



Effect of Dietary Supplementation of Binahong *Anredera Cordifolia* (Ten.) Steenis Extract as a Feed Additive on the In Vitro Ruminal Fermentation

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Abstract | Ruminants in tropical countries primarily face the issue of inefficient nutrient digestion. This study aimed to identify the optimal dose of Binahong extract as a feed additive in a ruminant diet, using nutrient degradation and fermentation in the rumen as indicators. A completely randomized design with 4 treatments and 4 replications was employed, involving binahong extract levels: control, 1%, 1.5%, and 2% based on dry matter (DM). One gram of feed substrate, supplemented with binahong extract, was incubated in buffered rumen fluid at 39°C for 48 hours in a 120 ml serum bottle. Gas production was measured at intervals of 2, 4, 6, 8, 10, 12, 16, 20, 24, 36, and 48 hours. Rumen fluid was also collected to calculate the population of protozoa at 4, 24 and 48 hours. After incubation, the residue was used for determining dry matter and organic matter degradability (DMD/OMD), while the supernatant was analyzed for pH, VFA, NH₃, and protozoa concentration. Data were analyzed using ANOVA, Differences between treatments were carried out by the Tukey test and regression. There was no significant of treatment on the DMD, OMD, NH₃ cocentration, but the VFA cocentration increased form 100.80 mM (without Binahong extract) to 105.78 mM (with Binahong extract). The evaluated extract dose was insufficient to impact certain parameters, or microbial adaptability to environmental changes nullified any effect. Meanwhile, VFA production increased due to changes in the rumen fermentation pattern. Treatment significantly affected (P<0.05) total gas production and protozoa populations. A linear relationship was observed between the binahong extract levels and both total gas production and protozoa population. Binahong supplementation elevated gas production, volatile fatty acid (VFA) concentration, and decreased protozoa populations in ruminants. The addition of 1% Binahong extract reduced protozoa by 30.2%, suggesting its potential to enhance nutrient utilization, feed efficiency, and livestock performance in tropical areas.

Keywords | Active compounds, *Anredera cordifolia*, Ruminal fermentation, Feed additive, Microbiota ruminal, Plant extract

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Active compounds extracted from plants can be used as safe feed additives to modify rumen fermentation and microbiota, as they can be beneficial and increase feed efficiency. The binahong plant (*Anredera corifolia* (Ten.) Steenis) is an herbal plant belonging to the Basellaceae family and potential to be used as a ruminant feed (Widodo *et al.*, 2022; Widu *et al.*, 2021). Binahong is known to contain various bioactive compounds, including tannins, saponins, flavonoids, and alkaloids, which are secondary metabolic products with various therapeutic effects and antimicrobial effects (Widodo *et al.*, 2022; Salim *et al.*, 2021). Tandi *et al.* (2023) reported that Binahong leaf extract contained 0.2512% w/w tannin, 0.1631% w/w saponin, 0.2433% w/w total flavonoid, and 0.0350% w/w alkaloid. Additionally, the ethanol extract of binahong leaves yielded a saponin content of 25.91% (Wardatun *et al.*, 2019). Varying concentrations of active compounds are found in different extracts of Binahong leaves. This variation inevitably leads to diverse effects when these extracts are applied to various substrates and animals. Consequently, additional studies are necessary to explore the potential use of binahong extract as a feed additive.

Studies on utilizing binahong leaf extract as a dietary supplement for ruminants remain scarce. Yolanda *et al.* 2024 investigated the potential of binahong leaves (*Anredera cordifolia* (Ten.) Steenis) as a herbal feed additive to mitigate subclinical mastitis in lactating dairy cows. The extraction analysis of binahong leaf extract revealed the presence of flavonoids (71.8 mg/g), phenols (6.21 mg/g), saponins (2.22%), and tannins (3.81%). The antibacterial activity assay demonstrated that extract concentrations of 10-15% exhibited strong potential as an antibacterial agent, inhibiting the growth of several bacteria responsible for subclinical mastitis, namely *Staphylococcus aureus*, *Staphylococcus epidermidis*, and *Streptococcus agalactiae*. These findings suggest that binahong leaf extract may serve as an effective herbal feed additive for the prevention of subclinical mastitis in lactating dairy cows.

Recent studies have demonstrated that binahong leaf extract exhibits potential as a natural anthelmintic, with concentrations of 15mg/ml effectively reducing the number of eggs of the parasite *Ostertagia sp.* in goats (Ginting *et al.*, 2023). The findings indicate that the active compounds present in binahong leaves exhibit potential benefits for ruminants. This observation is corroborated by research investigating the advantageous properties of active compounds in binahong, specifically flavonoids and alkaloid compounds, which have demonstrated antibacterial and immunomodulatory effects that may enhance the digestive health and immune function of livestock (Rohaeni *et al.*, 2024; Muiz, 2016). These properties indicate that Bina-

hong leaves may potentially contribute to the enhancement of livestock welfare and productivity through the augmentation of immune responses, mitigation of oxidative stress, and amelioration of common animal ailments.

Tannin compounds in Binahong exhibit the capacity to mitigate nitrogen degradation in the rumen. The effects of tannins on rumen fermentation and methane production vary depending on the source, type, and level of tannins use (Aboagye and Beauchemin, 2019). The decrease in rumen protozoa leads to increased nitrogen availability for microbial growth and enhanced microbial protein production. Furthermore, the reduction in protozoa results in a decrease in amino acid deamination. Protozoa typically degrade amino acids into ammonia and convert lipids into compounds that are less metabolically efficient for the animal. Restricting these processes enables ruminants to utilize nutrients more effectively, thereby improving feed efficiency (Suryani *et al.*, 2017). Moreover, secondary metabolites present in binahong leaves demonstrate potential to modify rumen fermentation, comparable to other phyto-biotic additives that enhance ruminant nutrition and reduce greenhouse gas emissions (Ahmed *et al.*, 2024).

The aim of this study is to investigate the effect of supplementation with Binahong leaf extract at different doses on in vitro ruminal fermentations. A series of in vitro ruminal fermentations will be performed to evaluate changes in gas production and microbiota and to reveal possible dose-dependent effects of Binahong leaf extract. In this experiment, the minimum dosage for using the active compound in the form of pure tannin was 1.1% dry matter (Pathak *et al.*, 2017) and the maximum dosage (2.0% dry matter) as supplement for ruminants (Jayanegara *et al.*, 2012). We adopted the same dosage used for the addition of binahong extract, which contains active compounds. Therefore this research is required to determine the best dosage of binahong leaves as a feed additive for ruminants. We hypothesised that supplementation with 1% Binahong extract would be able to improve in vitro ruminal fermentation.

MATERIALS AND METHODS

EXPERIMENTAL DESIGN

This research design used a completely randomized design (CRD) with four treatments and four replications. The treatments evaluated were as follows: A = Complete feed + 0% DM binahong extract, B = Complete feed + 1% DM binahong extract, C = Complete feed + 1.5% DM binahong extract, D = Complete feed + 2% DM binahong extract.

DIET

The complete feed formulation is prepared based on the nutritional requirements for etawa goats with a body weight of 18 - 26 kg. The ratio of forage and concentrate used is

60: 40. The composition and nutrient content of complete feed used can be seen in Table 1 and Table 2.

Table 1: Ingredients of the experimental diet (% DM basis).

Components	Treatments			
	0%	1%	1.5%	2%
<i>Brachiaria mutica</i>	60	60	60	60
Rice bran	14.5	14.5	14.5	14.5
Corn	10	10	10	10
Tofu dregs	12	12	12	12
Molasses	3	3	3	3
Premix	0.5	0.5	0.5	0.5
Total	100	100	100	100
Supplementation				
Binahong extract	0	1	1.5	2

Table 2: Nutrient content of complete feed (% DM basis).

Nutrients content	Feeds		
	Binahong leaves	<i>Brachiaria mutica</i>	Complete feed
Dry matter (DM)	90.66	92.58	92.17
Organic matter (OM)	20.89	11.04	90.93
Crude protein (CP)	13.15	11.41	20.18
Crude fiber (CF)	19.65	29.03	21.17
Eter Extract (EE)	8.76	3.19	7.47
NDF	52.2	78.71	49.01
ADF	16.37	40.42	27.05

NDF : Nutrient detergent fiber, **ADF** : Acid detergent fiber; **Source**: Laboratory analysis, Faculty of Animal Husbandry, Jambi University.

BINAHONG SAMPLE COLLECTION AND ANALYSIS

Binahong were obtained from the area of oil palm plantation in Kumpeh, Muaro Jambi, Indonesia. Shortly after collection binahong leaves are dried in an oven at 45°C for 48 hours then finely ground and filtered with a 60 mesh size. Extraction method, tannin and saponin content tests were carried out according to the method (Samirana *et al.*, 2017). Standardized extraction and preparation techniques were employed to obtain consistent extracts. A total of 100 grams of Binahong flour was extracted using 1 litre of 70% ethanol by the maceration method for 24 hours. Subsequently, the remaceration process was conducted twice. The maceration was concentrated using a rotary evaporator at 40° C to obtain a viscous extract. This procedure ensures the uniformity of the extraction process. The tannins and saponins contained in binahong leaf extract were 15.31 and 5.74 mg/l respectively.

IN VITRO PROCEDURE

A total of 1 g of sample from each treatment was weighed into a serum bottle (capacity 120 ml). At the same time

samples from each treatment were also analyzed for DM and OM. A total of 30 ml of anaerobic medium was added to the serum bottle containing the sample while CO₂ gas was flowing. Then the fermenter tubes were randomly allocated to the incubator at 39 °C. Samples were incubated for periods 48 hours. Blanks without samples were also prepared for each incubation period. Gas production was measured at 2, 4, 6, 8, 10, 12, 16, 24, 36, and 48 post incubation. The total gas produced for each bottle was measured using speed and recorded at each incubation time period. The cumulative gas volume (three duplicate runs) was fitted to the exponential equation $y = a + b(1 - e^{-ct})$ (Ørskov and McDonald, 1979). Where y is the cumulative gas production at time t hours. The constants a, b and c can be interpreted as gas production from the soluble fraction (a), gas production from the insoluble but fermentable fraction (b) and the reaction rate of gas formation (c). Samples for calculating protozoan populations were collected at 4, 24, and 48 hours. At the end of each incubation period, the pH was recorded and the fermentation process was terminated by the addition of a saturated HgCl₂ solution. The mixture of supernatant and residue particles in the tube was centrifuged for 30 minutes at a speed of 1200 rpm until separation occurred where the residue would settle at the bottom and the supernatant would be at the top. Residue samples were oven dried at 60°C for 24 h and used for dry matter (DM) and organic matter (OM) analysis according to (AOAC, 2019). The supernatant was used for total VFA analysis using distillation method according to (Department of Dairy Science, 1966). NH₃ analysis was carried out using the Conway method. Calculation of the protozoan population was based on the Hristov *et al.* (1999) method using a hemocytometer chamber, with a dilution of 1: 5 (1 ml sample with 5 ml methyl green formaldehyde solution). Protozoa were enumerated under 0.2 mm deep counting chambers.

STATISTIC ANALYSIS

This experiment was conducted based on a completely randomised design (CRD), with four treatments and four replicates. Four replicates are sufficient to identify significant differences among treatment means by Tukey test at a 5% probability and regression (Lavezo *et al.*, 2017; Sahara *et al.*, 2023). Analysis of variance (ANOVA) tests are based on the assumptions of normally distributed data, interval or continuous measurements, and homogeneity of variance between groups (Mishra *et al.*, 2019). However, if the data are not normally distributed, transformations and non-parametric tests such as the Kruskal-Wallis test may be employed. Analysis of variance was used to find the effect of treatment on the observed variables. If there were differences, further tests were performed using Tukey (SPSS 23). Total gas production, cumulative gas and protozoa population were tested using a nonlinear regression equation with SPSS version 20.

The response of dietary supplementation of *Anredera cordifolia* (Ten.) Steenis extract on the digestibility of dry matter (DMD), organic matter (OMD) could be seen in Figure 1. Supplementation of Binahong leaf extract in the complete feed had no significant effect $P>0.05$ on DMD and OMD. The extract of *Anredera cordifolia* (Ten.) Steenis as a source of tannins did not significantly affect DMD, OMD when tannin supplements at 1, 1.5 and 2 % of the DM were added to the complete feed. Tannin doses up to 2% are tolerated without adverse effects but do not enhance DMD and OMD. Tannins and saponins have complex interactions with different substrates. In this study, the substrate was a complete feed with a forage-to-concentrate ratio of 60:40. *Leucaena leucocephala* as a tannin source in a rice straw and concentrate-based diet with a 40:60 ratio shows potential for methane mitigation in ruminants (Ningrat *et al.*, 2019), but its effect on feed digestibility may vary. The source, type, and level of tannin supplementation are crucial for determining efficacy. Zhang *et al.* (2019) also found that 3% DM tannin supplementation did not significantly affect nutrient intake in lactating dairy cows. The *Anredera cordifolia* (Ten.) Steenis extract used in this study contained 15,321 mg/l of tannins. Tannins have complex structures and compositions, their sources should be considered when selecting the practical dietary levels (McMahon *et al.*, 2000). Low to moderate concentrations of tannins can improve digestive utilization of feed by reducing protein degradation in the rumen and increasing amino acid flow to the small intestine (Nawab *et al.*, 2020). This can lead to improved protein utilization and animal production efficiency, particularly in ruminants (Huang *et al.*, 2017). The addition of 2-4% nutmeg leaf tannin reduced rumen dry matter digestibility but did not significantly affect total dry matter digestibility (Canadianti *et al.*, 2020). Furthermore, a study demonstrated that condensed tannins from black wattle at levels up to 20 g/kg did not affect dry matter and organic matter digestibility, though it did reduce crude protein digestibility (Avila *et al.*, 2020). Although it has no effect on dry matter and organic matter digestibility, there is an increasing tendency for supplementation with binahong extract to increase DMD and OMD.

The concentration of VFA complete feed without Binahong extract was significantly different ($P<0.05$) compared to 1.5 levels and not significantly different with 1% and 2% levels (Figure 2). There was an increase in total VFA concentration of 13.13% and 6.27% at 1% and 2% levels of *Anredera cordifolia* (Ten.) Steenis extract addition, respectively. This indicates that supplementation of binahong extract increases microbials activity. Tannins and saponins can increase VFA production by modifying rumen microbial populations, enhancing hydrolase activities, and altering fermentation patterns. However, their effects are complex

and can vary based on the specific type, concentration, and environmental conditions. At the 1.5% level, the VFA concentration tends to be lower, which is consistent with the DMD and OMD produced. Widu *et al.* (2021) found that the use of binahong flour up to 30% in concentrate had an effect on increasing the concentrations of DMD, OMD, VFA and NH_3 in vitro. Sadarman *et al.* (2019) found that supplementation of tannin to both acacia and chestnuts had no significant influence on DM, OM degradation, total volatile fatty acids (VFA), and NH_3 . The accumulation of gas at 8, 12, and 24 h was influenced by acacia tannin. They concluded that supplementation of tannins up to levels 2%, acacia, and chestnuts did not interfere with the fermentation of rumen and in vitro by-products of soy sauce. In this study, total VFA production was in the range 96.19 - 114.05 mM. A decrease in total VFA production at the level of 1.5% is still within the normal range, normal VFA concentrations are in the range of 80-160 mM (McDonald *et al.*, 2012). This claim is supported by Hidayah (2016a), who reported that the addition of tannins and saponins at optimal doses decreased the protozoan population and increased total and partial VFA production. These compounds can also increase total VFA production and alter VFA profiles, with saponins tending to shift fermentation towards increased propionate and decreased acetate production (Yuliana *et al.*, 2019).

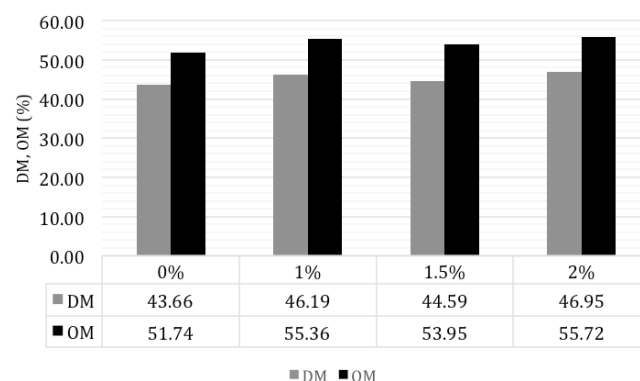


Figure 1: Effect levels of Binahong leaf extract on dry matter (DM) and organic matter (OM) degradability after 48 hours incubation.

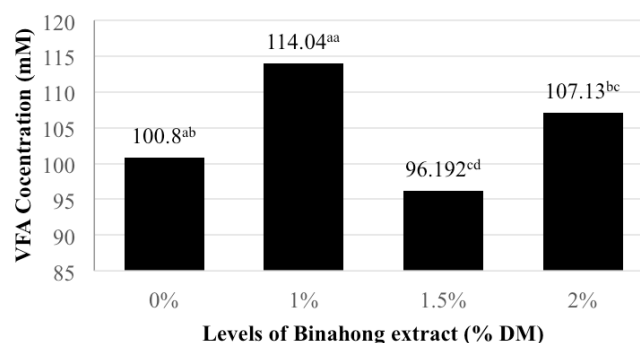


Figure 2: Effect levels of Binahong leaf extract on VFA after 48 hours incubation.

The effect of tannin and saponin as feed additives on volatile fatty acid (VFA) concentration in vitro is documented across several studies. [Chuzaemi et al. \(2022\)](#) reports that the addition of 4% myristic acid to a complete feed with condensed tannins increased propionic acid levels while decreasing acetic acid, butyric acid, total VFA, and the C2/C3 ratio. [Sliwinski et al. \(2002\)](#) noted that low doses of tannins did not significantly alter VFA concentration, while saponin supplementation showed potential to reduce ruminal ammonia concentration, which may influence VFA profiles. Contrast with the general depressive effect on VFA production reported in [Vasta et al. \(2019\)](#). The addition of tannins and saponins as feed additives appears to influence VFA concentration in vitro ([Chuzaemi et al., 2022](#); [Engle, 2023](#)). However, the overall impact on total VFA concentration and the specific VFA profile may vary depending on the type and concentration of tannins and saponins used, as well as the presence of other additives ([Hassanat and Benchaar, 2012](#); [Hixson et al., 2018](#); [Vasta et al., 2019](#)). Tannins and saponins have significant effects on VFA concentrations, which in turn affect rumen fermentation and overall ruminant health and productivity. Tannins typically exhibit an inverse relationship with total VFA concentrations, whereby increasing tannin levels correspond to decreasing VFA concentrations ([Hassanat and Benchaar, 2012](#)). This experiment suggests that supplementation binahong as feed additive can modulate rumen fermentation patterns, which is significant for improving VFA concentration.

The results of the analysis of variance showed that the addition of different levels of binahong extract had a significant effect ($P < 0.05$) on the rumen protozoa population ([Figure 3](#)). The results of the orthogonal polynomial test provide a linear relationship between the level of binahong leaf extract (X) and the protozoa population in the 48 hour incubation period (Y) with the equation $Y = -251.43X + 8.3286$ and coefficient of determination (R) = 0.72782.

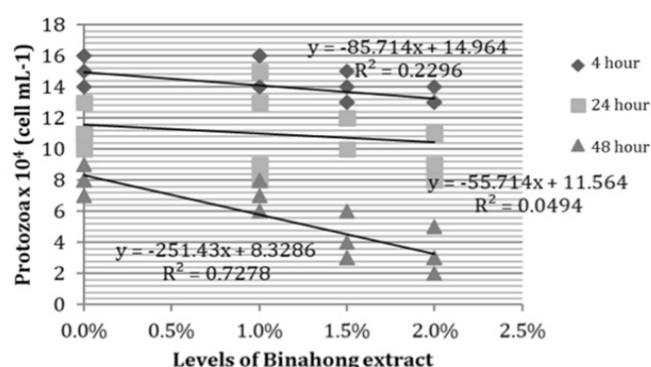


Figure 3: Effect of Binahong leaf extract levels on protozoan populations after 4, 24 and 48 hours of incubation.

The results of this study show that the higher the level of binahong extract, the protozoa population decreases. In-

creasing the level of supplementation of binahong extract reduced the protozoa population in the incubation periods of 4, 24 and 48 hours. This decline in protozoan populations is thought to be due to the active compounds contained in Binahong. The reduction in protozoa observed in this study may serve as an indicator of decreased methane production. Reducing protozoa in the rumen has been shown to reduce methane emissions and potentially increase energy availability for ruminants. Reducing the protozoan population inhibits the methanogenesis process because protozoa act as hosts for certain methane-producing bacteria ([Liu et al., 2021](#)). Consequently, reducing protozoa in the rumen offers potential benefits for both reducing greenhouse gas emissions and improving livestock production efficiency. Binahong contains saponins, which are triterpenoid glycosides commonly found in various plant species. The ability of saponins to form complexes with cholesterol, a key component of protozoan cell membranes, is believed to be one of the factors contributing to the observed reduction in protozoan populations in this research ([Bottger and Melzig, 2013](#)). Saponins and tannins can be used to reduce protozoa populations in the rumen. Saponins have the ability to reduce protozoan populations by forming complex bonds with sterols on the surface of protozoan membranes ([Ayemele et al., 2021](#); [Wink, 2015](#)).

The results of the analysis of variance showed that the addition of different levels of binahong extract had no significant effect ($P > 0.05$) on maximum gas production (a+b), cumulative gas production rate (c), total gas production, pH and NH_3 ([Table 3](#)). However, the trend shows that along with the increase in the concentration of binahong extract, it will be followed by a decrease in total gas production, fraction b and fraction a+b.

Table 3: The rumen fermentation characteristics of each treatment.

Variables		Treatments				SEM	P-value
		0%	1%	1.5%	2%		
Gas 72 hours	(ml g ⁻¹ BO)	161.81	134.35	115.48	110.23	10.0	>0.05
B	(ml g ⁻¹ OM)	162.31	135.05	115.32	114.40	9.73	>0.05
a+b	(ml g ⁻¹ OM)	160.25	127.66	104.76	100.32	11.87	>0.05
C	(ml h ⁻¹)	0.04	0.04	0.20	0.064	0.03	>0.05
pH		6.7	6.4	6.1	6.2	9.50	>0.05
NH ₃	(mM)	9.94	10.43	7.18	10.81	9.15	>0.05

a: gas production from the fermentation of the soluble fraction; **b:** gas production from the fermentation of the insoluble fraction, but potentially degraded; **c:** fermentation rate of the b fraction; **SEM:** standard error of the mean.

The reduction in gas production resulting from the utilization of binahong above 2% indicative of a decline in rumen microbial activity. The low activity of rumen microbes is not

related to the concentration of NH_3 and pH. Supplementation with binahong extract modified the fermentation patterns, resulting changes in rumen pH, ammonia release, and total VFA content. Rumenal pH is an important index of normal rumen function, and the rumen pH values (pH 6.1-6.7) in the present study were within the normal range for efficient rumen function (Yoon and Steern, 1996). Supplementation extract of binahong decreased the ruminal cocentration of pH and ammonia at level 1.5% but increased the levels of total VFA compared with control. These results are in accordance with supplementation tea saponin significantly decreased the ruminal concentration of ammonia but increased the levels of total VFA (Liu *et al.*, 2019). The decrease in NH_3 concentration to the 1.5% level is thought to be due to a decrease in the protozoan population. These finding simillar to Wina *et al.* (2005). The decrease in total gas production occurred in line with the increase in the level of binahong extract to an additional level of 2%. This proves the existence of microbial activity in the rumen. Thus, the higher level of supplementation binahong leaf extract could reduces fermentation activity by rumen microbes. This is in accordance with (Vargas *et al.*, 2020) that gas production is indeed a byproduct of the fermentation process in the rumen, reflecting the activity of the rumen microbiota The binahong leaf extract used in this research has a tannin and saponin content of 15.31 and 5.74 mg/l. The tannin and saponin content is thought to reduce the protozoa population so that the ability of the protozoa to digest easily soluble feed ingredients becomes low and the resulting gas production decreases as the level of binahong leaf extract increases. Maximum dose 2% dry matter of additive supplements in ruminants (Jayanegara *et al.*, 2012).

Gas production is mainly related to the chemical composition of the feed material, as a more digestible substrate will produce a greater volume of gas. In this study, a high increase in total cumulative gas production was found in the control treatment (0% levels of Binahong while supplementation with levels of Binahong extract tended to have lower gas production than the control (Figure 4). It is suggested that the addition of Binahong extract affects rumen microbial activity by reducing the protozoan population. A reduction in total gas production is often associated with reduced feed digestibility and overall fermentation activity. In many cases, a reduction in total gas production is associated with reduced methane emissions, which can be seen as a positive outcome for both animal productivity and environmental concerns. Supplementation of condensed tannins supplementation at 1-3% significantly reduced both total gas and methane production in in vitro tests (Pathak *et al.*, 2017). This methane mitigation effect is considered to be one of the most impactful benefits of tannins for ruminant production (Naumann *et al.*, 2017). This is consistent with the view of (Zain *et al.*, 2024) that gas production

is the result of a fermentation process in the rumen which is indicative rumen microbial activity.

The effect of tannins on total gas production in the rumen varies depending on the type and concentration of tannins used. Hassanat and Benchaar (2012), reported that in vitro gas production decreased with increasing tannin concentration, suggesting that tannins may reduce total gas production in the rumen. Similarly, Dhakal *et al.* (2022) found that the addition of an indigenous Nepalese fruit, containing tannins reduced total gas production when compared to the control. However, Chaturvedi *et al.* (2015) showed that while methane production was not affected by certain herbal additives containing tannins, total gas production was not influenced by the addition of these herbal combinations.

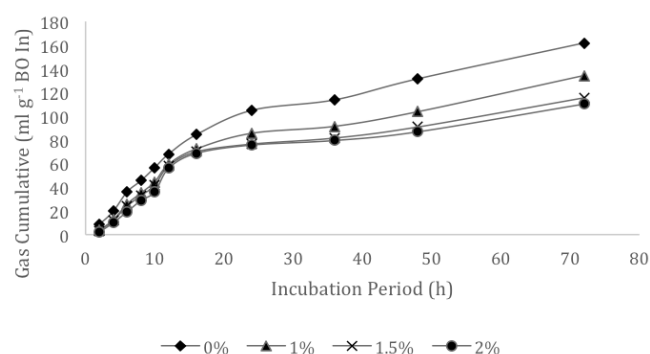


Figure 4: Gas production profile of each treatment during the 72-hour incubation period.

Figure 4 shows that binahong levels 0%, 1%, 1.5% and 2% have relatively the same fermentation rate and total gas production. The diet used in this study contained several soluble and easily fermentable carbohydrates, and was considered a soluble fraction and included in fraction A according to the model (Ørskov and McDonald, 1979).

Dhakal *et al.* (2022) demonstrated a reduction in total gas production with tannin-rich fruit additives, whereas Chaturvedi *et al.* (2015) showed no significant change in total gas production with the addition of different herbal tannin sources. This suggests that the effect of tannins on total gas production may be influenced by the specific type of tannin and the context of its application (Chaturvedi *et al.*, 2015; Dhakal *et al.*, 2022; Hassanat and Benchaar, 2012). In summary, tannins have the potential to reduce total gas production in the rumen, but the extent of this effect is variable and appears to depend on the source and concentration of tannins, as well as the composition of the diet.

CONCLUSIONS AND RECOMMENDATIONS

In the present study supplementation of Binahong extract of *Anredera Cordifolia* (Ten.) Steenis effectively increased

VFA at levels 1% without affecting on the DMD, OMD, and NH₃. These effects were probably due to a 30.2 % reduction in the population of ruminal protozoa and changes VFA. The reduction in protozoa numbers is expected to reduce the number of methanogens, and thus reduce methane emissions. In the future, Binahong extract of *Anredera Cordifolia* (Ten.) Steenis can be used by farmers and feed manufacturers in a variety of ways such like encapsulation as a phytogetic feed additive (PFA) to improve animal health and performance.

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NOVELTY STATEMENT

Enhancing nutrient fermentability in ruminants can be achieved through dietary supplementation with herbal ingredients. However, the efficacy of herbal supplementation is significantly influenced by the source, type, and dosage of the herbs utilized. Binahong, an herbal plant containing bioactive compounds, presents potential as a feed additive that has not been extensively investigated for ruminants. Consequently, the findings regarding the optimal levels of Binahong leaf extract utilization may serve as a reference for the application of herbal extracts as feed additives in ruminant nutrition.

AUTHOR'S CONTRIBUTIONS

All authors contributed to this article starting from making proposals, conducting research, data analysis and writing articles.

CONFLICT OF INTEREST

The authors have declared no conflict of interest.

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