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Utilization of Solid Residue *Melaleuca cajuputi* Powell Leaves as Cattle Feed

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Abstract: Distillation process of *M. cajuputi* Powell leaves to produce cajuput oil, yields a large amount of solid residue as waste materials. *In vitro* testing was conducted to evaluate the potential of solid residue of *M. cajuputi* Powell leaves as cattle feed. The measured variables were NH_3, volatile fatty acids (VFA), Dry Matter Digestibility (DMD), and Organic Matter Digestibility (DMO). Completely randomized design was made with 5 different treatments and 4 replications, in order to get 20 experimental units. Data was analyzed by analysis of variance (ANOVA), followed by Duncan's multiple range test with a significance level of 5%. The results showed that giving 100% of the solid residue of *M. cajuputi* Powell leaves produced VFA, DMD and DMO for about 102.25 mM, 59.75% and 42.28% respectively, but with lesser amount of NH_3 (2.54mM). These results were significant ($P < 0.05$) and are higher than the results by using field grass. It can be concluded that the solid residue of *M. cajuputi* Powell leaves has the potential to be used as cattle feed.

Key words: Solid residue, *M. cajuputi* Powell, *in vitro,* cattle feed

INTRODUCTION

M. cajuputi Powell is a native species to Indonesia, and is already widely known by its use in the industry for manufacturing cajuput oil. This species contains eucalyptol (1,8-cineol), which is one type of monoterpene with large amounts (15-60%) and has the function for medicinal purposes (Turnbull, 1986; Boland *et al.*, 1991). The processors of the *M. cajuputi* Powell leaf oil extract the oil only to profit by the high price of cajuput oil on the market. However, they simply burn the residue, polluting the air, rather than utilizing it for another productive use.

These leaves actually have great potential benefits when they are utilized properly. Utilization of waste as cattle feed, is an alternative to improve the availability of fodder in making up the feed rations. Conventionally the feed ration ingredients commonly used do not utilize the waste from agricultural processing, thus the opportunity is to utilize the residual potential of the post-extraction waste as fodder for ruminants (Murni *et al.*, 2008).

Utilization of agricultural waste as an alternative feed is one of the solutions to overcome the shortage of feed for ruminants. By utilizing the residue from agricultural processing we can encourage the development of ruminants in an integrated agribusiness production system. This creates a closed cycle, utilizing all of the agricultural biomass produced, supplementing the fodder for animal husbandry, yielding both fertilizers and bio-gas, resulting in an environmentally friendly, "zero waste biomass production system". Recently we have published regarding the use of fresh leaves of *M. cajuputi* Powell as cattle feed (Widiana *et al.*, 2014). The objective of this present study is to present the efficacy of utilizing the solid residue of *M. cajuputi* Powell as cattle feed.

MATERIALS AND METHODS

The *in vitro* test was conducted using cow (ongole) rumen fluid. The measured variables were NH_3 production by using Conway Microdiffusion (Sutardi, 1994), VFA using steam distillation method (Sutardi, 1994), DMD, and DMO through procedures developed by Tilley and Terry (1963). The implementation of an *in vitro* test was conducted in Ruminant Nutrition Laboratory, Faculty of Animal Husbandry, Padjadjaran University, Bandung.

Solid residue remains after steam distillation of *M. cajuputi* Powell fresh leaves. The fresh leaves of *M. cajuputi* Powell is taken from Pulang Pisau District, Central Kalimantan. The grass was obtained from the grass garden in the Faculty of Animal Husbandry, Padjadjaran University, West Java. Rumen fluid was taken from the Ongole cattle breed.

Experiments were performed using Completely Randomized Design consisting of 5 treatments that are R0 (100% field grass), R1 (75% field grass: 25% solid residue of *M. cajuputi* Powell leaves), R2 (50% field grass: 50% solid residue of *M. cajuputi* Powell leaves),

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R3 (25% field grass: 75% solid residue of *M. cajuputi* Powell leaves), and R4 (100% solid residue of *M. cajuputi* Powell leaves). Each test utilized four replications until it recovered 20 experiment units. Data was analyzed by analysis of variance (ANOVA) and followed by Duncan multiple range test with significance level of 5%.

RESULTS AND DISCUSSION

Influence of treatment on Rumen Fermentability: The result of in vitro test showing the effect of the use of *M. cajuputi* Powell leaf residue as cattle feed in a mixture with field grass, at various percentages, can be seen in Table 1.

Table 1: Averaging of NH_3 production and VFA levels in each treatment

Variables	R0	R1	R2	R3	R4
NH_3 (mM)	3.74^{e}	2.81^{b}	3.30^{c}	3.55^{d}	2.54^{a}
VFA (mM)	169.75^{c}	117.75^{a}	127.75^{b}	158.75^{bc}	102.25^{a}

Description: Superscript different in the same row indicate significantly different ($p<0.05$).
R0 (100% field grass), R1 (75% field grass: 25% solid residue of leaves), R2 (50% field grass: 50% solid residue of leaves), R3 (25% field grass: 75% solid residue of leaves) and R4 (100% solid residue of leaves).
VFA: Volatile fatty acid.

Table 1 showed that, in general, the use of solid residues of *M. cajuputi* Powell leaves, with or without a mixture with field grass, could produce lesser amounts of NH_3 (R4 = 2.54 mM). The result of this study differ from the previous results on the use of fresh leaves of *M. cajuputi* Powell that can increase the production of NH_3 (R4 = 4.01 mM) (Widiana *et al*., 2014).The proximate test of solid residue leaves of *M. cajuputi* Powell showed the protein and Non Nitrogen Free Extract (NNFE) contents to be 10.65% and 56.77%, respectively. Carbohydrate is one of the matter included in NNFE. Russell *et al*. (1983) stated that the utilization of NH_3 in the rumens related to carbohydrate availability. Carbohydrate availability determines the rate of microbial growth in the rumen (Hoover and Stokes, 1991) and efficiency of ruminal ammonia utilization (Heldt *et al*., 1999). If energy is limiting, ruminal microorganisms degrade feed proteins to ammonia (Russell *et al*., 1983), and microbial ammonia uptake is suppressed (Hristov and Broderick, 1996). The value of NH_3 on the use of solid residue of *M. cajuputi* Powell is quite less than the optimum NH_3 needed, as Sutardi (1979) stated, that NH_3 levels needed to support microbial growth ranged from 4-12 mM. The concentration of NH_3 in the rumen is an important value, because it affects the growth of rumen microbes.

Volatile fatty acids (VFA) are important sources of metabolic energy and are a carbon source for the synthesis of microbial chain fatty acids, because they are capable of supplying more than 60% of the energy needed by ruminants. The use of solid residue of *M. cajuputi* Powell leaves as cattle feed produce a VFA value of 102.25 mM. This value is less than the result value for use of fresh leaves of *M. cajuputi* Powell (R4 = 151.25 mM) (Widiana *et al*., 2014). Solid residue of *M. cajuputi* Powell leaves is produced from the distillation process in the cajuput oil industry. Generally, the heating process will reduce the pH value. Rumen pH can range from approximately eight to less than five. Slyter *et al*. (1966) stated that VFA production is often reduced at more acidic pH. This statement could explain why the use of solid residue leaves of *M. cajuputi* Powell has a lower value of VFA than fresh leaves of *M. cajuputi* Powell. However, the use of solid residue of *M. cajuputi* Powell leaves as cattle feed has also turned out to produce VFA in the normal range. Sutardi *et al*. (1983) stated that the VFA levels in the range of 80-160 mM may still be sufficient for optimal microbial protein synthesis.

Influence on digestibility: The digestibility refers to how the nutrient of a feed can be digested, metabolized, and utilized by the animal's body. Duncan multiple range test for the averaging of DMD and DMO of their conduct is presented in Table 2.

Table 2: Averaging dry matter digestibility (DMD) and organic matter digestibility (DMO) in each treatment

Variables	R0	R1	R2	R3	R4
DMD (%)	55.57^{d}	55.42^{c}	48.26^{b}	45.35^{a}	59.75^{e}
OMD (%)	41.08^{c}	41.28^{c}	38.38^{b}	34.17^{a}	42.28^{d}

Description: Different superscripts in the same row indicate significantly different ($p<0.05$).
R0 (100% field grass), R1 (75% field grass: 25% solid residue of leaves), R2 (50% field grass: 50% solid residue of leaves), R3 (25% field grass: 75% solid residue of leaves) and R4 (100% solid residue of leaves).
DMD: Dry matter digestibility. OMD: Organic matter digestibility.

Use of solid residue of *M. cajuputi* Powell leaves, significantly increases ($P <0.05$) in the digestibility of dry matter and organic matter indicating that solid residue of *M. cajuputi* Powell leaves is effected by microbial activity in the rumen. In addition, gelam leaves, which contain antioxidants are expected to help rumen microbe in the digestion of the feed. Kitta *et al*. (1992) reported that antioxidants can increase the activity and the life of bacteria, which can increase the digestibility of the feed material.

Conclusion: Solid residue leaves of *M. cajuputi* Powell have the potential to be developed as a cattle feed. The *in vitro* tests shows the production of NH_3 (2.54mM), VFA (102.25 mM), DMD (59.75%), and DMO (42.28%) using 100% of solid residue leaves of *M. cajuputi* Powell, which indicates a sub standard production of NH_3. In order to compensate for this deficiency, feed mixtures that include high Nitrogen concentrates can be added to the *M. cajuputi* Powell solid residue leaves, thereby meeting the required standards for ruminant fodder.

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