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THE UTILIZATION OF BANANA STEM JUICE AS A TANNIN SOURCE TO PROTECT PROTEIN FEED FROM DEGRADATION IN THE RUMEN: *IN VITRO* PROTEIN DIGESTIBILITY

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Abstract

Study was conducted to evaluate the *in vitro* digestibility of soybean meal mixed with banana stem juice as a tannin source to protect protein feed from degradation in the rumen. Banana stem juice was mixed with soybean meal as a protein source, at three concentration levels namely 1:1; 1:2; and 1:3 (w/v) as first factor. The mixture then heated at 60°C and at 90°C (as second factor), in a forced-air oven before grinding and passing through 60-mesh screen in a Willey mill. Samples then incubated in the rumen fluid and followed by incubation with pepsin solution, to determine *in vitro* protein digestibility. The experiment was arranged using 3 x 2 factorial designs with three replications. The results showed that *in vitro* Protein digestibility in rumen liquid was not significantly affected by concentration levels but was affected by heating. Protein digestibility of soybean meal mixed with banana stem juice and heated at 60°C was 47% lower compared to untreated soybean meal (23.41 vs. 43.5%). *In vitro* protein digestibility of treated soybean meal heated at 90°C was significantly higher than heated at 60°C (81.89 % vs 23.41%). Suggesting that protein can be protected from degradation in the rumen. when mixed with banana stem juice and heated at 60°C. Protein digestibility of treated soybean meal incubated in rumen fluid followed by pepsin solution was not affected by heating (91.82 vs. 90.13). This indicated that un-degraded protein in the rumen of treated soybean meal dried at 60°C could be digested in the post rumen digestive tract, which is represented by pepsin digestion. Therefore it can be can be concluded that soybean meal treated with banana stem juice can protect protein from *in vitro* rumen degradability

Key words: Tannin, Banana stem, Protected protein, Degradability

Introduction

Livestock with high productivity (such as growing, late pregnancy and lactation) need more nutrients; meanwhile the ability to consume the feed to meet its requirement is limited. Supplying nutrient especially crude protein based on Kearl (1982) and Haryanto and Djajanegara (1992) recommendation, often did not give expected result. This condition is caused by supplying only in quantity requirement

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is not used efficiently due to major part of nutrient will be degraded in the rumen become intermediary products (such as ammonia, amino acid and peptides) and could not be fully used by rumen bacteria, because the rapid of utilization of the intermediary products by rumen microbial is not as fast as the rate of feed degradation in the rumen (Leng and Nolan, 984). This condition results in loss of intermediary products in the form of ammonium through urine. Considering inefficiency of feed degradation in the rumen and knowing the minimum ammonia-N (NH_3-N) in the rumen liquid (mg/l) for optimum rumen microbes activity and proliferation (Egan, 1980), assessment of undegraded protein from rumen microbes is needed in order to make feed utilization more efficient. Hvelplund (1985) reported that by-pass protein (protected protein) has an important role to meet host requirement, especially for livestock with high productivity.

Special treatment is needed to protect feed protein from degradation in the rumen (by-pass protein) but can be hydrolysed in the small intestine so that this by-pass protein can be utilized by host animal for production. One of the treatment methods is protection with tannin. Protein protection using tannin is relatively better and gives more positive respond (Barry and Blaney, 1987). However, the feeding value of this protected protein depends on concentration, type and bonding between tannin and protein. Protected protein can be obtained by mixing tannin with feed protein.

Banana stem juice reported by Mathius *et al.*, (2001) tannin content in banana is varied depend on variety and plant part of banana. Banana stem usually used as livestock feed especially in the dry season to meet water need. The objective of the study was to assess the utilization of banana stem juice as tannin source to protect protein from rumen degradation.

Materials and methods

The study was conducted in the Laboratory of Research Institute for Animal Production. Commercial soybean meal was used as protein feed. To make protected protein, soybean meal was mixed with banana stem juice, which was extracted by pressing banana stem. The soybean meal was mixed with banana juice at three ratios 1:1; 1:2 and 1:3 (w/v). The mixtures then heated at 60° C or 90° C in a forced-air oven. Next, samples were ground through 60 mesh in Willey miller. Samples were incubated for in vitro digestibility, which was done according to the method of Tilley and Terry (1969). Rumen fluid was obtained using rumen tube from sheep fed on king grass *ad libitum* supplemented with 400 g/head/day commercial concentrate. To determined nitrogen digestibility in the rumen, samples only incubated in rumen fluid for 24 hours in anaerobe condition, then residue from incubation in the rumen fluid was strained and analysed for N content. On the other hand, protein digestibility in post rumen digestive tract, sample was incubated in rumen fluid for 24 hours, then fermentation was stopped by adding $HgCl_2$ solution, followed by pepsin solution prior to incubation for another 24 hours in aerobe condition, after

that residue was strained and dried for N content analysis. The experiment was arranged using 3x2 factorial designs using ratios of soybean meal to banana juice as first factor and heating as a second factor. All treatment was repeated three times.

Results and discussion

In vitro protein digestibility of samples incubated in the rumen liquid medium and in the rumen liquid continued in pepsin solution is shown in Table 1. The protein digestibility of soybean meal incubated in rumen liquid was not significantly affected by concentration of banana stem juice. The digestibility was significantly affected by heat treatments. Protein digestibility of treated soybean meal heated at 60°C incubated in rumen fluid was significantly lower than heating at 90°C (23.41 vs. 81.89%). There was no significant interaction between concentration of banana stem juice and drying sample through heating. Table 1 shows the lowest protein digestibility in rumen liquid medium is in concentration of 1:2 and 1:1 with drying at 60°C. However, this digestibility is not significantly different at similar drying at 60°C (17.80% vs. 20.22%). When this digestibility is compared to control (untreated soy bean meal protein digestibility 43.5%), it shows that protein degradation is decreased up to 47%.

The decrease of protein digestibility indicated that protein of soybean meal was protected from rumen microbial degradation in the rumen. This is due to the presence of tannin in banana stem, which inhibit the degradation of dietary protein in the rumen and decrease rumen ammonia concentration. According to Norton and Ahn, (1997) tannin may inhibit activity of proteolytic enzymes in the rumen. The increase ratio of soy bean meal and banana stem juice at 1:3 (w/v) and dried at 60°C results in increased protein digestibility (32.22%) although still lowers than control. Wisdom *et al.* (as cited by Leinmuller *et al.*, 1991) reported that tannin utilization for feed protein protector should be in balanced ratio. Ratio that exceeds the certain limit will cause in imperfect bonding between tannin and protein, resulting the expected protein digestibility could not be achieved. In addition Jones and Megan (1977) reported that the best ratio of tannin is 1 mg to 11 mg protein.

Drying of sample by heating at 90°C of treated soybean meal causes higher protein degradation in rumen fluid incubation than control (81.89 vs. 43.5%). This decreased digestibility at drying 90°C could be due to heating may decreased the activity of tannin as protein protector. Ahn *et al.*, (1989) reported that drying of tropical forages decreases the apparent content and activity of condensed tannins and increases the digestibility of organic matter, fibre and N of sheep fed diets supplemented with *Calliandra calothyrsus* leaf.

Table 1. *In vitro* protein digestibility (%) of soybean meal protected with banana stem juice at different ratios concentration and heat treatments

Treatment		Medium incubation	
Heating	Concentration	Rumen liquid	Rumen liquid + pepsin
Control		43.5	97.5
60^0C	1:1	20.22	88.46
	1:2	17.80	92.50
	1:3	32.22	94.50
Average 60^0C		23.41[a]	91.82
90^0C	1:1	78.50	89.03
	1:2	78.40	92.37
	1:3	88.78	88.99
Average 60^0C		81.89[b]	90.13

The digestibility of protein soybean meal incubated in rumen liquid continued in pepsin solution is high at both drying temperature (91.82 and 90.13). This digestibility value indicated that almost all protein in soybean meal is digested in post rumen digestive tract, which is represented by enzymatic digestion, in this case is pepsin. The increase of protein digestibility in this medium indicated that treatment on feed protein source with banana stem juice result in decreasing protein degradability in the rumen and this protein still can be digested in the lower digestive tract. Results from this study suggest that mixture of soybean meal and banana stem when dried at 60°C can reduce protein degradability and can be digested in the post rumen tract. However, further study is needed to see the extent of the role by-pass protein obtained from banana stem juice protection in increasing ruminant productivity.

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