EFFECTS OF ORAL ADMINISTRATION OF *FICUS THONINGII* (STRANGLER FIG) STEM BARK EXTRACT ON RUMEN FERMENTATION PARAMETERS AND MICROBIAL COUNT OF WEST AFRICAN DWARF GOATS

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ABSTRACT

The study was aimed at investigating the effects of Ficus thoningii stem bark extract (FSBE) on rumen fermentation parameters and microbial count of West African dwarf goats in a 84-day feeding trial. Fifteen West African dwarf goats were divided into three treatment groups and administered FSBE at three doses of 0, 10 and 20ml/head/day for each of the three treatments respectively. Phytochemical composition of FSBE was determined. Rumen fluid of the goats was collected at the end of the study and the pH, total volatile fatty acids (TVFA), ammonia-nitrogen and microbial population were also determined. Results show that FSBE at 10 % concentration contains tannin, phenol, flavonoids, phytate, oxalate and saponin. The administration of FSBE did not significantly ($p>0.05$) affect pH, TVFA, and bacteria count. Ammonia-nitrogen decreased as the dosage of FSBE administered to the goats increased. The lowest ($p<0.05$) ammonia-nitrogen (40.72 and 45.33 mg/dL) concentration was obtained in goats administered 10 and 20ml dosage of FSBE respectively. FSBE increased ($p<0.05$) fungi count but reduced protozoa count at 10 and 20 ml doses. It was therefore concluded that FSBE can be used up to 20 mL dosage to manipulate rumen fermentation for reduced ammonia-nitrogen and protozoa population.

Keywords: Strangler fig, *in vitro*, ammonia nitrogen, volatile fatty acids, microbial population

INTRODUCTION

In a bid to find alternatives to antibiotics which usage has been restricted or banned in some countries, many phytogenics plants have been investigated by scientists (Adebayo *et al*., 2019). According to Varga-Visi *et al*. (2023) productivity of animals can be improved by the inclusion of plant derived products such as herbs or essential oils. Phytogenic feed additives contain plant secondary metabolites (PSMs), which are bioactive compounds with a wide range of physiological effects (Varga-Visi *et al*., 2023). Plant secondary metabolites in an animal's diet can change the composition of the gut microbiome. In the ruminants, the effects of PSMs on ruminal fermentation can include the modification of volatile fatty acid (VFA) concentration, methane emission, and ammonia–nitrogen concentration (Calsamiglia *et al*., 2007; Bodas *et al*., 2012). *Ficus thoningii* (Strangler fig) is a medicinal plant that contains various secondary metabolites which include alkaloids, terpenoids, flavonoids, tannins and active proteins (Dangarembizi *et al*., 2013). *Ficus thoningii* leaf meal has been evaluated (Berhe and Tanga, 2013) and used as protein supplement for ruminants (Bamikole and Ikhatua, 2010). However, there is dearth of information on the use of its stem bark extract in livestock nutrition. Thus, this study seeks to assess the effects of *F. thonningii* stem bark extract on rumen fermentation parameters and microbial count.

MATERIALS AND METHODS

Experimental Site

The study was conducted at the Animal Nutrition Laboratory, Federal University of Agriculture, Abeokuta, Ogun state, Nigeria.

Processing of the Extract

The root bark of *Ficus thonningii* was sourced within the University environment. A clean cutlass was used to remove the bark from the stem. Thereafter, the bark was air-dried under shade until brittle and milled to pass through 1mm sieve. The stem bark powder was soaked at a rate of 2g in 20ml of distilled water for twenty four (24) hours to make 10% concentration using a modified method of

Oyelere *et al*. (2021). The filtrate was collected in a 500mL beaker after being sieved using muslin cloth.

Experimental Animals and Management

Fifteen West African dwarf bucks were used for the study. The animals were divided into three treatment groups of five goats with five replicates in a completely randomized design. They were fed *Panicum maximum* and concentrate supplement (approximately 14% CP) in ratio 60:40 at 5% of their body weight. The animals were administered *Ficus thoningii* stem bark extract (FSBE) before morning feeding at the dosage of 0, 10 and 20mL per animal per day for each of the three treatments respectively. The experiment lasted for 84 days.

Determination of rumen fermentation parameters

Rumen fluid was collected on the last day of the study to determine total volatile fatty acid production and ammonia nitrogen concentration. Approximately 30 mL of rumen fluid was collected from each goat before feeding (pre-feeding) and 6 hours after morning feeding (post-feeding) and immediately after collection pH was measured using a portable pH meter (HANNA instruments HI 98153) and thereafter the fluid was freed from coarse particles by filtration through four-layers of cheese cloth. One half of the fluid was acidified with few drops of concentrated H_2SO_4 and stored frozen at -20 °C for the determination of ammonia nitrogen concentration using steam distillation procedures (Ogubai and Sereke, 1997). The second half was stored frozen at -20 °C for the determination of total volatile fatty acid (TVFA) concentration using Markham apparatus as described by Barnett and Reid (1956). This was carried out by adding 2 mL of rumen fluid together with 1 mL 10% potassium oxalate buffer and 1 ml oxalic acid injected into the Markham apparatus, where a distillate of 100 mL was collected. This was then titrated against a standard 0.01N NaOH with 2 drops of phenolphthalein as indicator. Concentration of TVFA was then calculated using the following equation:

$$\text{TVFA (mM)} = \frac{NAOH\ volume\ x\ NAOH\ normality\ x\ 1000}{rumen\ inoculum\ volume}$$

Determination of Microbial count

Rumen Fluid was collected from four goats on the last day of the experiment. Samples of unstrained rumen fluid collected from each animal was immediately fixed with 10% formalin solution (1:9 v/v, rumen fluid: 10% formalin solution) and taken to the laboratory for the determination of bacteria, fungi and protozoa population according to Galyean *et al*. (1989).

Chemical analyses

Phytochemical screening of Ficus extract was done according to the standard scientific procedures (AOAC, 2000).

Statistical analysis

Data obtained from the experiment were subjected to one-way analysis of variance (ANOVA) using SAS (2003). Significant differences among means was separated using Duncan multiple range test of the same software.

RESULTS AND DISCUSSION

Table 1 shows the phytochemical composition of *Ficus thoningii* stem bark extract (FSBE). Results shows that FSBE at 10 % concentration contains tannin, phenol, flavonoids, phytate, oxalate and saponin. This result agrees with the earlier finding of the same phytochemicals in *F. thoningii* (Ahur *et al*., 2010). Secondary metabolites such as saponins, tannins and essential oils have anti-microbial activity thus they can be used as additive to manipulate rumen fermentation and alter microbial population in the rumen (Cieslak *et al.,* 2009).

Table 2 shows the rumen environment parameters of experimental goats. All the parameters measured at the pre-feeding phase were not significantly ($p>0.05$) different. At the post feeding phase, ammonia-nitrogen reduced ($p<0.05$) as the doses of FSBE increased with the highest value obtained in animals receiving no FSBE (control) and the lowest value obtained at 10 and 20 ml dosage of FSBE. This indicated that the secondary compounds in FSBE interferes with microbial activities in the rumen and hence protein degradation. Plants containing tannin and saponin have been reported to reduce ammonia production in the rumen (Patra and Saxena, 2010; Bodas *et al*., 2012). Reduction in ammonia-nitrogen will reduce nitrogen as the protein will be available for digestion in the lower tract where it will be enzymatically digested into amino acid and available for production purposes.The

microbial count of WAD goats administered oral doses of FSBE was presented in table 3. The result shows that the bacteria count of the goats were not significantly (P>0.05) affected across the treatment groups by FSBE administration. However the fungi and protozoa counts were significantly (p<0.05) influenced. Fungi count increased in goats administered 10 and 20 mL FSBE. This suggested that FSBE may not be antifungal. It was also an indication of better digestibility of feed. According to Preston and Leng (1986) fungi are the first to colonize feed after ingestion thereby exposing them to further breakdown by bacteria. Protozoa count were significantly (P<0.05) affected with the highest count (0.55 x 10^6 cells/mL) obtained in goats on the control (0 ml FSBE) and lowest count (0.25 x 10^6 cells/mL) obtained in goats administered 10 and 20 mL FSBE. The result indicated that FSBE possess anti-protozoa properties. Decrease in the population of protozoa is advantageous as they play a role in methane production in the rumen. Phytochemicals such as tannin has been reported to reduce protozoa population in the rumen. Carlos and Edgar (2010) reported that tannins and phenolic monomers have been found to be toxic to some of the rumen microbes, especially ciliate protozoa, fibre degrading bacteria and methanogenic archaea, and as a result methanogenesis in the rumen can also be reduced.

Table 1: Phytochemical composition of *Ficus thoningii* stem bark extract (FSBE)

Parameters	(mg/100mL)
Tannins	56.03
Phenol	62.60
Flavonoids	26.67
Phytates	0.42
Oxalates	3.19
Alkaloids %	0.00
Saponins %	0.34

Table 2: Rumen environment parameters of West African dwarf goats administered *Ficus thoningii* stem bark extract (FSBE)

	Doses of FRBE				
Parameters	**0**	**10**	**20**	**SEM**	**P-value**
Pre feeding					
pH	6.43	6.32	6.42	0.06	0.555
TVFA (mM)	56.55	59.88	56.88	0.42	0.386
NH_3-N (mg/dL)	30.10	32.91	32.42	0.05	0.380
Post feeding					
pH	6.20	6.14	6.15	0.05	0.745
TVFA (mM)	60.79	64.69	59.86	1.04	0.515
NH_3-N (mg/dL)	51.68^a	45.33^b	40.72^b	1.89	0.037

Means on the same row with different superscripts are significantly different (p<0.05)

Table 3: Microbial count of West African dwarf goats administered oral doses of *Ficus thonningii* stem bark extract (FSBE)

	Doses of FSBE (mL)				
Parameters	**0**	**10**	**20**	**SEM**	**P-value**
Total Bacterial count (x10^9cfu/mL)	3.05	3.25	3.20	0.05	0.262
Total Fungi count (x10^9cfu/mL)	1.00^b	1.15^a	1.35^a	0.08	0.015
Total protozoa count (x10^6 cells/mL)	0.55^a	0.25^b	0.25^b	0.09	0.029

Means on the same row with different superscripts are significantly different (p<0.05)

CONCLUSION

Ficus thoningii stem bark extract reduced rumen ammonia-nitrogen and protozoa count at 10 and 20 mL doses and could therefore be used for rumen manipulation to reduce nutrient losses.

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