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Effect of Type and Level of Supplement on the *in vitro* Organic Matter Digestibility of Banana Leaf Diets Offered to Ruminants in Uganda

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Abstract: An experiment was conducted to determine the effect of type and level of supplement on the *in vitro* organic matter digestibility of banana leaf diets. Mature leaves from six varieties of banana; Matooke (MT), Kayinja (BW), Ndiizi (ND), Bogoya (BG), Kisubi (KS) and Kivuuvu (BR) were collected from Busiita parish, Sironko district on the slopes of Mt. Elgon in Eastern Uganda. These were dried at 60°C to a constant weight, ground to pass through a 1 mm screen and mixed with supplements of Cottonseed Cake (CSC), Sunflower Cake (SFC) and Maize Bran (MB) at levels of 0, 15 and 30% each giving a total of eighteen different mixtures. *In vitro* digestibility was determined using the method described by Tilley and Terry. Inoculum was obtained from a fistulated steer fed a normal grass diet. Samples were incubated for a period of 96 h. Statistical analysis for a one-way Analysis Of Variance (ANOVA) was carried out using SAS. The mean *in vitro* organic matter digestibilities for the 18 treatments were: Alone (55.4%), with MB (66.3%), with CSC (62.3%) and 58.5% with SFC. For the different varieties, mean banana leaf *in vitro* OMD values were; 59.6% for BG, 58.7% for BR, 66.9% for BW, 56.6% for KS, 58.2% for MT and 63.8% for ND. The digestibility mean values for most varieties were not significantly different ($p>0.05$) except those of BW (66.9%) and ND (63.8%). When banana leaf organic matter was supplemented with MB, digestibility was higher ($p<0.05$) than that of other diets where either CSC or SFC were used as supplements, although CSC mean digestibility values were higher than those for SFC. The changes in OMD were 19.7, 12.6 and 5.5% for MB, CSC and SFC, respectively compared to no supplement. At the different levels of supplementation, the mean *in vitro* OMD were; 60.7% for the 15 and 64.1% for the 30% levels of supplementation. The OMD was increased by about 15.7% at 30% levels compared to the 9.5% increase at the 15% level of supplementation. The study revealed that addition of an easily available source of nutrients can greatly enhance digestibility of banana leaves.

Key words: *In vitro* OMD, supplement, banana, diets, ruminants, Uganda

INTRODUCTION

In Uganda, Livestock sector contributes 7% of the national GDP and 17% of the AGDP. Ruminnats form 37% of the total livestock number, where they serve as a source of income, cropping manure and food for many livelihoods especially the resource poor and smallholder farmers Uganda Bureau of Statistics (UBOS). It is these smallholders together with pastoralists who own most of the bulky (about, 80%) of the livestock. Pastures naturally provide the basis for ruminant diets in Uganda. However, sources may not be available throughout due to lack of grazing as a result of increasing pressure on land or changing agricultural practices. Consequently, farmers have had to rely on other feed sources some of which include crop residues to provide protein and energy requirements for their animals. Crop residues largely form the basic diet for ruminants in the highlands of Eastern Uganda. Banana leaf diet is one of such crop residues used. Banana by product used to feed livestock form bananas include; pseudo-stems, peels and leaves. Crop residues are good and inexpensive sources of protein and energy and their use in feeding livestock is not a knew phenomenon (Mora *et al*., 1992). One limitation of using these residues is that their nutritive values are low.

Consequently, in order to use those more efficiently as animal feeds, there is need to provide supplements to improve their nutritive values to meet the animal's requirements. The main purpose of this study is to assess the effect of supplement on the *in vitro* organic matter digestibility of banana leaf diets. This study focuses mainly on the type and level of supplement inclusion in the diets.

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MATERIALS AND METHODS

Preparation of samples: Banana leaves used in this study were collected from Busiita parish, Budadiri Sub-county, Sironko district. Sironko district is located in the North Eastern part of Uganda along latitude 10 1227N and longitude 240158E, on the slopes of mountain Elgon and lies at an altitude of 3864 ft above sea level. These were mature fresh leaves, from six cultivars of banana. The cultivars included; the cooking type (Matooke and Kivuuvu), the sweet type (Bogoya and Ndiizi) and the brewing type (Kisubi and Kayinja). In the laboratory, each fresh sample was weighted, chopped and oven dried at 60°C overnight to a constant weight.

They were weighed after drying to determine Dry Matter (DM) and ground to pass through a 1 mm sieve. The supplements used were bought from a commercial feed supply shop and they included; Maize Bran (MB), Cotton Seed Cake (CSC) and Sunflower Cake (SFC). The diets were constituted by mixing banana leaf samples with supplements at levels of 0, 15 and 30%. The diets were stored coded in air tight bottles at room temperature for the subsequent determination of proximate composition and *in vitro* digestibility. Ruminal flora (Inoculum) was collected in a vacuum flask from Makerere University Agricultural Research Institute Kabanyolo (MUARIK) from a fistulated cow fed on basal diet and taken to the animal nutrition laboratory in the Faculty of Agriculture.

Determination of *in vitro* rumen digestibility: Dry diets (0.5 g) were subjected to a 48 h digestion period with buffer/rumen fluid mixture in three sealed fermenter flasks followed by 48 h digestion with pepsin in weak acid (Tilley and Terry, 1963). All incubations were carried out in triplicate. Three blank tubes were used in each run. After 48 h with pepsin in weak acid, samples were filtered (Whatman No. 4) by gravity and the residues placed in porcelain crucibles for drying at 105°C overnight and then ashed in a furnace at 550°C. The dry residues were weighed and digestibility was calculated using the equation:

$$\textit{In vitro}\ \text{OMD\%} = \frac{(\text{Oven wt - Furnace wt.})}{\text{Wt. of fresh sample}} \times 100$$

Statistical analyses: Data were subjected to one-way Analysis Of Variance (ANOVA). This was carried out to compare the IOMD values, with level and type of supplement as the main factors using the GLM procedure of SAS (2003).

Significance between individual means was identified using the Duncan's LSD. Mean differences were considered significant at $p<0.05$. The statistical model included the fixed effects of variety of banana, type of supplement and level of supplement. The formula for the statistical model was:

$$Y_{IJK} = U + A_I + B_J + C_K + E_{IJK}$$

Where:

U = General mean
A_i = Effect of ith level of supplement
B_J = Effect of jth type of supplement
C_K = Effect of kth variety of banana
E_{IJK} = Random error

All effects were considered to be fixed except for E_{IJK} which was considered normally distributed.

RESULTS AND DISCUSSION

Effect of type of supplement on *in vitro* organic matter digestibility: The effect of type of supplement on *in vitro* OMD for the different banana varieties is shown in Table 1. Maize bran supplemented diets generally were slightly superior ($p<0.05$) to both Cottonseed Cake (CSC) and Sunflower Cake (SFC) supplemented diets. This was showed by the fact that supplementing with MB increased the organic matter digestibility by 19.7%, while that of Cottonseed Cake (CSC) increased it by 12.6% and Sunflower (SFC) by 5.5% compared to those where no supplement was used. There was some varietal difference in *in vitro* OMD, with ND and BW having the highest values 60.7 and 60.5%, respectively (Table 1).

Effect of level of supplement on *in vitro* organic matter digestibility: The *in vitro* OMD values for the different varieties of banana (Leaf) when graded levels of supplement were added are shown in Table 2. At the different levels of supplementation, the mean *in vitro* OMD were 60.7% for the 15 and 64.1% for the 30% levels of supplementation.

The OMD was increased by about 15.7% in the high (30%) supplemented diets scompared to the 9.5% increase in the low (15%) supplemented diets. The digestibility of organic matter in the total ration increased ($p<0.05$) with

Table 1: Effect of type of supplement on *in vitro* OMD

	Types of supplement			
Varieties	None	MB	CSC	SFC
BG	56.6^{ab}	67.3^{ab}	60.2^{c}	54.5^{c}
BR	53.0^{b}	66.3^{b}	57.4^{c}	58.2^{b}
BW	60.5^{a}	71.2^{a}	72.0^{a}	63.7^{a}
KS	49.5^{c}	59.3^{c}	62.7^{c}	55.0^{c}
MT	52.1^{bc}	62.5^{bc}	59.3^{c}	58.9^{b}
ND	60.7^{a}	71.4^{a}	63.5^{bc}	60.6^{ab}
LSD	4.6	5.1	4.8	3.5

^{abc}Means in a coloum with different superscript differ ($p<0.05$)

Table 2: Effect of level of supplement on *in vitro* OMD of banana leaf

Levels of supplements in diet	Variety of banana (Leaf)					
	BG	BR	BW	KS	MT	ND
Maize bran						
0%	56.60^{a}	53.00^{ab}	60.50^{b}	49.50^{b}	52.20^{b}	60.70^{a}
15%	60.90^{b}	62.10^{b}	70.30^{a}	59.00^{a}	60.90^{a}	70.80^{ab}
30%	73.60^{a}	70.50^{a}	72.10^{a}	59.60^{a}	64.10^{a}	72.10^{a}
LSD	3.76	5.86	5.66	8.71	4.07	10.49
Cotton seed cake						
0%	56.60^{a}	53.00^{ab}	60.50^{b}	49.50^{b}	52.20^{b}	60.70^{a}
15%	58.20^{a}	56.60^{a}	71.60^{a}	61.60^{a}	58.10^{ab}	61.40^{a}
30%	62.20^{a}	58.10^{a}	72.30^{a}	63.80^{a}	60.50^{a}	63.50^{a}
LSD	7.10	3.28	9.25	6.54	3.13	6.30
Sunflower						
0%	56.60^{ab}	53.00^{b}	60.50^{a}	49.50^{b}	52.20^{b}	60.70^{a}
15%	58.20^{a}	54.60^{b}	60.60^{a}	48.20^{b}	58.00^{a}	60.80^{a}
30%	50.70^{b}	61.70^{a}	67.50^{a}	61.70^{a}	59.90^{a}	60.40^{a}
LSD	7.10	3.28	9.25	6.54	3.13	6.30

^{abc}Means in a column for a particular supplement with different superscripts differ ($p<0.05$)

each additional CSC, SFC and MB level. The digestibility of the 30% supplemented rations was greater ($p<0.05$) than that of either 15% supplemented diets or without.

Effect of type of supplement on *in vitro* organic matter digestibility: Maize Bran (MB) supplemented diets were generally superior ($p<0.05$) to both CSC and SFC supplemented diets. The findings are in agreement with Abate and Kiflewahid (1992), who reported that brans are more degraded compared to oil proteins and cotton seed cake is better degraded than sunflower seed cake among the oil proteins. Diets based on MB could have provided more Metabolizable energy that promoted the rapid multiplication of ruminal flora causing a huge break down of the cellulose walls compared to either CSC or SFC.

Effect of level of supplement on *in vitro* organic matter digestibility: Level of supplement, significantly ($p<0.05$) affected the *in vitro* OMD. OMD increased with each additional level of supplement. The results reported in here concerning the increased digestibility of OM in banana of leaf with increasing supplemental CSC, SFC and MB are in agreement with the observations of Lamb and Eadie (1979), who reported increased DM and OM digestibility with increasing proportions of barley supplement with a forage-based diet.

This could be due to the increase in the proportions of easily digestible matter and/or Metabolizable energy content as the supplement increases. There different banana leaf varieties showed more or less no difference in *in vitro* OMD except for ND and BW. This could be due to differences in tannin levels, the two varieties, having less tannin contents.

CONCLUSION

From the findings of the study, it can be said that generally, supplementation increased the *in vitro* OMD of banana leaf by 12.6%. Maize bran supplemented diets generally were slightly superior to both cottonseed cake and sunflower supplemented diets. Up to 30% diets with higher levels of supplement were better digested compared to those with lower ones. We don't know what happens if supplement is increased above 30%.

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