Total VFA Production and Protozoa Population with Jengkol (*Archidendron jiringa*) Peel Powder Supplementation on *In Vitro*

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Abstract. Jengkol (*Archidendron jiringa*) peel is a by-product that has not been utilized optimally. Some research reported that jengkol peel had potency as a source of fiber and bioactive compound (saponins and tannins) for ruminant. This experiment was designed to evaluate the effects of jengkol peel powder supplementation on total volatile fatty acid (VFA) production and protozoa population on *in vitro* ruminal fermentation. The treatments were arranged in a randomized block design with three treatments (2%, 4%, 6% DM) and four replications. The variables observed included total VFA production and protozoa population. Data were tested using Analysis of Variance (ANOVA) and the differences among treatments means were examined by Duncan Multiple Range Test. The results showed that increasing supplementation of jengkol peel powder increased total VFA production ($P<0.01$) but did not affect protozoa population ($P>0.05$). It is concluded that supplementation of jengkol (*A. jiringa*) peel powder until 6% DM potentially improved rumen fermentation.

Key words: jengkol peel powder, protozoa, total VFA

1. Introduction

Agricultural by-products are abundant in Indonesia. Many farmers have been using this by-products as the main source as livestock feed, especially for ruminant. Ones of them are jengkol (Archidendron jiringa) by-product like peels have not been utilized optimally. Hidayah et al. [1] reported that Jengkol peels is very potential to be used as ruminant feed. They are available in high quantity, the proportion of weight of peel (59.99%) is higher than seed (40.01%). Data of BPS [2] reported that Indonesia produced 66,065 tons of jengkol there would be 36,065 tons of peels available.

Beside potential from quantity aspect, jengkol peel potential to from nutritional value. Jengkol peels contain 33.07 to 35.28% of crude fiber and 51.56-52.81% of total digestible nutrient. This value is within the range of the recommended value for ruminant as source of energy. Jengkol peels are also contain 17.91-35.13% of saponin that potential as an alternative to natural feed additive to increase animal productivity. Therefore, the aim of this study to evaluate the effects of Jengkol peel powder supplementation on *in vitro* on total VFA production and and protozoa population.

2. Methodology

Jengkol peel and native grass were sun-dried for 5-6 hours until its weight was stable. After that, the materials were ground to form powder.

In vitro fermentation was conducted according to the method of Tilley & Terry [3]. Into each 100 mL fermentation tube, 500 mg substrate, 40 mL McDougall buffer, and 10 mL rumen fluid were added at conducted at 39 ºC. The rumen fluid for this experiment was collected after 3 h morning feeding from the 3 rumens fistulated Ongole crossbred beef cattle with Ethical Approval from Animal Care and Use Committee (AUAC) 01-2013b LIPI Cibinong. Samples from aliquol were taken after 4 h incubation for total VFA production and protozoa population.

Determination of VF4A by a Distilled Method. Protozoa population was determined using Fuch Rosenthal Counting Chamber (4 x 4 x 0.2 mm) under a microscope (40×). The 0.5 mL liquid sample from 4 h incubation tubes were mixed with 2 mL methyl green formaldehyde saline solution.

The experiment was conducted in a randomized block design with 4 treatments (supplementation of Jengkol peel powder at 0%, 2%, 4%, 6% DM) and 4 replications.

The treatment tested was the ration:

A = Native grass (100%) + Jengkol peel powder (0%)
B = Native grass (98%) + Jengkol peel powder (2%)
C = Native grass (96%) + Jengkol peel powder (4%)
D = Native grass (94%) + Jengkol peel powder (6%)

Data were tested using Analysis of Variance (ANOVA) and the differences among treatments' means were examined by Duncan Multiple Range Test [4].

3. Result and Discussion

Total VFA production

Supplementation of 2-6% Jengkol peel powder significantly increased ($P<0.05$) total VFA production (**Table 1**). This matter presumably due to that saponin content of jengkol peel capable to stimulated growth of rumen bacteria which lead to increase rumen fermentation. Wallace *et al.* [5] reported that saponins stimulated growth of *Provotella ruminicola*, whereas growth *of Butirivibrio fibrisolvent and Streptococcus bovis* was inhibited. The increasing of total VFA production with higher jengkol peel powder supplementation indicated that energy for ruminant and protein microbial synthesis process increase in rumen. Total VFA production in this research ranged from 50.75-105.13 mM that lower than standard optimum levels of total VFA production in rumen. Mc Donald *et al.* [6] stated that the optimum level of total VFA in rumen range from 70-150 mM.

Hapsari *et al.* [7] reported that addition of saponin form *Ageratum conyzoides* leaves *and Zingiber officinale* (ZO) extract on *in vitro* ruminal fermentation of dairy cow increased total VFA production. The different result reported by Patra *et al.* [8], utilizing *Yucca* and *Quillaja* as sources of saponins and tannin with levels 0.2, 0.4, 0.6 g/l resulted total VFA production same with control. The type of compound or its concentration in the plant or extract used in the study may be a number of factor determining the efficacy of plant secondary compound to increase total VFA production [9].

Table 1. Total VFA Production with Supplementation of Jengkol Peel Powder

Jengkol peel powder (%)	Total VFA (mM)
2	58.75 ± 5.45^{a}
4	84.40 ± 5.51^{b}
6	105.13 ± 6.99^{c}

Note : Different superscripts on the same line represents a significant difference ($P<0.05$).

Protozoa population

Supplementation of 2-6% Jengkol peel powder did not decreased protozoa population significantly (P>0.05), just decreased numerically (**Table 2**). This matter presumably due to that saponin content of jengkol peel did not capable to decreased significantly protozoa population. Goel and Makkar [10] stated that saponin have potent antiprotozoal activity by forming complex with sterol in protozoa cell membrane. Francis *et al*. [11] stated that saponins to be mediated by their capacity to form irreversible complexes with cholesterol in the protozoa cell membrane to cause destruction of cell membrane, cell lysis and death.

Table 2. Protozoa population with supplementation of jengkol peel powder

Jengkol peel powder (%)	Protozoa (10^4/ml)
2	3.9×10^4
4	3.4×10^4
6	3.0×10^4

Patra & Yu [12] stated that utilization of *Quillaja saponaria* as a saponin source at 0.6 g/L significantly decreased protozoa and increase *S. ruminantium, R. amylophilus, P. ruminicola, P. bryantii, C. aminophilum, C. sticklandii* (P<0.05) bacteria. Istiqomah *et al.* [13] reported that the higher dose addition of saponin from *H. tiliaceus* on basal diet (0, 5, 10, 15, 20%) decreased (P<0.05) protozoa population. The different result reported by Bhatta *et al.* [14] that different level of tannin (0, 5, 10, 15, 20, 25% DM) on feed decrease (P<0.01) protozoa population.

4. Conclusion

Supplementation of jengkol (*A. jiringa*) peel powder until 6% DM potentially improved rumen fermentation.

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