



Comparative Performance of Pelleted Napier Grass (*Pennisetum purpureum*)-based with *Indigofera*: A Complete Ration Mix (CRM) fed to Grower Sheep

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Authors' contributions

This work was carried out in collaboration between both authors. Author ELL conducted the study, performed the methodology, and wrote the first draft of the manuscript. Author CCP designed the study, managed the analyses of the study, wrote the protocol. Both authors read and approved the final manuscript.

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ABSTRACT

This study aims to determine the comparative performance of pelletized Napier grass (*Pennisetum purpureum*)-based with *Indigofera*: A Complete Ration Mix (CRM) to grower sheep in terms of feed intake and weight gain; and to determine the degradability in terms of the amount and rates of roughage disappearance in the rumen with respect to time through a Paired T-test Design. The research was conducted at Saccalan Farm, Kidapawan City, North Cotabato, Philippines from December 2013 to February 2014. A fabricated heavy-duty pelleting machine was used to pelletize mixed ingredients containing the formulated Complete Ration Mix (CRM) of 60:40 (Napier:Indigofera) (Test Group A) and 80:20 (Napier:Indigofera) (Test Group B). Further, an "in sacco" method was used in determining the amount and rates of roughage disappearance in the rumen with respect to time. There were four (4) heads of sheep assigned per test group and these were confined and provided with daily nutritional requirements according to weight and dry matter requirements. A highly significant difference was observed (P 0.01) in feed intake. Test Group B with 80:20 had a mean of 0.92 kg. while Test Group A, which had 60:20 ration, resulted a mean of 0.78 kg. However, for the average daily weight gain, no significant difference was obtained between

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Test Group A and Test Group B with a mean of 0.14kg and 0.09kg. The same result was noted in feed conversion efficiency with a mean of 5.59 kg and 10.49 kg. The disappearance rate and percentage degradability showed the same trend. As the time incubation increases, the weight of the residues decreases, which resulted to the increase of percentage degradability (g) and disappearance rate (%) using "in sacco" technique. Numerically, for disappearance rate, .05g (0 hr), 0.10g (6 hrs), 0.10g (12 hrs), 0.15g (24 hrs), 0.20g (48 hrs), 0.30g (72 hrs), 0.45g (96 hrs), and 0.50g (120 hrs); while 2.5%, 5.0%, 7.5%, 10%, 15%, 22.5%, and 25% for each stipulated number of hours for the percentage degradability. This study will be used as reference in formulating ration and proportion of grasses and legumes with concentrates for ruminant nutrition.

Keywords: Sheep; pelleted napier grass; complete ration mix (CRM).

ABBREVIATIONS

CRM : Complete Ration Mix

1. INTRODUCTION

Sheep are ruminant animals that help digest fibrous meals by relying on a mutually beneficial connection with bacteria, protozoa, and fungi in their rumen [1]. As a result, diets must be designed with the notion of feeding the rumen to the sheep [2]. Body upkeep, physical activity, growth, milk production, reproduction, and health are all dependent on nutrient intake [3]. Although certain mobilization of body tissues can provide some nutrients and energy for brief periods of time, such as in early breastfeeding, all of the nutrient needs must be satisfied by the diet at the end [4].

In a process called "ruminating" or "chewing the cud," the sheep regurgitates, chews, and then swallows the food numerous times [5]. The rumen microorganisms, as well as the sheep eating and rechewing the food, allow the food to break down sufficiently for the animal to absorb the nutrients. Sheep owners should be aware that the rumen fluid's microbial composition changes when the kind of diet is changed, thus any feed change should be introduced gradually [6]. An abrupt shift in feed (from dry to lush, from pasture to grain, etc.) can quickly make a sheep sick and even kill it (Hobby Farmers, Basic nutrition for sheep, Tasmania) [7].

The objectives of the study were: a) to determine the degradability of Napier grass (*Pennisetum purpureum*) using "in sacco" method in terms of the amount and rates of roughage disappearance in the rumen with respect to time; and b) to determine the comparative performance of pelletized Napier grass (*Pennisetum purpureum*)-based with *Indigofera*: A Complete Ration Mix (CRM) to grower sheep

in terms of feed intake, weight gain and feed conversion efficiency. The study was conducted at the Sacdalan Sheep Farm, Binoligan, Kidapawan City, North Cotabato, Philippines from December 2013 to February 2014.

2. MATERIALS AND METHODS

2.1 Experimental Design and Treatment

The study was carried out in a T-test design comparing two test rations with four heads of sheep assigned per test group. The animals were fed with the following:

Group A: Grass-based pelleted complete ration mixed 60:40 ratio
Napier: *Indigofera*

Group B: Grass-based pelleted complete ration mixed 80:20 ratio
Napier: *Indigofera*

2.2 Source of Grasses and Legumes

The grasses (Napier) and legumes (*Indigofera*) were harvested from the USM Germplasm collection garden. The grasses were cut 3-4 inches from the ground after each has been initially cut for regrowth stages.

2.3 Cutting of the Grasses

The grasses were cut according to their standard cutting stages. Napier was cut at 40 days, after the regrowth stage. The grass and legumes were sundried for 3-4 days to reach about 14% moisture content, this was processed and ground with a laboratory grinder passing a sieve at 22 microns.

Table 1. Napier grass-based formulation for 60:40 (Napier:Indigo) ration for Group A.

Ingredients	Parts by weight (kg)	Percent crude protein (%)	Total crude protein (%)
Rice bran D1	3	12.50	0.37
Corn bran	1.1	08.00	0.09
Soybean Oil Meal	16.39	42	6.88
Copra Meal	8.5	20	1.70
Napier grass	42	08.00	3.36
Indigofera	28	20	5.6
Salt	0.5	-	-
Limestone	0.5	-	-
TOTAL	100 kg	-	18.00

Table 2. Napier grass-based formulation for 80:20 (Napier:Indigo) ration for Group B

Ingredients	Parts by weight (kg)	Percent crude protein (%)	Total crude protein (%)
Rice bran D1	1	12.50	0.12
Corn bran	1.47	08.00	0.12
Soybean Oil Meal	23.53	42	9.88
Copra Meal	3	20	0.6
Napier grass	56	08.00	4.48
Indigofera	14	20	2.8
Salt	0.5	-	-
Limestone	0.5	-	-
TOTAL	100 kg	-	18.00

2.4 Characteristic of the Nylon Bag

The bags were prepared from nylon or synthetic fiber material with a pore size of 41µ. The pore size was compromised between minimal losses of small particles and making sure that microbes, including protozoa, can enter the bags uninhibited and considering that gas can also escape from the bags [8].

2.5 Digestibility Using “In Sacco” Method

The ground samples weighing 2g were placed inside the nylon bag. The bags were sewn with nylon thread with double seam and close stitching. These were tied with a separate length of nylon thread (e.g., fishing line) and attached to a long string in a plastic tube once the pre-weighted samples were filled-in. The bags were anchored with about 50 cm of nylon thread (about 25cm of nylon for sheep/goats) to the cannula top and suspended deep into the rumen. The bags were reused as long as no holes were found [9]. The bags were always checked for breakages before use.

2.6 “In Sacco” Incubation

Each sample was incubated at periods of 0, 6, 12, 24, 36, 48, 72, 96, and 120 hours using 32nylon bags. All bags were incubated on day

one at the same time and withdrawn at different times (sequential withdrawal) for less disturbance to the rumen environment.

2.7 Washing and Drying

After the withdrawal of the samples, the bags were immediately dipped into cold water to stop the further microbial activity and then rinsed in cold tap water to remove the rumen matter from the outside of the bag. The bags were washed under running cold water for about 30 minutes with tap water while rubbing gently between thumb and fingers until the water runs clear. The washed bags were dried in an oven at 60-65°C for about 48 hrs and samples were weighed after oven drying.

2.8 Procedures in Making Pelleted Ration

2.8.1 Harvesting grasses

The grasses were cut at the vegetative stage and air-dried and/or sundried until they reached 14% moisture content. The dried grasses were hammered finely using a hammer mill.

2.8.2 Preparation and formulation of test feeds

A ratio for grower sheep containing to 16-18% crude protein (CP) was formulated with a ratio of

60:40 for test group A and 80:20 for the test group B (grass: legumes)

2.8.3 Preparation of concentrates

The concentrate ingredients were bought from a reliable source from the market. The ingredients for the concentrate were rice bran D1, corn bran, soybean oil meal, copra meal, salt, and limestone. These ingredients were weighted according to the feed formulation prior to mixing.

2.8.4 Pelleting and drying of the pellets

The mixed ingredients were pelleted using a fabricated pelleting machine. The pellets were sundried for 1-2 hours and then air-dried until the desired moisture was attained.

2.9 Housing of Grower Sheep

The experimental animal was confined in cages. The flooring was covered with bedding materials made of sawdust, sand, and salt at three (3) parts sawdust, one (1) part of sand, and 200g of salt mixed properly. The sheep house at Sacdalan farm was prepared seven (7) days prior to the transfer of experimental sheep. It was sprayed with IMO (Indigenous Microorganism) on the sides and floors.

2.10 Identification of the Grower Sheep

Proper identification of grower sheep was done using neck chains and plastic ear tags with corresponding numbers for proper monitoring and recording.

2.11 Wool Shearing

Firstly, the wool was shorn accordingly, weighed, and deducted from the initial bodyweight of the sheep. Secondly, cut of wool was also recorded and computed as a portion of the final weight

2.12 Health Care and Sanitation

The daily observation was done to check the condition and performance of the grower sheep. The sheep pen was disinfected every week to avoid odor and flies. Feed troughs and waterers were washed thoroughly with antibacterial dishwashing soap. Changing of litter materials and disposal of manure were done every 15 days.

2.13 Feeding Trial

Preliminary feeding was done by gradually diluting conventional feeds with the CRM. Dilution starts at 20% until they adopt fully the new feed. More or less 7 days were scheduled to finish depending on the animal adapting to the new ration. The feeding trial commenced by introducing full feeding of pelleted CRM as a diet for test groups A and B.

2.14 Feeding of Pelleted CRM

Feeding of pelleted CRM to grower sheep was based on their daily nutrient requirement according to their weight and dry matter requirement [10]. Since the weight of grower sheep is 13kg and it's about 6% of the live weight, then 780g of pelleted feeds were fed to one animal each day at 7 AM feed refuse was checked at 5:00 in the morning.

2.15 Data Gathered

2.15.1 Weight of grower sheep

The initial weight of experimental grower sheep was recorded at the start of the study. Weight gain was determined by getting the difference between the final weight and the initial weight. The formulae used were:

Initial weight (Kg/Sheep) = Fasted weight of Individual Sheep (kg)

Final Weight (Kg/Sheep) = fasted weight of individual sheep at the termination of the feeding trial

Weight Gain = Final Weight – Initial Weight

Average Daily Weight Gain (kg) = $\frac{\text{Total Weight Gain}}{\text{No.of Days}}$

Final Weight (Kg/Sheep) = Final weight – Wool weight

2.15.2 Feed intake

The feed intake of experimental sheep was recorded from the start-up to the termination of the study in order to determine the consumption of the sheep. The feed conversion efficiency was also computed. The formulae used were as follows:

$$\text{Total feed intake} = \frac{\text{Total feed offered (kg)} - \text{Total feed refused (kg)}}{\text{Number of Sheep (kg)}}$$

$$\text{Average Daily feed Intake (kg)} = \frac{\text{Total Feed intake}}{\text{Number of days}}$$

$$\text{Feed Conversion Efficiency} = \frac{\text{Feed intake}}{\text{Weight Gain (kg)}}$$

2.15.3 Degradability of feeds

The ruminal degradability was calculated using the formula:

$$\text{Disappearance} = (\text{SWa}-\text{BW}) \times \text{DMA} - (\text{SWb}-\text{SW}) \times \text{DMb}(\text{Swa}-\text{Bw}) \times \text{DMA}$$

Where

SWa = Weight of the original sample + nylon bag

BW = Weight of empty nylon bag

SWb = Weight of sample + nylon bag after incubation

DMA = Dry matter of feed sample

DMb = Dry matter residue sample

2.15.4 DM Disappearance

The nylon bag technique described by Ørskov et.al., (1980) for the determination of the degradation of feedstuffs in the rumen at various incubation periods applying this equation:

$$Y = a + b (1-e^{-ct}) \dots \dots \dots \text{Ørskov and McDonald (1979)}$$

$$Y = a + b (1-e^{-c(t-t_l)}) \dots \dots \dots \text{McDonald (1981) model with lag}$$

Where: Y = degradability at time (t)
 a = intercept
 b = potentially degradable fraction
 c = rate of degradation of b
 t_l = lag time

2.15.5 Percent Degradability

The percent degradability was calculated using the formula:

$$\text{Percent degradability} = \frac{\text{Degraded materials (g)}}{\text{Weight of sample (g)}} \times 100$$

2.15.6 Statistical Analysis

The data gathered were compared and analyzed using paired T-test for independent samples to compare the differences between treatments.

3. RESULTS AND DISCUSSION

3.1 Feed Intake

Statistical analysis revealed a highly significant difference (P<0.01) between treatment means. The sheep in Test Group B fed with an 80:20 ration of pelleted Napier grass-based complete ration mix (CRM) had a feed intake of 0.92 kg performed better than sheep in Test Group A with a 60:20 ration of pelleted Napier grass-based complete ration mix (CRM) with a mean value of 0.78 kg. The average daily feed intake of grower sheep fed with pelleted Napier grass-based complete ration mix (CRM) is shown in Table 1, Column 2. This implied that the grower sheep fed with pelleted Napier grass-based complete ration mix (CRM) with 80:20 ration is palatable and performed better than grower sheep fed with pelleted Napier grass-based complete ration mix with 60:40 ration. As Napier grass is a high-yielding fodder crop with good palatability, highly nutritious especially when young, with dark green leaves and less than 1 meter tall (Orodho, 2006).

3.2 Weight Gain

Statistical analysis revealed no significant difference between test means. The average daily weight gain of grower sheep fed with pelleted Napier grass-based complete ration mix (CRM) is shown in Table 3 Column 3.

This implies that the average daily weight gain of grower sheep is not influenced by the CRM ratio. The average daily gain of grower sheep fed with pelleted Napier grass-based complete ration mix (CRM) in Test Group A (60:40) was 0.14kg and 0.09 kg for sheep in Test Group B (80:20). This implies that the average daily weight gain of the grower sheep not influenced by the CRM ration [11].

3.3 Feed Conversion Efficiency

The statistical analysis revealed no significant difference between test means. Grower sheep fed pelleted Napier grass-based complete ration mix (CRM) in Test Group A (60:40) had a feed conversion efficiency of 5.59 kg, while sheep in Test Group B had a feed conversion efficiency of 10.49 kg (80:20). This means that the CRM ration has no effect on the feed conversion efficiency of grower sheep.

Table 3. Summary of the results of the comparative test of means on feed intake, average weight gain, and feed conversion efficiency of the grower sheep fed with pelleted Napier grass-based complete ration mix (CRM)

Treatment	Feed intake (kg)	Average daily weight gain (kg)	Feed conversion efficiency (kg)
A (60:40)	0.78 ^b	0.14	5.59
B (80:20)	0.92 ^a	0.09	10.49
T	-2.64	2.35	-1.95
Df	77.18	5.69	3.27
p-value	0.00	0.06	0.14
Significance	**	ns	ns
ns = not significant			
** = highly significant at 1% level			

Table 4. Summary results on the rate of percent disappearance of Napier grass under “in sacco” method. Department of Animal Science, CA Annex 2, University of Southern Mindanao, Kabacan, Cotabato. 2014

Material	Period (hrs)	Sample (g)	Residue (g)	Disappearance (g)	Degradability (%)
Napier Grass	0	2	1.9	0.05	2.5
	6	2	1.8	0.10	5.0
	12	2	1.8	0.10	5.0
	24	2	1.7	0.15	7.5
	48	2	1.6	0.20	10.0
	72	2	1.4	0.30	15.0
	96	2	1.1	0.45	22.5
	120	2	1.0	0.50	25.0

3.4 Disappearance of Napier Grass

Based on Table 4, the mean disappearance was 0.05g, 0.10g, 0.10g, 0.15g, 0.20g, 0.30g, 0.45g, and 0.50g, for 0, 6, 12, 24, 48, 72, 96, 120 hours, respectively. In the case of a 0 hour (where no microbial influence) cannot be compared to the samples with incubation process. The trend shows that residue weight decreases with time and consequently, the computed disappearance follows the same trend.

3.5 Percent Degradability

Table 4 shows the result of the % degradability of Napier grass using the "in sacco" method. For 0, 6, 12, 24, 48, 72, 96, and 120 hours, the computed percent degradability was 2.5%, 5.0%, 7.5%, 10%, 15%, 22.5%, and 25%, respectively. The samples with no incubation process cannot be compared to the samples with an incubation process in the case of 0 hour (where no microbial influence). The trend reveals that the disappearance weight has increased over time, and the estimated degradability has followed suit.

4. CONCLUSION

Based on the results of the study it is concluded that the grower sheep Test Group B with 80:40 (Napier:Indigofera) ration is more palatable compared to grower sheep Test Group A with 60:40 ration.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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