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RESEARCH NOTE

IN SITU NUTRIENT DEGRADABILITY OF BANANA (*Musa sapientum*) PSEUDOSTEM AND WATER HYACINTH [*Eichhornia crassipess* (Mart.)] IN DAIRY CATTLE

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ABSTRACT

In situ **degradation of banana pseudostem (BPS) and water hyacinth (WH) in cannulated dairy cattle were investigated. The samples were dried, ground and inserted into a digestion bag before they were incubated inside the rumen of the cannulated dairy cattle for 3, 6, 12, 24, 48 and 72 h. Results showed that DM degradable fractions in BPS and WH were greater compared (*P*<0.05) to Napier grass (NG). Degradable OM fractions were greatest in BPS which may indicate more readily available OM in BPS for rumen microorganisms. Degradable fractions of NDF were the same among the feed samples. The degradation curves of the three samples showed that banana pseudostem had the highest DM degradability of 80% at 12 h. It is also seen that after 72 h, the total DM degraded was the same for all treatments.**

Key words: banana pseudostem, water hyacinth, Napier grass, dairy cattle, rumen degradability

INTRODUCTION

Land for forage production and pasture development is almost always of limited availability in most tropical countries. Ruminant production in the Philippines is highly dependent on grass forages as the main nutritional source on top of supplemented concentrates. Thus, the lower forage supply due to reduction in pasture area led to a greater emphasis on the development of a feeding system which will not compete with the land and food requirements of the human population (Foulkes and Preston 1978). By taking advantage of the ruminant's capacity to convert feedstuffs that cannot be extensively used by monogastric animals, the use of unconventional feeds as a substitute for forage becomes possible.

There is a substantial underutilization of feed residues and agricultural wastes in the country which could be upgraded to support animal production. Food and Agriculture Organization statistics show that the total production of bananas reached a record of 117.9 million tons in 2015 (FAO, 2017). Taking into account the wastage in banana production,

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approximately 35–37 million tons of by-products and pseudostems can be available each year for use as animal feed. Previous experiments have concluded the positive effects of using banana foliage in supplemented and even in complete diets (Reynolds and Lund,1993). Fresh banana foliage can be included up to 15% of the diet (diet DM) of lactating without the harm of altering milk production and performance (El-Ghani, 1999).

Water hyacinth, on the other hand, is a major environmental concern in many countries including the Philippines. It quickly invades large water areas with its high rate of vegetative propagation forming dense mats of congregated hyacinths that obstruct waterways. Its effects are more apparent because the country is surrounded by several bodies of water.

The efficiency of milk and meat production in ruminants is directly related to the nutrition the animal obtained from the feed offered. Thorough feed evaluation of alternative and new feedstuffs is necessary for the research on ruminant nutrition. Nonetheless, despite the abundance of a variety of unconventional feedstuffs, little information is available on the ruminal degradability of these products. The *in situ* ruminal degradability technique has long been utilized to evaluate the relative degradability of feedstuffs in ruminants (Ørskov and McDonald, 1979). Aside from providing a reliable means of predicting digestibility, it further provides information on degradation kinetics which is of use in the strategic supplementation of ruminant diets in the tropics (Dhanoa *et al.*, 2000).

Hence, the objective of this study was to determine the *in situ* nutrient degradability of banana pseudostem and water hyacinth in dairy cattle.

MATERIALS AND METHODS

To determine the degradability of banana pseudostem (BPS) (*Musa paradisica* L.) and water hyacinth (WH) (*Eichhornia crassipes* (Mart.)) in dairy cattle, ground BPS, WL and Napier grass (NG) were subjected to ruminal incubation via in sacco method (FAO, 1995). Fresh samples of BPS (after fruiting) were obtained from Dairyville, College, Los Baños, Laguna and WH (before flowering) from Bayan, Los Baños, Laguna. The samples were oven-dried (70°C for 3 days), ground and screened through a 2mm sieve. Three (3) grams of ground samples were placed in a 9x15 cm digestion bag made from locally called "Gina" cloth or Pongee silk fabric with approximately 40-60-micron perforation.

The experiment was conducted at the Dairy Training and Research Institute Farm, University of the Philippines Los Baños. Three (3) experimental animals, which were cannulated Holstein-Friesian x Sahiwal dairy cows, were used: 1935 (428 kg, 10 years old), 2081 (368 kg, 5 years old) and 2124 (375 kg, 4 years old).

Following a 3x3 Latin Square Design, triplicate samples of BPS, WH and NG were randomly incubated in the rumen of three experimental animals for 3, 6, 12, 24, 48 and 72 hours. After the 3-day incubation period, the animals rested for 7 days before undergoing another round of incubation of the next sample. The rumen was allowed to rest for 7 days in order to washout the effects of the previous period. Incubated samples, together with control samples (unincubated) were washed with running water until the water becomes clear then the bags were dried to constant weight at 70°C for 3 days.

The cannulated cows were fed with the following diets: control (NG only), control + 40% BPS and control + 40% WH, each according to the sample to be incubated in its rumen. Prior to incubation, the cows were acclimatized to their rations, for one week, by gradually

incorporating in their diets either BPS or WH. Acclimatization was done in order to avoid dietary upsets in the rumen which can result in changes in microbial hence, affecting fermentation and fiber digestion (Moran, 2005).

Each fraction of the sample withdrawn at an incubation time was subjected to the following analysis: DM, OM (AOAC, 1999) and NDF (Van Soest *et al.*, 1991). Rumen DM, OM and NDF degradability were estimated using the equation proposed by Ørskov and McDonald (1979). The model parameters were estimated using the non-linear procedure of GraphPad Prism 7 (GraphPad Software, Inc., San Diego, CA) and separated curves were fitted to the data points of each replicate. Data gathered was analyzed using the PROC MIXED procedure of SAS.

RESULTS AND DISCUSSION

Degradable fractions of banana pseudostem (BPS) and water hyacinth (WH) are presented in Table 1. Dry matter (DM) degradation of BPS and WH differed significantly from that of Napier grass ($P<0.05$) and DM degradable fractions in BPS and WH were greater compared to Napier grass (NG). The degradability of WH (63.50%) in this study was close to 68.09% (leaves), 60.82% (shoots) and 52.91% (whole plant) degradability of water hyacinth as reported by Aboud *et al.* (2005). The relatively high rapidly soluble DM values in BPS and WH reveals them as being potentially good sources of more nutrients for microbial growth (Djouvinov and Todorov, 1994).

The DM degradation curves are presented in Figure 1.1. Both BPS and WH have high initial degradation with about 50% of its dry matter degraded at 24 h. Napier grass, on

Table 1. Nutrient degradability of banana pseudostem (BPS) and water hyacinth (WH) and Napier grass (NG)[1].

Degradability, %	Samples			SEM	*P*-value
	BPS	WH	NG		
Dry matter					
Rapidly soluble fraction	74.47[a]	63.50[a]	30.95[b]	4.50	0.0007
Slowly soluble fraction	15.81[b]	48.76[ab]	73.45[a]	10.21	0.0296
Degradation rate constant	0.03	0.03	0.01	0.01	0.1235
Organic Matter					
Rapidly soluble fraction	47.14[a]	29.44[ab]	23.72[b]	5.30	0.0266
Slowly soluble fraction	21.53	26.58	47.51	8.24	0.0842
Degradation rate constant	0.03	0.09	0.04	0.05	0.5939
Neutral detergent fiber					
Rapidly soluble fraction	33.25	17.96	12.91	8.77	0.0569
Slowly soluble fraction	25.17	60.08	46.49	31.04	0.6299
Degradation rate constant	0.04	0.06	0.04	0.03	0.8469

[1]Analyzed at the Advanced Animal Science Research and Training Laboratory (AASRTL) and Dairy Training and Research Institute

[ab]Values within a row with different superscript letters are different ($P<0.05$).

the other hand, follows the standard non-linear degradation curve and caught up closely to BPS and WH at 48-72 h incubation period. Figure 1.2 shows BPS with the highest OM degradation at 72 h. The more horizontal degradation curve of water hyacinth suggests limited OM degradability. Figure 1.3 shows that NG despite having a low initial degradation, had the highest NDF degradability at 48 h while water hyacinth had the least (<40%). Foulkes and Preston (1978) reported that the dry matter of BPS was relatively digestible for ruminants (75%). However, despite this apparently high DM digestibility, pseudostems alone can barely meet the maintenance requirements of ruminants. Nevertheless, the result of this study is an indication that BPS can be considered as a potential alternative substitute by inclusion when there is a low supply of grass forage. Also, WH contains a high amount of cellulose and hemicellulose which acts as an energy source for ruminants (Mukherjee and Nandi, 2004). It can be fed fresh and wilted with roughages. Water hyacinth cannot be fed solely but can be used up to 50% replacement (Nampoothiri, 2017).

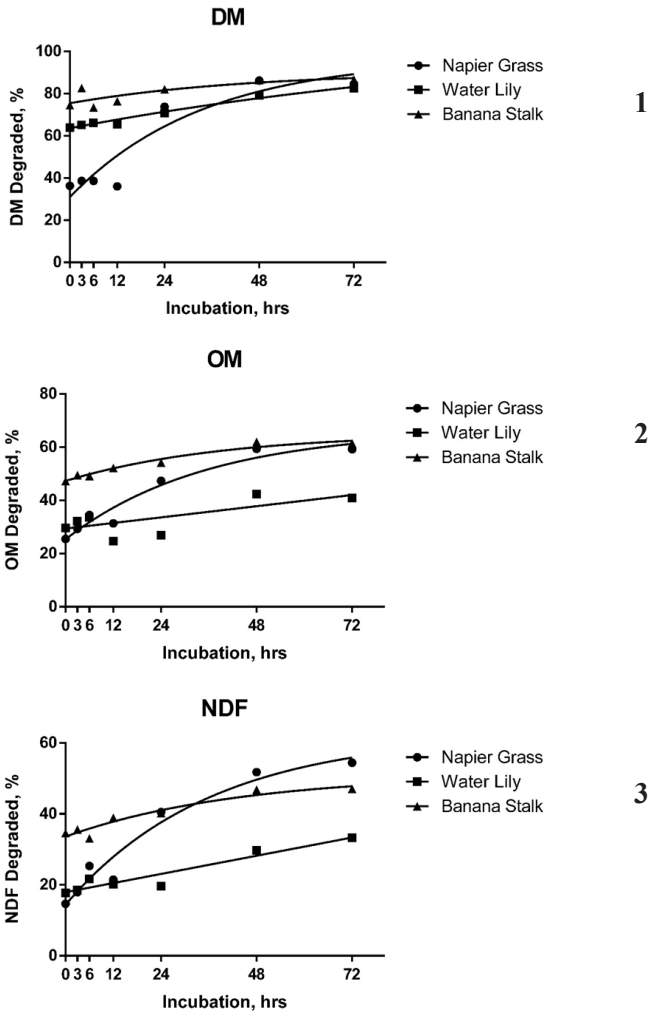

Figure 1. Degradation of NG, WH and BPS at 0, 3, 6 12, 24, 48 and 72 h for (A) dry matter (DM), (B) organic matter (OM) and (C) neutral detergent fiber (NDF).

In conclusion, banana pseudostem and water hyacinth are possible alternative feed ingredients for dairy cattle. High dry matter degradability of both banana pseudostem and water hyacinth in this study indicate that both can be fed to dairy cattle.

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