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Effect of Feeding Fresh Banana Plant Waste and its Silage on Dry Matter Intake, Nutrient Digestibility and Rumen Fermentation Parameters in Osmanabadi Kids

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ABSTRACT

This study was conducted to evaluate the possibility of incorporating banana plant waste either fresh or as silage in the diet of small ruminants. To study the effect of fresh banana plant waste and its silage on the performance of Osmanabadi kids, 15 growing kids were randomly allocated into three groups (n=5) on body weight (16.0 kg) and age (8-11 months) basis. The fresh banana plant waste silage (FBPWS) was fed to one of the three treatment groups (T_3) and compared with groups fed fresh banana plant waste (FBPW; T_2) and sorghum straw (T_1) as source of roughage with concentrate mixture in the ratio of 55.8:47.2 (T_1), 25.3:74.7 (T_2) and 38.9:61.1 (T_3). The DM and CP (%) content of FBPW and FBPWS were 8.60 and 8.84; 29.97 and 5.44 respectively, while silage had pH of 5.05. The DMI in T_2 (0.54%) and T_3 (0.98%) groups were significantly ($P<0.01$) lower than T_1 group (1.57%). When these roughage sources were supplemented with CFM, it supported daily gain (g/d) of 2.33 and 14.14 in T_2 and T_3 groups which indicated that these were maintenance type of roughages. There was no significant difference between treatments in any of the nutrient digestibility parameters. The DCP and TDN content (%) in T_1, T_2 and T_3 groups were 4.43 and 66.24; 9.96 and 73.50; 6.21 and 69.55 respectively. The pH values of rumen fluid of three groups were within the normal range of variations, whereas, TVFA levels were different among the treatment groups. Total nitrogen, TCA precipitable- N and soluble nitrogen levels were similar among groups. It is concluded that FBPW and FBPW silage due to their low DM level could not be a sole source of roughage in the diet of ruminants and require to be supplemented with either good quality hay or straw and CFM to meet the nutrient requirements to support growth.

Keywords: Fresh banana plant waste, Banana plant waste silage, Gain, Kids

INTRODUCTION

Among several fruit plants wastes used as animal feed, banana plant by-products like stem and leaves may be one of the major substitutes of roughages after harvesting fruits (Bhimsen *et al.,* 2014). Presently the by-products of banana plants are thrown out as waste on roadsides, fields and allowed to rot away or sometimes burnt in the field (Amaranth and Balakrishnan, 2007). Banana plant wastes cannot be stored for longer period due to higher moisture level and in order to increase the self life for efficient utilisation of wastes, silage making is preferred. The moisture level can be reduced to desired level by adding any dry roughages and cereal grain powder to enhance fermentation process to obtain good quality silage. Hence, attempt was made to convert it into silage and evaluate for its nutritional significance in Osmanabad goats in comparison with fresh banana plant waste feeding.

MATERIALS AND METHODS

The banana plant wastes were collected, chopped manually and dried under sun for 5 days to reduce the moisture to 73%. Then banana plant waste (85%) was mixed with sugarcane bagasse (13%) as a water absorbent material and ground sorghum grain (2%) as a source of carbohydrate and the DM content of mixed material was 36.65%. The same was filled in silo pit (above ground level, 8 cu m, capacity of 5.6 tons). After 6 weeks, the containers were opened and characteristics of silage were studied for their physical characteristics like pH, colour, texture, and odour. Fifteen Osmanabadi kids (8-11 months age; 16 kg BW) were divided into three groups of 5 kids each in completely randomised design and designated with following treatments; free choice feeding of sorghum

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stover and concentrate feed mixture (CFM) (T_1) serves as control group, free choice feeding of fresh banana plant waste and CFM (T_2) and free choice of banana plant waste silage and CFM (T_3). All the kids were housed individually in metabolic cage and provided with similar management practices. All the kids were dewormed with fenbendazole and were vaccinated against FMD, ET, PPR and HS as per standard schedule. The animals were fed as per requirement of NRC (1981). During the experimental period, daily feed intake and weekly body weight gain were recorded. All 15 kids were subjected for metabolism trial for 5 days at the end of the experiment. The rumen liquor was collected before the start and end of the experiment by passing stomach tube into the rumen from all kids at two hours post feeding and pH was recorded immediately using electronic digital pH meter and rumen fluid was stored at –20°C for estimation of NH_3-N, TN, TCA-N and soluble nitrogen (Gloppe and Hvidsten, 1995) and TVFA's according to Barnet and Reid (1956). The samples of feed ingredients, concentrate feed mixture (CFM), fresh banana plant waste (FBPW), fresh banana plant waste silage (FBPWS) and faecal matter were subjected to proximate analysis (AOAC,1995) and forage fiber fraction (Van Soest *et al.,* 1991). Data obtained were subjected to analysis of variance using the General Linear Model procedures of Statistical Analytical System (SAS, 2012).

RESULTS AND DISCUSSION

The physical characteristics like colour of silage was brownish yellow and no mould growth was seen, but pH of the silage was 5.05. The level of volatile fatty acids (75 mmol/kg) was well comparable with the good silage and the NH_3-N level was slightly higher (4.66 mg/dl) than the normal value.

DM (%) content of FBPW and FBPWS was similar to the values (Table 1) reported by Marie-Magdeleine (2010). The CP (8.84% DMB) in FBPW was reduced to 5.44 % when it was ensiled with 2% sorghum grain powder and 13 % sugarcane bagasse and value was lower than the values (14 to 15%) reported by Hambade and Patel (2001), Khattab *et al.*(2000) and Rahman and Huque (2002). The NDF and ADF values were well comparable with values obtained both for fresh and silage in the study conducted by Ally and Kunjikutty (2003) and Rahman and Huque (2002). The ADL content of FBPW and FBPWS was higher (9.39 and 9.72) than values reported (5.25%) by Reddy and Reddy (1991) for fresh banana plant waste and its silage (3.61%) by Khattab *et al.* (2000).

Significantly lower ($P<0.01$) DMI from FBPW

Table 1. Chemical composition (% DM) of fresh banana plant waste (FBPW), its silage (FBPWS), sorgum stover (SS) and concentrate mixture (CFM) fed to experimental kids

Particular	FBPW	FBPWS	SS	CFM
Organic matter	85.22	84.48	90.61	93.96
Crude protein	8.84	5.44	2.73	16.69
Crude fibre	35.34	37.76	35.08	3.56
Ether extract	1.27	1.15	1.75	2.31
Nitrogen free extract	39.77	40.13	51.05	71.40
Total ash	14.78	15.52	9.39	6.04
Acid insoluble ash	2.74	3.60	3.65	1.06
Neutral detergent fibre	69.13	73.58	76.86	23.59
Acid detergent fibre	43.11	52.72	52.18	9.37
Cellulose	29.87	36.18	39.99	5.79
Hemicellulose	26.02	20.86	24.68	14.22
Acid detergent lignin	9.39	9.72	5.60	6.88

Note: FBPW- Fresh banana plant waste, FBPWS- Fresh banana plant waste silage, SS-sorgum stover, CFM- concentrate feed mixture

(T_2) and FBPWS (T_3) groups was attributed to higher moisture level when compared to DMI from sorghum stover (T_1) (Table 2). The DMI from CFM was not differed among the groups as its quantity was restricted. The difference in total DMI among the groups was due to variation in intake of FBPW and FBPWS. The roughage and concentrate ratio in T_1, T_2 and T_3 were 55.8: 47.2, 25.3:74.7 and 38.9: 61.1, respectively. As per cent of body weight, kids in T_2 group had very low DMI than T_3 groups (0.54 v/s 0.98%) which was significantly (P<0.01) lower than T_1 group (1.57%). On the contrary, Reddy and Reddy (1991) noticed DMI of 1.61% of live weight in bulls and Gupta *et al* (2001) observed 1.26 % DMI in bullock when fed whole banana plant alone. The significant variations in DMI did not cause variation in CP intake due to difference in the CP level of feedstuffs but total CPI in all groups was higher than the maintenance requirement of kids. Significantly higher (P<0.01) total intake of OM, CF, EE, NDF and ADF was observed in T_1 group followed by T_3 and T_2 groups. The difference in the nutrient intake was attributed to the variations in the DMI. The results were well corroborated with the findings of Ginni (2014).

The daily gain of 2.33 g/d in T_2 group indicated that nutrients received by kids were just sufficient for maintenance, the gain in T_3 group was little better than T_2 group (Table 3) which indicated that FBPW and FBPWS might be used as maintenance type of roughage with little supplementation. There was no significant difference among treatments in any of the nutrient digestibility parameter (Table 3). These values were higher than the values reported by Hambade and Patel (2001), similar to the values reported by Ally and

Table 2.Mean daily DM intake and nutrients intake of experimental kids

Parameter		T_1	T_2	T_3	SEM	P-Value
DMI, g/d	Rough	266.63^{a}	81.85^{b}	153.67^{c}	8.30	<0.01
	CFM	238.29	242.21	241.59	1.21	0.39
	Total	504.92^{a}	324.05^{b}	395.25^{c}	8.91	<0.01
%BW	Rough	1.57^{a}	0.54^{b}	0.98^{c}	0.05	<0.01
	CFM	1.43	1.57	1.53	0.06	0.63
	Total	3.00^{a}	2.11^{b}	2.51^{ab}	0.10	<0.05
CPI, g/d	Rough	7.28	7.28	8.36	0.39	0.43
	CFM	39.77	40.42	40.32	0.20	0.39
	Total	47.05	47.66	48.68	0.48	0.39
%BW		0.28	0.31	0.31	0.01	0.65
OMI, g/d		465.49^{a}	297.33^{b}	356.81^{c}	8.01	<.0.01
%BW		2.77^{a}	1.94^{b}	2.26^{ab}	0.09	<.0.01
CFI, g/d		102.02^{a}	37.55^{b}	66.62^{c}	2.94	<.0.01
%BW		0.60^{a}	0.25^{b}	0.42^{c}	0.02	<.0.01
EEI, g/d		10.17^{a}	6.64^{b}	7.35^{b}	0.15	<.0.01
%BW		0.06^{a}	0.04^{b}	0.04^{b}	0.02	<.0.01
NFEI, g/d		306.26^{a}	205.49^{b}	234.16^{b}	4.53	<.0.01
%BW		1.82^{a}	1.34^{b}	1.48^{ab}	0.06	<.0.05
NDFI, g/d		261.14^{a}	113.72^{b}	170.06^{c}	6.39	<.0.01
%BW		1.55^{a}	0.74^{b}	1.08^{c}	0.05	<.0.01
ADFI, g/d		161.45^{a}	57.98^{b}	103.64^{c}	4.24	<.0.01
%BW		0.95^{a}	0.38^{b}	0.66^{c}	0.03	<.0.01

P<0.05, P<0.01, Means with different superscripts in a row differ significantly

Kunjikutty (2003) and Ginni (2014) in Osmanabadi kids. No significant difference was observed between the groups in mean nitrogen intake and dung nitrogen outgo but there was a significant difference (P<0.01) in urine nitrogen outgo, whereas no difference was noticed in total nitrogen outgo among the groups. However, all the kids in the treatment groups were on positive nitrogen balance which was evident in terms of marginal gain of daily body weight (Table 3).

DCP (%) in T_2 group was significantly higher (P<0.01) than T_3 and T_1 because of higher digestibility of CP (67.48%), while there was no significant difference in TDN and ME levels in the experimental diets. However, intake of DCP, TDN and ME among the groups were statistically significant (P <0.01). The findings of this study were similar to the values reported by Bhuyan *et al.* (1989) and Ally and Kunjikutty (2003) and Ginni (2014).

The intension of analysing rumen fluid parameters of the experimental kids was to know the trend of rumen ecology related to the constant feeding of FBPW and its silage in comparison with usual roughage feeding. On observation, pH values of rumen of the kids were within the normal range under different treatments

Table 3. Mean body weight, daily gain, nutrient digestibility and density in experimental kids

Parameter	T_1	T_2	T_3	SEM	P-Value
Body Weight					
Initial (kg)	16.00	16.00	16.02	2.61	0.99
Final (kg)	17.25	16.10	16.61	2.66	0.79
Gain (g/d)	29.76	2.33	14.14	26.69	0.30
Nutrient digestibility, %					
DM	65.01	74.53	71.22	2.10	0.21
OM	70.09	78.10	75.02	1.90	0.26
CP	46.46[a]	67.48[b]	50.40[b]	1.63	<0.01
CF	63.67	69.86	67.29	2.05	0.48
EE	64.25	69.11	78.58	3.06	0.19
NFE	76.09	82.25	82.25	2.08	0.40
NDF	56.82	53.19	52.46	3.11	0.83
ADF	63.32	52.62	54.06	2.40	0.24
Nitrogen balance (g/d)					
Nitrogen intake	7.57	7.5	7.78	0.20	NS
Faeces-N Out go	3.95[a]	2.66[b]	3.92[a]	0.34	<0.01
Urine-N Out go	1.18[b]	2.98[a]	2.36[a]	0.38	<0.01
Total-N-out go	5.13	6.15	6.28	0.52	NS
N balance	2.44	1.35	1.50	0.51	NS
Nutrient density					
DCP, %	4.34[a]	9.96[b]	6.21[c]	0.26	<0.01
TDN, %	66.24	73.50	69.55	1.19	0.30
DOMD, %	64.62	71.71	67.73	1.79	0.30
ME, MJ/kg	10.00	11.10	10.50	0.28	0.32
DCPI, g/d	21.86[a]	32.06[b]	24.53[a]	0.71	<0.01
TDNI, g/d	335.14[a]	236.36[b]	274.81[b]	8.56	<0.01
MEI, MJ/d	5.06[a]	3.57[b]	4.15[b]	0.13	<0.01

P<0.05, P<0.01, Means with different superscripts in a row differ significantly.

Table 4. Rumen parameters: pH, total volatile fatty acids(TVFAs), ammonia nitrogen(NH_3-N),totalnitrogen(TN), TCA precipitable nitrogen(TCA-N) and soluble nitrogen(SN) in phase-I

Parameter	T_1	T_2	T_3	Mean	SEM	P-Value
pH						
Initial	6.79[a]	6.71	6.65[a]	6.72[a]	0.05	NS
Final	6.29[b]	6.32	6.16[b]	6.26[b]	0.05	NS
TVFA's, m mol/dl						
Initial	12.11	10.92	10.36[a]	11.13[a]	0.16	<0.01
Final	13.25	11.99	9.03[b]	11.42[a]	0.16	<0.01
NH_3-N, mg/dl						
Initial	26.70	22.69[a]	28.11[a]	25.83[a]	0.51	<0.05
Final	29.72	13.15[b]	17.67[b]	20.18[b]	0.51	<0.01
TN, mg/dl						
Initial	96.96	99.52	96.32	97.6[a]	1.01	NS
Final	104.41	79.31[b]	99.39[a]	94.37[b]	1.01	<0.01
TCA-N, mg/dl						
Initial	50.70	54.72[a]	59.24[a]	54.89[a]	1.27	NS
Final	50.20	27.11[b]	25.10[b]	34.14[b]	1.27	<0.01
Soluble –N, mg/dl						
Initial	46.26	44.80	37.08	42.71[a]	1.69	NS
Final	54.21	52.21	74.30[b]	60.24[b]	1.69	<0.01

P<0.05, P<0.01, Means with different superscripts between columns differ significantly.

even though the proportion of roughage component was only 25% of total DMI in T_2 group. Similar pH values were reported in ruminants fed with banana plant waste and its silage in various experiments (Reddy and Reddy 1991; Rahman and Haque 2002; Mahanta and Pachauri, 2005; Ginni,2014). Significant difference in the level of TVFA between the treatments was observed due to the dietary variation and nutrient intake in kids. The values reported in this study were far lower than the values obtained by Rahman and Haque (2002).

Highly significant (P<0.01) level of total nitrogen in T_1 group between the treatment at the final of the experiment in T_1 and T_2 might be due to variation in the DCP intake. TCA precipitable nitrogen is an indication of insoluble or unavailable nitrogen and no significant difference among the treatments was observed. The TCA precipitable nitrogen level was lower in T_2 and T_3 than in T_1 group which indicated that available nitrogen was more in banana plant waste and banana plant waste silage when compared to sorghum (Table 4). No significant difference was observed among the treatments in the level of soluble nitrogen.

CONCLUSIONS

From the results it is evident that FBPW can supply nutrients enough to meet maintenance requirements of goats. In order to achieve higher performance FBPW based diet need concentrate supplementation along with feeding of good quality hay.

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