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

Pengaruh Suplementasi Tepung Kulit Jengkol (Archidendron jiringa) pada Proporsi Molar VFA, Produksi Metan, dan Keseimbangan Hidrogen In Vitro

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ABSTRACT

This research was designed to study about effects of supplementation jengkol (*Archidendron jiringa*) peel powder on VFA molar proportion, production of methane, and hydrogen balance in vitro. The experiment used randomized block design with 4 treatments (0%, 2%, 4%, 6%) and 4 replications. The research observed of VFA molar proportion, production of methane, and hydrogen balance. Data were analyzed using Analysis of Variance (ANOVA), and the Duncan Multiple Range Test examined the differences among treatment means. The results showed that the supplementation of jengkol (*A. jiringa*) peel powder until 6% did not affect (P>0.05) VFA molar proportion but the treatment without supplementation of jengkol (*A. jiringa*) peel powder had the highest (P<0.05) methane and H2 production. It was concluded that the supplementation of jengkol (*A. jiringa*) peel powder until 6% decreased methane and hydrogen production but did not affect on VFA molar proportion.

Keywords: jengkol peel powder, methane, VFA molar proportion

ABSTRAK

Penenelitian ini bertujuan untuk mengecaluasi pengaruh suplementasi tepung kulit jengkol (Archidendron jiringa) pada proporsi molar VFA, produksi metan, dan keseimbangan hidrogen in vitro. Rancangan penelitian menggunakan rancangan acak kelompok, 4 perlakuan suplementasi (0%, 2%, 4%, 6%) dan 4 ulangan. Variabel yang diamati meliputi proporsi molar VFA, produksi metan, dan keseimbangan hidrogen. Data dianalisa menggunakan ANOVA dan perbedaan perlakuan diuji lanjut dengan uji DMRT. Hasil penelitian melaporkan, suplementasi tepung kulit jengkol (A. jiringa) sampai 6% tidak berpengaruh (P>0,05) pada proporsi molar VFA tetapi perlakuan kontrol (tanpa suplementasi kulit jengkol) paling tinggi produksi metan dan H_2 *nya. Kesimpulannya yaitu suplementasi tepung kulit jengkol (A. jiringa) sampai 6% menurunkan produksi metan dan hidrogen tetapi tidak mempengaruhi proporsi molar VFA.*

Kata kunci: tepung kulit jengkol, metan, proprosi molar VFA

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

Table 1. VFA molar proportion (%)

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

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 defaunate effect, stimulate growth of rumen bacteria, and decrease methanogenesis. Wina *et al*. (2005); Wanapat *et al*. (2013) reported that saponins have been strong defaunation 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^{o}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 catirrier. 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 2. Methane gas production (CH_4)

Jengkol Peel Powder (%)	CH_4 (%)
0	5.51 ± 0.73[c]
2	2.35 ± 0.41[a]
4	2.60 ± 0.18[a]
6	3.16 ± 0.23[b]

Note: Means in the same column with different superscript differ significantly (P<0.05).

Table 3. Hydrogen (H_2) balance (CH_4)

Estimation Model	Jengkol Peel Powder (%)	H_2
H_2 Production	0	34.27 ± 7.04[b]
	2	12.76 ± 0.83[a]
	4	17.39 ± 1.18[a]
	6	19.16 ± 2.56[a]
H_2 Utilization	0	7.54 ± 1.58 [b]
	2	2.92 ± 0.08[a]
	4	4.34 ± 0.54[a]
	6	3.97 ± 1.24[a]

Note: Means in the same column with different superscript differ significantly (P<0.05).

and propionate (Table 1). Proportion of acetate were 68.77% – 75.86%, propionate were12.88% - 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 (CH_4) 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 defaunate 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 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.

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