

The Effect Additional of Sodium Carbonate as Buffer in Utilization of Tofu By-product Lactic Acid Bacteria Fermentation as Basal Ration on Rumen Fermentation Bligon Goat During Lactation

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ABSTRACT

This study was aimed to evaluate the effect of NaHCO₃ addition as a buffer in fermented tofu waste concentrate by lactic acid bacteria on rumen fermentation characteristics of Bligon goats. The experiment was conducted in Jetak Village, Sidokarto, Godean, Sleman for 8 weeks. The experiment used eight lactating weight of body at 21 to 25 kg. The goats were divided into two treatments: control and treatment groups. The goats in control group were offered basal feed as much as 3% dry matter of body weight, consisted of 60% forage and 40% fermented concentrate feed. Goats were fed with the same basal feed in control group with the addition of NaHCO₃ as much as 3% of the fermented concentrate feed (as fed). The examination was conducted to collect data on rumen fermentation characteristics of the collection-0 (t0) and 3 (t1) hours after feeding include: pH, VFA production, NH₃ concentration, and microbial proteins products. Data were analyzed statistically with T-test. The results showed that the addition of buffer to the concentrate feed fermentation LAB significantly affect (P<0.05) pH, total VFA production (t0), and NH₃ concentration (t1), but no significant effects were detected on total VFA production (t1), microbial protein, and NH₃ concentration (t0). It is concluded that NaHCO₃ addition as a buffer in fermented tofu waste concentrate able to maintain rumen pH in normal conditions, that the bio-fermentation process in the rumen optimally.

Keywords: Bligon Goats, Fermented concentrate, NaHCO₃, VFA, NH₃, Protein microbes

INTRODUCTION

Bligon goat is a small ruminant that many found in Indonesia, especially rural communities. These goats are commonly found in smallholder farms and use traditional systems. Nowadays goat breeders are faced with the problem of providing a feed that is difficult to get especially in the dry season.

Concentrate feeding or supplements using raw materials with high nutrient (protein, energy, and mineral) ingredients should be used to supplement the nutritional deficiencies found in the basal diet. Providing high quality concentrate feed will accelerate the growth of the animal, so that the weight of animal can be achieved in a short time. However, feeding of concentrates in high amounts is not good because it can cause a decrease in rumen pH. This is due to the concentration of high soluble carbohydrate content that will increase the production of volatile fatty acid (VFA) and suppress the *buffering system* in the rumen, while due to reduced mastication and decreased saliva production (Arora, 1995).

The usual feed conservation is by fermentation using anaerobic LAB. The preservation principle of feed is to spur the creation of anaerobic conditions and decrease the value of pH to

acid in a short time. There are four important things to get the condition: eliminating air quickly by compressing the feed material, produces lactic acid which decreases the pH value, prevents oxygen entering the silo, and inhibits mold growth during storage.

The end product of the anaerobic fermentation process has a low pH, and is not recommended directly to the animal; due to rumen microbes only grow if the neutral pH condition. The usual treatment to reduce the low pH is by feeding the aerated air before being fed to livestock but it can be added to the material having buffering properties of pH, such as the addition of sodium bicarbonate (NaHCO₃). Addition of buffer in fermentation concentrate feed aims to neutralize feed pH so that fermentation in the rumen running normally. This can be seen on the values of rumen acidity (pH), fermentation pattern, osmotic pressure, protein degradation, and microbial synthesis.

MATERIALS AND METHODS

This research uses equipment such as equipment for the fermentation process include plastic and silo capacity of 100 kg. The research used eight Bligon goats placed in individual cages with chaff litter and equipped with feeding holder, drinking holder, a set of Geishausser (Geishausser, 1993), a set of proximate analyzers, a GENESYS 20 brand spectrophotometer, waterbath, Hanna pH meters, centrifuges, Vortex mixer model VM-1000 Volt 220, 1.5 mL safelock tube, and gas chromatography (GC) Schimadzu GC-8A type. The results of chemical content analysis of feed material presented in Table 1.

Table 1. Chemical composition of feedstuff

nutrient (%)	Feedstuff		
	Grass field	Groundnut straw	Fermented concentrate
DM	22,75	23,48	41,51
Ash	13,56	11,66	10,28
Crude Protein	15,32	17,59	14,00
Crude fat	3,32	4,38	13,11
Crude fiber	22,21	28,43	21,14

This research was conducted by direct feeding method (in vivo). Previously, all materials were fermented on silos with a total volume of 100 kg for 14 days. After the fermentation, the fresh concentrate fermentation in two treatments based on the levels of NaHCO₃, 0 and 3% addition. Each treatment got 4 repetitions, then observed the pH value. Goats are fed based on 3% of body weight (DM). Goats are divided into two groups, the first group as the control and the second group being treated. The control group (T0) was fed 60% forage (a mixture of ground grass and groundnut straw) and 40% fermentation concentrate while the treatment group (T1) was fed 60% forage (mixture of ground grass and groundnut straw) and 40% fermented concentrate plus NaHCO₃ as much as 3% by weight of concentrate. Rumen fluid collection at the end of two months of maintenance. The examination was conducted to collect data on rumen fermentation characteristics of the collection-0 (t0) and 3 (t1) hours after feeding include: pH, VFA production, NH₃ concentration, and microbial proteins products. Data were analyzed statistically with T-test

RESULT AND DISCUSION

Dietary treatments effects on ruminal ammonia concentration, ruminal pH, Protein microbes and ruminal VFA concentration are presented in Table 2.

Tabel 2. Effect of NaHCO₃ addition as buffer in fermented tofu waste concentrate by lactic acid bacteria on the rumen fermentation characteristic

	0 hours		P- Value	3 hours		P- Value
	T0	T1		T0	T1	
Ph	6,81 ± 0,09	7,21 ± 0,15	<0,01	6,54 ± 0,20	6,87 ± 0,22	<0,01
VFA	16,93 ± 1,15	11,80 ± 0,64	<0,01	20,40 ± 0,89	20,78 ± 1,80	0,718
Individual VFA,						
• Acetate (A)	10,55 ± 1,52	6,95 ± 0,48	<0,01	12,43 ± 0,12	13,21 ± 1,14	0,227
• Propionate (P)	5,09 ± 1,07	3,46 ± 0,27	0,026	5,87 ± 0,74	5,63 ± 0,53	0,615
• Butyrate (B)	2,64 ± 0,42	1,38 ± 0,05	0,01	2,10 ± 0,16	1,95 ± 0,15	0,205
(A+B):P	2,50 ± 0,28	2,41 ± 0,18	0,14	2,50 ± 0,28	2,69 ± 0,10	0,240
NH ₃ mg/100ml	18,80 ± 6,20	13,02 ± 8,17	0,3	18,79 ± 3,57	7,21 ± 4,48	<0,01
N-Microbe, mg/mL	0,38 ± 0,097	0,35 ± 0,06	0,260	0,34 ± 0,13	0,28 ± 0,14	0,583

pH ruminal

The results showed that the addition of NaHCO₃ as a buffer increased the pH of fermentation concentrate ($P < 0.05$). The addition of 3% NaHCO₃ to the LAB fermentation concentrate feed positively affected the rumen condition. The pH value of rumen goat fluid fed with BAL fermentation concentrate with addition of 3% NaHCO₃ was in the range of 7.21 ± 0.15 before feeding and 6.87 ± 0.08 at 3 h after feeding. This means that the rumen conditions in the treatment are in an ideal condition for the growth of rumen microbes. The low pH value condition of 3 h post-feeding due to the accumulation of VFA which is the result of a carbohydrate and acidic overhaul. This is in the opinion of Van Soest (1994) which states that the factors that affect the pH value of rumen fluid is the length of stay time of food calculated since eating feed and salivary secretion. Van Houtert (1993) added a decrease in the pH value of rumen will last 0.5 - 4 hours post-feeding. The pH value of the rumen will return to normal after 5 hours post-feeding due to the base saliva and low VFA concentration after absorption by the rumen's microvilli.

VFA production

The results showed that the addition of 3% NaHCO₃ to the fermented concentrate for two months affected the ecosystem in the rumen and it was evident from the production of VFA at 0 hour before feeding insignificant effect ($P < 0,05$), but did not affect VFA production at 3 h after feeding. The production of rumen goat VFA fed with fermentation concentrate with addition of 3% NaHCO₃ was in the range of 11.80 ± 0.64 mM before feeding and 20.78 ± 1.79 mM at 3 h after feeding. Yost et al. (1977) states that the increased absorption of VFA results in a decrease in rumen pH. The absorption rate of VFA is influenced by the carbon bond length at the individual VFA. The absorption rate in the individual VFAs sequentially is butyric, followed by propionate, and then acetate.

The results showed that the addition of 3% NaHCO₃ had significant effect ($P < 0,05$) on acetic acid production (C2) at 0 h but no significant effect on C3, C4 and C2 (C4) / C3. Based on Table 2 it is known that the result acetic acid ranged from 6.95 to 13.21 mM, propionic acid ranged from 3.46 to 5.87 mM and butyric acid ranged from 1.38 to 2.64 mM. The results are lower than the results of research Suryani et al. (2014), goats fed forage and concentrate (60:40) producing acetic acid, propionate and butyricates respectively of 23.44, 8.74, and 3.43 mM. Differences in individual VFA production in this study are caused by several factors,

including the type of feed given, the chemical composition of feed ingredients, and the type of animal used.

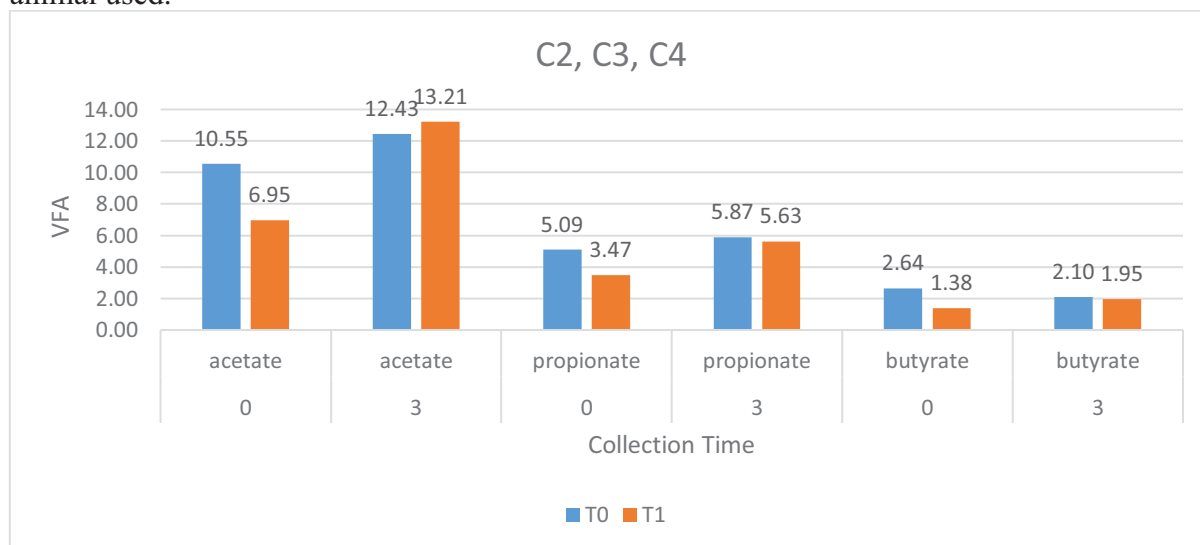


Figure 1. Graph of VFA production

Ammonia concentration

The results showed that the addition of NaHCO_3 to 3% level in the fermented concentrate did not affect the NH_3 concentration of rumen fluid on the taking of 0 hours before feeding which was in the range of 13.02 ± 8.17 to 18.80 ± 6.20 mg / 100 mL. The addition of NaHCO_3 3% level in the fermented concentrate affected the NH_3 concentration of rumen fluid at 3 h after feeding in the range of 7.21 ± 4.84 to 18.79 ± 3.57 mg / 100 mL. This shows the ideal rumen conditions so that rumen microbes are able to utilize NH_3 to grow. The value is in accordance with the opinion of Bondi (1987) that optimal growth and microbial activity in the rumen required ammonia concentrations ranging from 5 to 50 mg / 100 mL of rumen fluid.

Table 2 shows the rumen fluid NH_3 concentrations at 3 hour post-feeding were lower than the 0 hour. This suggests most of the NH_3 has been used for the growth of rumen microbes. Khorasani and Kennelly (2001) states that peak NH_3 production occurs in the morning after 1 to 2 hours post-feeding and at night after 6 to 7 hours post-feeding. Church (1988) states that factors may affect the degradation of feed ingredients in the rumen include feed chemical composition, NH_3 rumen production, rumen VFA, pH rumen, rumen outflow rate, technological treatment, and the presence of anti-nutrient content in the feed.

Protein microbe

The results showed that the addition of NaHCO_3 to level 3% in the fermented concentrate did not affect the microbial protein in feed fermentation process in the rumen. Although NH_3 concentrations at 3 hour post-feeding were lower than the 0 hour, there was no significant change in microbial protein synthesis. This is related to the imbalance between protein and feed carbohydrates available in the rumen. McDonald et al. (1995) states the rumen ideal conditions that, when high protein content is offset by the high energy content of feed ingredients with the aim that the degradation of proteins in the rumen NH_3 can be exploited by rumen microbes for microbial protein synthesis.

CONCLUSIONS

Based on the result of the research, it was concluded that the NaHCO_3 addition as a buffer in fermented tofu waste concentrate by lactic acid bacteria was able to maintain the rumen pH

under normal conditions, so that the bio-fermentation process in the rumen was normal. Feeding fermented *tofu waste* concentrate by lactic acid bacteria can be given by adding NaHCO₃ as a buffer.

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