acid detergent fiber [3] :

The procedure was the same as the NDF but only different in the solvent. ADF used on acid detergent solution (ADS).

NDICP and ADICP [4] :

After obtaining the residue of NDF analysis and then proceed to the analysis of crude protein it will get the value of NDICP. Whereas for ADICP procedure exactly the same as the procedure NDICP except a solvent.

3. RESULTS AND DISCUSSION

The results showed that soybean contained higher protein than that of redbean (Table 1). The higher drying temperatures will be increase the crude protein content in soybean and redbean because the content of dry material has also increased. Increasing drying temperatures increased NDICP and ADICP of both soybean and redbean, probably due to the formation of maillard compounds. The reaction between proteins with reducing sugars known as the maillard reaction, is also a major cause of protein damage during processing. Maillard reaction occurs between the aldehyde group of a reducing sugar with the amine group of amino acids, especially lysine epsilon-amino-alpha-amino and N-terminal amino acid. Maillard reaction ended with the formation of brown pigment called *malanoidin*. A decrease in nutrient value the protein as a result of the maillard reaction occurs as follows: (1) lysine and cystine suffered damage as a result of reacting with a carbonyl compound or dicarbonyl and aldehydes, whereas lysine is one of the essential amino acids; (2) a decrease in the availability of all the amino acids, including leucine, which is usually the most stable, as a result of the formation of cross-linking (cross-linkage) between the amino acids via the maillard reaction products; and (3) a decrease in digestibility due to inhibition of the enzyme penetration into the substrate protein or by covering the enzyme proteins can be attacked because of the occurrence of crosslinking.

Table 1. Insoluble nitrogen fractions in soybean and redbean

Grain species	Temperatures	CP	NDF	ADF	NDICP	ADICP
	°C	% DM				
Soybean	50	43.75 ^c	20.68 ^a	15.82 ^c	6.58 ^a	6.37 ^a
	60	44.05 ^{cd}	22.06 ^b	15.39 ^c	6.41 ^a	6.30 ^a
	70	44.68 ^d	22.10 ^b	16.56 ^{cd}	11.69 ^c	7.36 ^{ab}
	80	44.82 ^d	22.27 ^b	17.20 ^d	11.11 ^c	7.32 ^{ab}
Redbean	50	21.83 ^a	27.92 ^c	10.52 ^a	10.13 ^b	8.07 ^b
	60	22.39 ^{ab}	34.96 ^d	10.81 ^a	9.42 ^b	9.29 ^b
	70	22.66 ^b	35.56 ^d	11.62 ^{ab}	12.54 ^d	9.68 ^c
	80	23.18 ^b	35.41 ^d	12.20 ^b	13.96 ^e	10.14 ^c
SEM		2.82	1.63	0.67	0.65	0.37

CP, crude protein; NDF, neutral detergent fiber; ADF, acid detergent fiber; NDICP, neutral detergent insoluble crude protein; ADICP, acid detergent insoluble crude protein; SEM, standart error of the mean. Values in the same column with different superscripts are different at P<0,05.

Neutral detergent insoluble crude protein (NDICP) is also called protein remaining in NDF residue while acid detergent insoluble crude protein (ADICP) also called protein residue remaining in the ADF. NDICP and ADICP is a crude protein still bound in the cell walls also called rumen degradation resistant proteins, causing low digestibility of crude protein. NDICP and ADICP values were generally similar between materials dried at 50 and 60 °C. Higher levels of such insoluble nitrogen fractions are not desirable due to their lower utilization efficiency in the digestive tract of animals. Fiber digestibility of feed ingredients will be strongly influenced by the content of the cell wall constituent materials [5]. The cell walls of which were contained in the feed will cause hard feed degraded in the rumen.

4. CONCLUSIONS

Increasing drying temperatures increased of insoluble nitrogen fraction in soybean and redbean and the most optimal drying temperatures were at 50 and 60 °C.

5. REFERENCES

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