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Rumen Metabolite of Balinese Cows that Being Given Stewed Water of Lannea coromandelica Peel as Feed Additive

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Abstract

The research has been conducted to find out rumen metabolite of Balinese cows that being given stewed water of Lannea coromandelica peel as a feed additive. The research used group random design (RAK) with 4 treatments of rations and 3 times repetition. Each repetition used three Balinese cows. The weight of cows being used ranging between 137.5 – 235 kg. Basic rations being given were equal, arranged based on a percentage of dry material (% DM) namely: 50% of arrow grass, 20% of gamal leaves (Gliricidia sepium), 1% of urea and 29% of rice bran. Whereas for treatment was feed additive level. The basic ratio of +0 was feed additive (A). The basic ration of +1000 ml was feed additive (B). The basic ration of +1500 ml was feed additive (C) and a basic ration of +2000 ml was feed additive (D). Variables being observed were: N-NH3, volatile fatty acid total and volatile fatty acid partial (acetic acid, propionate acid and butyrate acid). The result of research showed that the administration of 1000 ml-2000 ml of feed additive of stewed water of Lannea coromandelica peel in basic ration differed markedly ($P<0.05$) to increase the concentration of N-NH3, volatile fatty acid total and volatile fatty acid partial. The utilization of stewed water of Lannea coromandelica peel as a feed additive in basic ration was increasing rumen metabolite of Balinese cows.

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1. Introduction

Balinese cow is germ plasma of Indonesian origin and cultivated by people due to the easiness of its husbandry system and has advantages compared to other beef cattle developed in the country. The advantages of Balinese cows among others are: having good adaptation toward the environment, especially the ability to adapt toward low-quality feed, high fertility of 83%, carcass percentage of 56% (Gun-toro, 2002), pregnancy number of 85.9% and calve percentage of 70-81% (Diwiyanto & Praharani, 2010).

Husbandry of Balinese cows as beef cattle, the attention needs to be directed in an effort for improving productivity. Hardjosubroto (1994) suggested that the productivity of beef cattle usually stated as a function of reproduction and growth level. The productivity of Balinese cows will be optimal if supported with growth. The growth of Balinese cow highly influenced by many factors, one of the factors among others is the availability of feed both qualitatively and quantitatively. Oka *et al.,* (2012) suggested that the productivity of cattle, in particular for growth and production, 60% were influenced by feed, nutrient content, and technology to formulate the ration.

Arrow grass is a natural grass, has potential to be utilized as green feed, but raw protein content only 5.91 (Sio, 2012). Arrow grass with low raw protein content, if given to Balinese cow as a single feed, is to cause a reduced growth of Balinese cows which resulted in the decrease of body weight's growth. It is because of low raw protein, is not adequate for the needs of microbes' body protein, so that it will not optimally to digest the feed to produce rumen metabolite as the source of energy for cattle.

With respect to the low raw protein of arrow grass, then the solution to be offered is the utilization of several feed materials and feed supplements in order to fulfill protein needs of rumen microbes and cattle. Feed materials being used are arrow grass, gamal leaves, urea and rice bran. Arrow grass as the source of energy feed, gamal leaves is functional feed which can be relied on to increase the protein of arrow grass. Putra (1999) suggested that gamal leaves had raw protein content and total digestible nutrient (TDN) which was high with high ammonia genesis rate so that it could improve the growth of rumen microbes and its activity in producing high rumen metabolite.

Content could trigger the protein synthesis of microbes' body. Urea is one of feed supplements with high NPN content and utilized by Balinese cow for growth. Urea in the rumen is 100% degraded into ammonia (NH_3), however, its utilization is only slightly, because if an excessive amount it can cause poisoning and death. Therefore urea administration needs to be accompanied with the addition of a readily source of energy feeding or easily fermented. Rice bran is readily source of energy feed, able to recycle ammonia which has a function as a source of energy and amino acid protein framework of microbes. However, quantitatively rice bran does not change ammonia so much so that another approach that can be done is feed additive administration of stewed water of Lannea coromandelica peel. The stewed water of Lannea coromandelica peel contains phenol compound (31.7%), saponin (30%) and flavonoid (0.43%), it can increase the consumption and digestion of ration nutrient so that it can also increase rumen metabolite as the source of energy for cattle growth.

2. Materials and Methods

2.1 Location and Timing of Research

The research was conducted on the group of stock farmers "Ulnaet Tuan", at the Village of Letmafo, District of Insana Tengah, Regency of Timor Tengah Utara, Province of Nusa Tenggara Timur, for 3 months.

2.2 Cage and Cattle

The cage being used in this research was an individual cage with the size of 1.5x2.0 m, as many as 12 cages for 12 Balinese bulls. The cages were equipped with food containers with the size of 75cm x 60cm, drink containers were using a bucket. The cage's roof was made of gewang leaves, floor made of cement and food container was made of board. Cattle being used were Balinese bulls numbering 12 bulls, age within 2-3 years with body weight averaging 178 kg.

2.3 Ration and Drink Water

Ration being used in this study consisted of arrow grass, gamal leaves, rice bran and urea which was arranged based on a percentage of dry material (% DM). Drink water for cattle was from a well.

2.4 Administration of Ration and Drink Water

All treatments were getting equal ration, meanwhile administration of stewed Lannea coromandelica peel as a feed additive for treatment A = 0 ml, B = 1000 ml, C = 1500 ml and D = 2000 ml. Administration of stewed water of Lannea coromandelica peel was mixed with urea and rice bran in the form of mash later was given to cattle according to treatment. After administration of stewed peel, it was followed with the administration of arrow grass and gamal leaves. Drink water was given after administration of arrow grass and gamal leaves.

2.5 The making of stewed water of Lannea coromandelica peel

Lannea coromandelica peel was taken from the tree, then it was weighed and stewed with water (1 kg of peel: 2 liters of water) for 20 minutes on the boiling point of 20^0C. Stewed water later was separated from the peel, measured and mixed with rice bran according to treatment. Tools being used in this study were: electronic scale (Allflex) to weigh cattle, hanging scale with a capacity of 50 kg to weight ratio, weighing scale to measure remains of ration, machetes, sickle, shovel, bucket, basin.

2.6 Trial Design

The design is used in this study was group random design (RAK) with 4 treatments of ration and 3 groups of cattle's weight as repetition. Each repetition used three bulls with age of two to three years with average body weight of 177.5 kg (I), 175.5 kg (II), 177.3 kg (III) and 176.7 kg (IV). Four treatment rations being tested were: basalt ration without feed additive as control (A), basic ration with feed additive of 1000 ml (B), basic ration with feed additive of 1500 ml (C) and basic ration with feed additive of 2000 ml (D).

2.7 Observed Variables

Research variables being observed comprised of: concentration of N-NH_3, volatile fatty acid total and volatile fatty acid partial (acetic acid, propionate acid and butyrate acid).

2.8 Statistical Analysis

Collected data were analyzed with variance and if there was a significant difference ($P<0.05$) between treatments, it was followed by Duncan's multiple distance test (Steel & Torrie, 1989).

Table 1
Composition of research ration (% DM)

Ration Composition	Treatment			
	A	B	C	D
Heteropogon contortus (%)	50	50	50	50
Glyricidia (%)	20	20	20	20
Urea (%)	1	1	1	1
Rice bran (%)	29	29	29	29
Total	100	100	100	100
Lannea coromandelica bark boiled (ml)	-	1000	1500	2000

Table 2
Ration nutrient content (% DM)

Conten Nutrien (%DM)	Treatment				Kearl (1982)	Standard
	A	B	C	D		
Dry Matter (%)		92.37	92.37	92.37	92.37	
Energy (Kcal/kg)		4086.79	4086.79	4086.79		
Crude Protein (%)		12.4	12.4	12.4	12.4	12.32
Crude Fiber (%)	18.63	18.63	18.63	18.63	18.63	
Crude Fat(%)	5.96	5.96	5.96	5.96		
Organic Matter (%)	88.45	88.45	88.45	88.45		
Rebusan *Lannea Coromandelica*						
Fenol (g)	-	2,7	4,05	5,4		
Flavonoid (g)	-	4,30	6,45	8,60		
Saponin (g)	-	60	90	120		
Tanin (g)	-	0,8	1,2	1,6		

Note:
- Ration Nutrient Content, analysis result from Feed Chemical Laboratory of Faculty of Agriculture Undana (2015)
- Phenol, Tannins, analysis result from Analytic Laboratory of Udayana University (2014)
- Saponin, analysis result from Laboratory of Cattle Research Center Ciawi Bogor (2014)
- Flavanoid, analysis result from Laboratory of Pharmacology, Faculty of Pharmacy, University of Hasanudin Makasar (2015)

3. Results and Discussions

3.1 Rumen Metabolite of Balinese Cow

Rumen metabolite is an outcome of feed digestion by way of microbe's fermentative which consists of volatile fatty acid (VFA) total, VFA partial, and N-NH_3. Rumen's metabolite product of cow research can be presented in table 4. The value of rumen's pH is very important for rumen microbe's life. Kauffman *et al.*, (1980) in Putra (2004) suggested that rumen's pH was one of the factors which were very influential to the population of rumen microbes. Kamra (2005) suggested that optimum pH for rumen microbe's growth was between 6-6.9 and normal range of rumen's fluid pH was at 5.5-7.2 (Owens & Goetsch, 1988).

Feed is very influential for rumen's pH. Rumen's pH will be high at 7.0 if given green cattle fodder and in contrast pH will be low or decreased to 4.6 if given concentrate feeding. Viera (1986) in Putra (2004) suggested that the occurrence of rumen's pH decrease was one of the causes of non-structural carbohydrate fermentation (starch and/or sugar) which was faster so that causing decreased saliva secretion within the rumen.

pH average in ration without stewed water of Lannea coromandelica peel (A) is 7.06 and in the ration of B, C, and D, pH respectively is 6.79, 6.91 and 6.82. The result of the research shows that pH average in ration B, C, and D is not significant ($P>0.05$) with ration A. The range of pH from the result of research is 6.79-7.06. This pH value is in the normal range of 5.5-7.2 (Owens & Goetsch, 1988).

Ammonia concentration (N-NH_3) is a reflection of protein quality of feed in ruminant cattle. The stewed water of santen timber peel has significant influence ($P<0.05$) towards concentration of N-NH_3. The concentration of N-NH_3 in treatment A is: 6.66 mM, meanwhile in treatment B, C and D respectively are 9.33 mM, 10.50 mM, and 11.31 mM. The result of research shows that treatment B with concentration of 9.33 mM is higher compared with treatment A, but statistically it is not significant ($P>0.05$), meanwhile in treatment C and D at 10.50 mM and 11.31 mM differs significantly ($P< 0.05$) compared with treatment A. The highest N-NH_3 concentration is in treatment D at 11.31 mM. N-NH_3 is a final result of feed protein decomposition by rumen microbes and NH_3 assimilation for microbe's growth. The elevation of N-NH_3 concentration in treatment D is related with stewed water of Lannea coromandelica peel, in which the compound of saponin and phenol is able to increase protein digestion (Table 3), so that rumen's fermentation product (N-NH_3) is increased. N-NH_3 concentration acquired from the result of study is in the normal

range for rumen's microbe growth at 4-12 mM (Sutardi, 1979). McDonald *et al.,* (2002) stated that the range of optimal NH_3 concentration for protein synthesis of rumen's microbe is at 6-21 mMol.

Table 3
Nutrient digestion of balinese cow

Variable	Treatment				SEM
	A	B	C	D	
Dry Matter (%)	53,34[b]	62,73[b]	71,54[a]	69,55[a]	1.62
Crude Protein (%)	56,14[b]	65,93[a]	71[a]	71,93[a]	2.99
Crude Fiber (%)	57,05[b]	66,83[ab]	73,1[a]	71,43[a]	1.39
Organic Matter (%)	56.64[b]	65,43[b]	73,49[a]	71.58[a]	1,53

Note:
- Value with different superscript in the same row is significantly different (P<0.05),
- A = ration without stewed water of santen timber peel.
- B = ration with stewed water of santen timber peel of 1000 ml.
- C = ration with stewed water of santen timber peel of 1500 ml.
- D = ration with stewed water of santen timber peel of 2000 ml.

The average of total VFA level in Balinese cow which getting treatment A is 182.56 mM and treatment of B, C and D respectively are 186.65 mM, 198.82 mM, and 196.70 mM (Table 4). The result of the research shows that production of VFA total in treatment B is higher compared with treatment A, but not significantly differ (P>0.05), meanwhile in treatment C and D is significant (P<0.05). Treatment B compared with C is significant, but C with D is not significant. The highest VFA total is in treatment C at 198.82 mM. Meanwhile, the lowest is in treatment A at 182.56 mM. VFA is the main source of energy for ruminant cattle (Owen and Bergen, 1983; Preston and Leng, 1987). Ensminger et al. (1990) suggested that 60-80% of energy needs on ruminant cattle coming from VFA.

The high VFA total in treatment C indicates the presence of the role of saponin compound in increasing bacterial population so that feed digestion especially digestion of organic material is increasing (Table 3). Askar & Abdurachman (2002) stated that the increasing number of rumen microbe causing the higher of synthesis of microbe's protein (SPM) followed by the forming of VFA compound, which is the outcome of rumen's microbe fermentation. France & Dijkstra (2005) suggested that the level of VFA was influenced by basalt feeding, carbohydrate type of feed, the physical form of feed, consumption rate, amount of feed and usage of the additive. Sutardi (1979) suggested that maximum VFA content needed to sustain rumen's microbe growth was between 80-160 mM. The result of VFA obtained from this study is different with the result of study by Suryani (2012) that is concentration of VFA total ranging between 192.72-220.71 mM with complete ration

From various green material with different types and compositions. Mariani (2012) found that concentration of VFA total ranged between 143.42-229.92 mM in a ration with different protein and energy.

The average of VFA partial can be presented in Table 4. The administration of stewed water of santen timber peel has a significant effect (P<0.05) towards concentration of acetic acid, butyrate acid, and propionate acid. The concentration of acetic acid in ration A is 35.20 mM, and in ration B, C and D respectively are: 39.25 mM, 55.47 mM, and 60.35 mM. The highest concentration of acetic acid is in treatment D which is 60.35 mM. This is because saponin compound presence in stewed water of Lannea coromandelica peel is able to increase the activity of cellulolytic bacteria in digesting raw fibers.

Table 4
The Effect of Stewed Water of Lannea coromandelica Peel
Toward Rumen Metabolite of Balinese Cows

Variable	Treatment				SEM
	A	B	C	D	
pH	7.06[a]	6.79[a]	6.91[a]	6.82[a]	0.069
N-NH_3 (mMol)	6.66[b]	9.33[a]	11.40[a]	11.31[a]	0.78
VFA Total (mMol)	182.56[b]	186.65[b]	198.82[a]	196.70[a]	1.44
Asetat Acid (mMol)	35.20[b]	39.25[b]	60.47[a]	60.35[a]	1.12

PropionatAcid. (mMol)	21.15^{b}	24.71^{b}	30.15^{a}	29.36^{a}	0.41
Butirat Acid (mMol)	8.10^{ab}	9.21^{b}	14.32^{a}	12.36^{b}	0.45

Note:
- Value with different superscript in the same row is significantly different (P<0.05),
- A = ration without stewed water of santen timber peel.
- B = ration with stewed water of santen timber peel of 1000 ml.
- C = ration with stewed water of santen timber peel of 1500 ml.
- D = ration with stewed water of santen timber peel of 2000 ml.

The concentration of butyrate acid in treatment A is 8.10 mM, and concentration of butyrate acid in ration B, C, and D respectively are 9.21 mM, 14.32 mM and 12.36 mM. The concentration of propionate acid in ratio A is 21.15 mM, and concentration of propionate acid in ration B, C, and D respectively are 24.71 mM, 30.15 mM and 29.36 mM. The highest concentration of butyrate acid is in treatment C at 14.32 mM Meanwhile the highest concentration of propionate acid is in treatment C at 30.15 mM. The high concentration of butyrate and propionate acid in this research is because of saponin compound presence in stewed water of Lannea coromandelica peel which is able to increase feed digestion (table 3) so that concentration of butyrate and propionate acid becomes high.

Acetic acid and butyrate acid is used as a source of energy for host animals through oxidation in the citric acid cycle. Meanwhile acetic acid is an important substrate for lipogenesis, meanwhile propionate acid as a substrate for gluconeogenesis (France and Dijkstra, 2005).

3.2 Appearance of Balinese Cow

The average of daily body weight growth of Balinese cow during the study is presented in Table 4. The result of research shows that on treatment getting feed additive supplement of stewed water of Lannea coromandelica peel at 1000 ml (B), the body weight growth is higher compared to treatment A, but statistically it is not significantly different (P>0.05), meanwhile in treatment C and D it is significant (P<0.05) to increase daily body weight growth. The highest body weight growth is in treatment D (0.69 kg/e/h). Body weight of cattle is the result obtained from cattle consuming ration in a certain point of time. Body weight of cattle is influenced by type, quality, and continuity of feed. Sukardi et al. (2005) suggested that body weight growth was highly influenced by protein and calorie being consumed. Nuriyasa (2012) stated that the highest consumption of ration resulted in highest body weight.

The growth of body weight of Balinese cows in this study is high, it is related to the administration of feed additive of stewed water of Lannea coromandelica peel. The compound of flavonoid, saponin and phenol presence in stewed water of Lannea coromandelica peel is able to improve consumption of ration which positively correlated with increasing the consumption of dry material and nutrient of the ration as well as digestion of dry material and nutrient of ration (Table 3). Consumption of high dry material and ration nutrient is important for rumen microbe growth so that fermentation process in the rumen is very optimal to produce rumen metabolite (VFA and N-NH_3). VFA and NH_3 are rumen fermentation product, utilized as a source of energy for cattle growth. The higher the absorption of VFA and NH_3 by cattle, will contribute positively to the cattle growth, marked with the high of body weight growth. Yaghoubi et al. (2008) reported that calf being given flavonoid with medium and high dose successively $7.3x10^{-4}$ gr/kg of body weight and $3.6x10^{-3}$ gr/kg of body weight, flavonoid in both doses causing the increasing of humoral immune response in the age of 4-5 weeks for calf followed by the increase in body weight in the 5^{th} and 6^{th} week.

The administration of feed additive of stewed water of Lannea coromandelica peel at 2000 ml is the most efficient in changing ration into body weight. It can be seen on FCR score of treatment D, the lowest is the most efficient (Table 5). The administration of feed additive of stewed water of Lannea coromandelica peel in treatment D increases the efficiency of ration usage which shown with low FCR. Body weight growth acquired from this research is higher compared to the result of a study by Mariani (2013) at 0.56 kg/e/h on the requirement of protein and energy which means that Balinese cows are growing based on the trial of feeding and body composition. The result of research is lower compared to the result of a study by Suryani (2012) at 0.88 kg/e/h on Balinese cows that were given green material with different type and composition.

Table 5
The appearance of Balinese cow

Variable	Treatment				SEM
	A	B	C	D	
Initial Weight (kg)	177,5[a]	177,5[a]	177,3[a]	181,7[a]	9,72
Final Weight (kg)	213,3[a]	225 [a]	236,7 [a]	243,7[a]	13,21
Total Weight Gain (kg)	35,8[b]	49,5[b]	59,33[a]	62[a]	2,83
Weight Gain (kg/e/h)	0.40[b]	0.55[ab]	0.66[a]	0.69[a]	0.03
FCR	13,78[b]	11,58[b]	9,92[ab]	9,6[ab]	0,87

Note:
***** Number with different superscript in the same row is significantly different (P<0.05)
* SEM: Standard Error of Treatment Means;
* PBB: Body weight growth;
* FCR: Feed Conversion Ratio; Kg/cow/day.

4. Conclusion

Based on the result and discussion above, it can be concluded that: The utilization of stewed water of Lannea coromandelica peel as a feed additive is significantly (P<0.05) increasing rumen metabolite of Balinese bulls.

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Statement of authorship
The author(s) have a responsibility for the conception and design of the study. The author(s) have approved the final article.

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