

In vitro Study of Noni Juice Extract Waste (*Morinda citrifolia* L.) and Pineapple Industrial Wastes (*Ananas comosus* L. Merr) as Energy Supplement in Dairy Goat Ration

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Abstract

The aim of the study was to evaluate the potency of noni juice extract waste (*Morinda citrifolia* L.) and pineapple industrial wastes (*Ananas comosus* L. Merr) as an energy supplement in dairy goat ration through in vitro study. This study used a complete randomized design with 5 treatments and 3 rumen fluid groups. The treatments were R0 as control (60% Napier grass (NG) + 40% concentrate), R1 (45% NG + 15% noni juice extract waste + 40% concentrate) + R2 (45% NG + 15% noni juice extract waste ammoniated + 40% concentrate), R3 (45% NG + 15% pineapple peel + 40% concentrate), and R4 (45% NG + 15% pineapple crown + 40% concentrate). The variables were total bacterial population, protozoal population, fermentation characteristic (total VFA and NH₃ concentration), and digestibility (dry matter and organic matter). Data were analyzed with analysis of variance (ANOVA) and differences among treatments were determined by orthogonal contrast. The results showed that total VFA concentration was significant increased ($P < 0.05$) by replacing 25% napier grass with noni juice extract waste (R1) or very significant increased ($P < 0.01$) by replacing the grass with pineapple peel (R3). The average increasing of total VFA concentration was 74% compared to control. As conclusions, 15% pineapple peel or 15% noni juice extract waste can use as an energy supplement by replacing 25% of napier grass in lactating dairy goat ration.

1. Introduction

Feed is one of important factors in livestock production. The quality and quantity of feed affect productivity in livestock. Lack of feed and its nutrient can cause livestock not producing optimally that can be impact on business farmers. Ruminants can digest forage as a main feed. [1] In dry season, ruminants facing a problem due to insufficient of forage or decrease of its quality.

Noni production (*Morinda citrifolia* Linn) in Indonesia reached 8.577.347 tons in 2014 [2]. Noni juice which is used as a traditional medicine for human, has a waste which called as noni juice extract waste (NJW) being disposed. NJW has been used as poultry feed, but still not many peoples use it as feed ruminant. [3] In formerly in vitro research, we found that total VFA production and NH₃ concentration linearly decreased when percentage of NJW linearly increased in ruminant ration due to of increasing the lignin content of NJW (24.51%). Lignin is one of the component in cell plants that has complicated degradation. The existence of lignin in feed can be a barrier in feed digestibility. Resolving lignin structure are required so that NJW can digest by ruminant. One of the methods to decrease the constraint such as ammonization may applicable to NJW. Ammoniation is chemically feed processing which used ammonia (NH₃) in the process for increasing feed digestibility and increase N (protein) concentration [4]. In this present research we applied ammonization to NJW.



The others energy source come from pineapple industry [2]. In 2014, Indonesia produced 1,835,483 tons pineapple and it is increase annually. The majority of pineapple can be used as canned food, jam, syrup, and other. It can give more waste. Some of them already have been used as feed. In this present research we tried to use the peel and crown of pineapple as two kinds of energy source in ruminant ration due to high fiber but low lignin content.

The aim of this study was to evaluate the potency of noni juice extract waste (*Morinda citrifolia* L.) and pineapple industrial wastes (*Ananas comosus* L. Merr) as energy supplement in dairy goat ration through in vitro study.

2. Materials and Methods

2.1 Materials

The materials used in this research were noni juice extract waste (NJW), pineapple industrial waste (peel and crown) (PIW), and urea. The treatment rations that comprised of Napier grass, tempe waste, soybean meals, coconut meals, corn, CaCO_3 , DCP, and premix were composed according to NRC (2007) for lactating dairy goats which contained 12-17% crude protein and 53-66% TDN. Ration composition and nutrient content are placed in Table 1.

2.2 Methods

Noni juice extract waste (NJW) dried in the sun for 2 days. Then NJW had been dried again in oven 60°C for 1 day. NJW which had dried in oven got weighed back then ground into flour. Some NJW flour been weight for ammoniation process. Ammoniation process used 3% urea from NJW total weight that being ammoniated. Pineapple industrial waste (PIW) consist of peel and crown then weighed, dried under the sun for 1 day weighed back. Both waste were then dried back with 60°C oven for 1 day. After drying the peel and the crown of the pineapple are weighed back finally ground into flour.

This research used complete randomized design with 5 treatments and 3 rumen fluid groups, each group had 2 rumen fluid mixed from different dairy goats. The treatments were R0 as control (60% Napier grass (NG) + 40% concentrate), R1 (45% NG + 15% NJW + 40% concentrate) + R2 (45% NG + 15% NJW ammoniated + 40% concentrate), R3 (45% NG + 15% pineapple peel + 40% concentrate), and R4 (45% NG + 15% pineapple crown + 40% concentrate). The variables were total bacterial population, protozoal population, fermentability (total VFA and NH_3 concentration), and digestibility (dry matter and organic matter). Data were analyzed with analysis of variance (ANOVA) and differences among treatments were determined by orthogonal contrast.

3. Results and Discussion

Feed undergoes a series of processes physically and chemically in the digestive tract before digest in the rumen[5]. In the rumen and reticulum, the microbes have roles to continue the fermentative digestion of diets. Table 2 shows effect of substitution 25% napier grass with 15% noni juice extract waste, 15% noni juice extract waste ammoniation, 15% pineapple peel or 15% pineapple crown upon in vitro fermentation characteristic (NH_3 concentration and total VFA concentration), digestibility (dry matter and organic matter), and population of rumen microbes (bacteria and protozoa).

Table 1. Rations composition and nutrien content

Materials	R0	R1	R2	R3	R4
Ration composition (%)					
Napier grass	60	45	45	45	45
Tempe waste	1	1	1	5	4
Soybean meals	15.50	18.20	13.00	15.20	14.00
Coconut meals	7	5	6.2	5	4
Noni juice extract waste (NJW)	0	15	0	0	0
Ammoniated NJW	0	0	15	0	0
Pineapple industrial waste, peel	0	0	0	15	0
Pineapple industrial waste, crown	0	0	0	0	15
Corn	14	13	17	12	15
CaCO ₃	0.3	0.3	0.3	0.3	0
DCP	1.2	1.5	1.5	1.5	2
Premix	1	1	1	1	1
Nutrien content (% DM)					
Dry matter ^a (DM)	91.13	91.03	92.10	90.37	91.18
Ash ^a	17.86	14.64	14.08	14.77	13.97
Ether Extract ^a (EE)	4.66	5.32	4.94	1.59	3.38
Crude Protein ^a (CP)	16.77	16.49	18.63	13.47	12.51
Crude Fiber ^a (CF)	25.78	25.38	26.67	25.75	25.40
Nitrogen Free Extract (NFE)	34.93	41.44	35.68	44.42	44.74
TDN ^b	51.78	54.56	54.94	53.94	54.48

^aProximate analyses result from Laboratory of Research Center for Biological Resources, IPB 2017;

^bTDN: *total digestible nutrients*; ^bcalculation based on Hartadi *et al.* (1997) : $37.937 - 1.018 (CF) - 4.886 (EE) + 0.173 (NFE) + 1.042 (CP) + 0.015 (CF)^2 - 0.058 (EE)^2 + 0.008 (CF) (NFE) + 0.119 (EE) (NFE) + 0.038 (EE) (CP) + 0.003 (EE)^2 (CP)$.

There were no significant effect on NH₃ concentration of rations when 25% of Napier grass were substituted by NJW or PIW. However, the average ammonia (NH₃) concentrations were higher than the ideal concentration in rumen according to ranges from 6-12 mM [6]. This might caused by high content of soybean meal in the rations which categorized as rumen degradable protein (RDP) and also by addition of urea in ammoniation process.

Table 2. The effect of substitution 25% napier grass with noni juice extract waste or pineapple industrial waste upon in vitro fermentation characteristic, digestibility and population of rumen microbes

Variables	Treatment				
	R0	R1	R2	R3	R4
NH ₃ (mM)	15.13±2.20	14.99±2.00	15.74±1.43	12.41±2.20	13.76±1.92
VFA (mM) ¹⁾	95.77±13.10c	164.90±24.68b	110.96±25.96c	167.87±22.18a	114.70±37.76c
DMD (%)	52.62±8.56	58.85±4.67	58.53±4.92	59.77±6.44	58.45±7.16
OMD (%)	47.83±9.67	55.80±5.51	55.38±5.68	56.81±7.00	54.53±9.25
Bacterial Population (log CFU ml ⁻¹)	8.59±0.59	8.96±0.12	8.43±0.23	9.06±0.57	9.03±0.26
Protozoal Population (log cells ml ⁻¹)	4.66±0.03	4.69±0.08	4.74±0.02	4.71±0.04	4.62±0.09

1) The numbers followed by different letters in the same row show the significant difference ($P < 0.05$). R0= (60% Napier grass (NG) + 40% concentrate), R1= (45% NG + 15% noni juice extract waste (NJW) + 40% concentrate), R2= (45% NG + 15% NJW ammoniated + 40% concentrate), R3= (45% NG + 15% pineapple peel + 40% concentrate), and R4= (45% NG + 15% pineapple crown + 40% concentrate). NH₃= NH₃ concentration, VFA= total VFA concentration, DMD= dry matter digestibility, OMD= organic matter digestibility.

Substitution of 25% of Napier grass with 15% NJW or 15% PIW in the rations showed significant effect on total VFA concentration ($P < 0.05$). The average of total VFA concentrations were higher than the optimal range 70-150 mM [6], due to high content of readily available carbohydrate (RAC) such as corn in all rations. From the orthogonal contrast test, total VFA concentrations showed very significantly increased by addition of pineapple peel ($P < 0.01$) and significantly increase by addition of NJW ($P < 0.05$). The increasing of total VFA concentration in R1 and R3 achieved almost 74% compared to control. That increasing might caused by very high RDP content of soybean meal (18.2%) in R1 which supported the synthesis of microbial protein to digest NJW. The increasing of total VFA concentration in R3, might caused by high NFE as RAC sources of pineapple peel as well as corn. The lower total VFA concentration in R2, might caused by ammoniation process of NJW was not effectively done due to high content of lignin in NJW. In case of R4, total VFA concentration was low, it might caused by high availability of undegradable compound in pineapple crown. [7] There was relationship between the amount of soluble and degradable nitrogen or protein in the microbial protein synthesis as well as its rate of degradation, the amount of digestible organic matter fermented in rumen and also availability of carbon chains (CHO's) to rumen microorganisms. Moreover, to increase more the microbial protein synthesis, both sources of nitrogen and degradable CHO's must be in a synchronized way.

The digestibility is an important factor in determining the value of feed [8]. In vitro digestibility is influenced by several factors such as mixing feed, composition feed, rumen fluids and materials, pH and temperature settings during fermentation, incubation length, sample particle size, and buffer solution [9]. The founding results showed that the treatment rations not affected the dry

matter as well as organic matter digestibility. The lowest value of both digestibility were showed in control (DMD 52.62% and OMD 47.83%), while similar value of both digestibility were achieved by all treatments (DMD 58.9% and OMD 55.63%). There is increasing the digestibility (12% in DMD and 16% in OMD) when substitution of 25% Napier grass were done with NJW and pineapple industry waste (PIW) in the rations. Availability of degradable protein such as soybean meal in the rations can support increasing the cellulolytical bacteria number, which in turn will digest NJW or PIW ration in longer time compare than control due to highly content of lignin or cellulose-lignin linkage.[10] Addition of RDP in diets containing non-fibre carbohydrates in Rusitec increased significantly apparent disappearance of diets, VFA total, acetate, acetate/propionate, methane, efficiency of microbial synthesis, *R. albus* and *R. flavefaciens*.

Rumen microbial activity determined the performance of the digestive system in ruminants. Microbes help ruminant in digesting feed up to 70-85% [11]. The average of bacteria population as well as protozoa population in this present research showed slightly below than other study (9-10 log CFU ml⁻¹ and 5 - 6 log CFU ml⁻¹, respectively) [6]. However, replacement type of fiber source (Napier grass with NJW or pineapple industry waste) in this research did not affect the rumen microbial population. Bacteria and protozoa population was not influenced by availability of NJW or PIW. In our previous research, we analyzed the phytochemical of NJW. NJW was not containsaponin and tannin, but contains high intensity of triterpenoid and flavonoid [3]. In medicinal herbs, saponin and tannin are usually function as anti-bacteria, and the triterpenoid and flavonoid function as antioxidant.

4. Conclusion

From in vitro investigation, total VFA concentration was significant increased ($P < 0.05$) by replacing 25% napier grass with 15% noni juice extract waste (R1) or very significant increased ($P < 0.01$) by replacing the grass with 15% pineapple peel (R3). The average increasing of total VFA concentration was 74% compared to control. Therefore, 15% pineapple peel or 15% noni juice extract waste can be used as an energy supplement by replacing 25% of napier grass in lactating dairy goat ration.

Acknowledgement

We would like to express our gratitude to Ministry of Research, Technology and Higher Education for research funding through PUPT-PSA Research Program, LPPM IPB 2017.

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