Supplementation of Jengkol Peel on VFA Molar Proportion, Methane Production, and Hydrogen Balance in Vitro

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INTRODUCTION

Many researchers reported that bioactive compound tannin and saponin can reduced methane production and increased livestock productivity (Jayanegara et al., 2011; Holtshausen et al., 2009). Jengkol (Archidendron jiringa) is a tropical plant Southeast Asian typical that contain tannin and saponins. In Indonesia, Jengkol widely grown in the western part, particularly in Bengkulu Province, Sumatera island as much 2,822 tons in 2017 (BPS, 2018). During this time the fruit was used as food and medicine, but until now there are not much information regarding to the utilization of Jengkol byproduct (peel and leaves) as feed supplement. Jengkol has potency as a feed supplement because its
good nutrition. According to (Hidayah et al., 2019) showed that jengkol peel contains CP (8.83%), CF (27.50%), saponin (56.92%), and tannin (7.82%).

Saponin are secondary compounds that have protozoa defaunating effect, stimulate growth of rumen bacteria, and decrease methanogenesis. Wina et al. (2005); Wanapat et al. (2013) reported that saponins have strong defaunating properties which could reduce methane production on in vitro and in vivo. Therefore, objective of this research to study about effects of supplementation jengkol (Archidendron jiringa) peel powder on VFA molar proportion, production of methane, and hydrogen balance in vitro.

METHODS

Preparing Materials
Forage and jengkol peel were sun dried until getting stable weight. After that, the materials were grinded with machine to form powder.

In Vitro Fermentation
The in vitro method according to the Tilley and Terry (1963). Into each 100 mL fermentation tube, 10 mL rumen fluid, 40 mL McDougall buffer, and 500 mg substrate were added at 39°C. The rumen fluid from 3 rumens fistulated Ongole crossbred beef cattle with Ethical Approval from Animal Care and Use Committee (AUAC) 01-2013b LIPI Cibinong. VFA analysis was taken from sample that were 4 h incubation.

Sampling and Measurement
VFA molar proportion were analyzed using gas chromatography with capillary column type containing 10% SP-1200, 1% H3PO4 on 80/100 Cromosorb WAW and nitrogen as gas carrier. Methane production was estimated from molar proportions of VFA according to Moss et al. (2000) (CH4 = 0.45 C2 – 0.275 C3 + 0.40 C4), and hydrogen balance was estimated from VFA molar proportion according to Mitsumori et al. (2012) [2HP (Hydrogen production)= 2 x C2 + C3 + 4 x C4 + 2 x Ci5 + 2 x C5 ] [2HUS (Hydrogen utilization) = 2 x C3 + 2 x C4 + C5].

Statistical Analysis
The ration in this experiment:
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%)

The experiment used randomized block design with 4 treatments (0%, 2%, 4%, 6%) and 4 replications. Data were analyzed using One-way ANOVA and Ducan Multiple Range Test examined the differences among treatment means (Steel and Torrie, 1995).

RESULTS AND DISCUSSIONS

VFA Molar Proportion
The supplementation of 2-6% Jengkol peel powder did not affect (P>0.05) the VFA molar proportion and ratio of acetate

<table>
<thead>
<tr>
<th>Parameter</th>
<th>0</th>
<th>2</th>
<th>4</th>
<th>6</th>
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<tbody>
<tr>
<td>Acetate (%)</td>
<td>73.64 ± 3.36</td>
<td>73.49 ± 3.50</td>
<td>68.77 ± 3.90</td>
<td>75.86 ± 4.24</td>
</tr>
<tr>
<td>Propionate (%)</td>
<td>13.84 ± 0.47</td>
<td>14.42 ± 1.02</td>
<td>14.90 ± 0.84</td>
<td>12.88 ± 2.00</td>
</tr>
<tr>
<td>Butirat (%)</td>
<td>7.19 ± 2.23</td>
<td>7.56 ± 1.21</td>
<td>8.45 ± 1.20</td>
<td>6.37 ± 1.54</td>
</tr>
<tr>
<td>Valerat (%)</td>
<td>5.48 ± 1.24</td>
<td>5.66 ± 0.74</td>
<td>7.87 ± 2.32</td>
<td>4.88 ± 0.71</td>
</tr>
<tr>
<td>A : P</td>
<td>5.32 ± 0.39</td>
<td>5.04 ± 0.57</td>
<td>4.64 ± 0.51</td>
<td>6.02 ± 1.26</td>
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</table>
Supplementation of Jengkol Peel

(2) and propionate (Table 1). Proportion of acetate were 68.77% – 75.86%, propionate were 12.88% - 14.90%, butyrate were 6.37% -8.45%, valerate were 4.88% - 7.87%, and A/P ratio were 4.64 -6.02. McDonald et al. (2002) reported that VFA molar proportion strongly influenced by type of feed that consumed. Cattle that consumed the feed with proportion of grass silage produced: acetate (74%), propionate (17%), butyrate (7%), and others (3%); while if the feed consumed was forage and concentrate (40%:60%) produced: acetate (61%), propionate (18%), butyrate (13%), and others (8%).

The result showed that supplementation Jengkol peel powder until 6% did not affect pattern of rumen fermentation. Hu et al. (2005) reported that supplementation of saponin extract from tea seed that contain 60% saponin at 0.4 mg/ml rumen fluid did not affect on partial and total VFA. Different result was reported by Wina et al. (2005) addition saponin in ration increased propionate proportion and decreased A:P ration.

Methane Gas Production (CH₄) and Hydrogen Balance

The supplementation of 2-6% Jengkol peel powder decreased (P<0.05) methan gas production and hydrogen production compared with the treatment without supplementation of Jengkol peel powder (Table 2). High hydrogen production was correlated with high methane production. This was presumably because the saponin in Jengkol peel powder could defaunata protozoa so decreased its population and activity from methanogen. Takahashi (2006) reported that defaunation can reduce the symbiosis mechanism between methanogen and protozoa, so just little hydrogen can converted to methane. Protozoa defaunation can reduce methane production linearly with decreasing protozoa and methanogen (Hess et al., 2003) reported that lerak extract that contained saponin can be used as metanogenesis inhibitor that reduced methane production.

Research from Pen et al. (2006), reported that supplementation of extract Yucca schidigera at 2, 4, and 6 ml/l rumen fluid highly significantly (P<0.001) decreased methane

<table>
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<th>Table 2. Methane gas production (CH₄)</th>
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<tr>
<td>Jengkol Peel Powder (%)</td>
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<tr>
<td>0</td>
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Note: Means in the same column with different superscript differ significantly (P<0.05).

<table>
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<tr>
<th>Table 3. Hydrogen (H₂) balance (CH₄)</th>
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<td>Estimation Model</td>
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<tr>
<td>H₂ Production</td>
</tr>
<tr>
<td>0</td>
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<td>2</td>
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H₂ Utilization

| Estimation Model | Jengkol Peel Powder (%) | H₂ |
| H₂ Utilization   |                         |    |
| 0                  | 7.54 ± 1.58<sup>b</sup> |
| 2                  | 2.92 ± 0.08<sup>a</sup> |
| 4                  | 4.34 ± 0.54<sup>a</sup> |
| 6                  | 3.97 ± 1.24<sup>a</sup> |

Note: Means in the same column with different superscript differ significantly (P<0.05).
production from 32% - 42% and decreased protozoa until 56%. Same result reported by Hu et al. (2005) supplementation of saponin extract from tea seed that contain 60% saponin at 0.2 – 0.4 mg/ml rumen fluid highly significantly (P<0.01) decreased protozoa population and methane production.

CONCLUSION

The research concluded that the supplementation of Jengkol (A. jiringa) peel powder until 6% decreased methane production and hydrogen balance but did not affect on VFA molar proportion.

ACKNOWLEDGMENTS

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REFERENCES


