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Evaluation of Banana Plant Waste and its Silage-based Diet on Performance of Osmanabadi Goats

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ABSTRACT

The fresh banana plant waste (FBPW) and its silage (FBPWS) based diets were evaluated in Osmanabadi goats for six weeks. Thirty goats (n=30) were divided into six groups of five each and allotted to one of the following diets: T_1 (FBPW plus concentrate feed mixture; CFM), T_2 (FBPWS alone), T_3 (FBPWS plus CFM), T_4 (FBPWS plus soybean meal), T_5 (FBPWS plus maize mixed with slow releasing nitrogen product) and T_6 (FBPWS plus wheat bran). Restricted feeding of red gram straw (RGS) was carried out in all groups. The crude protein content of the diets varied from 6.18 to 19.80%.The total dry matter (TDM) and crude protein (CP) intake for T_1, T_2, T_3, T_4, T_5 and T_6 groups varied from 384.75 to 554.07 and 23.79 to 95.57 g/d, respectively. Furthermore, animals in all the groups were on positive nitrogen balance with similar biochemical parameters. It was concluded that FBPW with CFM and FBPWS with SBM based diets were superior over remaining silage based diet in terms of achieving higher body weight gain.

Key words: Banana plant waste, Red gram straw, Silage, Serum biochemical parameters

INTRODUCTION

Banana (*Musa paradisiaca)* is the second largest fruit produced after citrus, contributing 16% of the world's total fruit production. India is the largest producer of banana contributing 27% of world's banana production (Mohapatra *et al.,* 2010). After harvesting the fruits, plants are thrown as wastes, which can be better utilized if the moisture content is reduced and supplemented with little concentrate feeds (Gupta *et al.,* 2001, Marie-Magdeleine *et al.,* 2010). However, in order to increase its shelf life for continuous and constant supply, silage making is preferred. This can be ensiled by reducing moisture by addition of any dry roughages and cereal grain powder as a source of energy to enhance fermentation process to obtain good quality silage. However, the information on making and utilization of FBPW based silage as ruminant feed is scarce. Hence, this experiment was conducted to study the effect of feeding different types of FBPW based silage on performance and serum biochemical parameters of goats.

MATERIALS AND METHODS

Aerial part of two year old banana plants (*Musa paradisiaca*) of G-9 variety were harvested after removing the fruits and were chopped manually to a length of 1-2 inches, dried under sun light till the moisture was reduced to 73%. Then chopped banana plant waste (85%) was mixed with sugarcane bagasse (13%) and sorghum grain (2%) powder to reduce the moisture content to 63.35%. The same was trampled/ filled layer by layer in silo pit up to the brim to have compaction density of approximately 320 kg wet matter/m^3(less due to sponginess nature of plant). The pit was covered with plastic sheet (tarpaulin sheet) and made air-tight by covering with mud and dung slurry.After 6 months (due to inclement weather), silo pit was opened and silage was studied for their physical and chemical characteristics.

Dry matter of silage was estimated by toluene distillation method (Dewar and McDonald, 1961). The samples of FBPW, RGS, diets and fecal samples were dried in a hot air oven at 60°C until constant weight and were subjected for proximate (AOAC, 2005) and fibre fractions (Goering and Van Soest, 1970) analysis.

A growth trial was conducted using thirty female Osmanabadi goats (8-11 months age; 16 kg BW), divided into six groups of five goats each in an experiment based on completely randomized design (CRD) and the experiment lasted for six weeks Treatment 1 (T_1) comprised of feeding of fresh banana

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plant waste (FBPW) with 247 g of concentrate mixture. Treatment 2 (T_2) acted as negative control that comprised of banana plant waste silage alone (FBPWS). Treatment 3 (T_3) acted as positive control comprised of FBPWS with 247 g CFM. Treatment 4 (T_4) comprised FBPWS with 157 g soybean meal. Treatment 5 (T_5) comprised of FBPWS with 245 g ground maize grain mixed with 10 g slow releasing nitrogenous product (SRNP). Treatment 6 (T_6) comprised of FBPWS with 239 g wheat bran or single ingredient concentrates was supplied to balance energy and protein. The FBPW and its silages were fed *ad lib* while red gram straw (*Cajanus cajan)* was fed to all groups in order to meet DM requirement. All the treatments were equally supplemented with mineral mixture.

Goats were individually dewormed before commencing the feeding trial and fed similar rations for 45 days. The FBPS/FBPWS and CFM were fed separately in small proportions. The daily allowance of CFM was fed twice at 07.30 and 17.00 h. Goats were weighed every week using an electronic weighing balance before access to feed and water. A metabolism trial of 5- days collection period was conducted at the end of trial, during which daily intake of feeds, output of faeces and urine were recorded. Faeces and urine were collected manually by total collection method, one tenth of daily faeces voided by individual goats were used for DM determination (60°C) and stored for further chemical analysis. Samples of faeces and urine were preserved using 10%(v/v) H_2SO_4 for N estimation (AOAC,2005). Blood samples were drawn before morning feeding at the start and end of experiment from jugular vein of all experimental goats in non-heparinized tube, serum was separated and frozen at -20°C. Serum was analyzed for total protein, albumiun, globulin, albumin:globulin ratio as described by Gornall *et al.* (1949) and serum urea nitrogen by Fawcett and Scott (1960). Experimental data on DMI, nutrient intake, body weight gain, digestibility, nitrogen balance and blood parameters were subjected to analysis of variance using the General Linear Model procedures of Statistical Analytical System (SAS Institute Inc., 2012, Version, 9.3.1). All the percent values have been converted by arc sine transformation and standard error of mean (SEM) values presented are of the arc sine transformed data.

RESULTS AND DISCUSSION

The chemical composition of roughages and experimental diets has been presented in Table 1. All the diets were comparable with respect to CP except T_2 and T_4 because the T_2 comprised only roughage component and T_4 contained SBM in addition to roughage.

The data on nutrient intake and digestibility have been illustrated in Table 2.The DMI from FBPW was significantly lower in T_3 group, whereas, DMI in groups fed silage alone was significantly higher ($P<0.01$) when compared to other groups. The higher ($P<0.01$) DMI was achieved when FBPWS was used as a sole source of roughage than the FBPW or FBPWS were supplemented with either CFM or any single ingredient

Table 1. Chemical composition (% on DMB) of diets used in experiment

Particular	FBPW	T_1	T_2	T_3	T_4	T_5	T_6
Organic Matter	85.22	93.21	89.67	92.98	89.77	93.08	91.26
Crude Protein	8.84	11.54	6.18	12.10	19.50	10.24	11.15
Ether extract	1.27	1.85	1.35	1.91	1.35	2.17	1.97
Total ash	14.78	6.79	10.33	7.02	10.22	6.92	8.74
Neutral detergent fibre	67.31	49.22	70.27	44.70	55.17	41.97	56.89
Acid detergent fibre	43.90	27.84	48.17	25.79	34.32	25.41	28.64
Lignin (sa)	9.39	6.87	10.64	5.93	7.90	5.98	6.92

T_1;FBPW+CFM+ RGS; T_2;FBPWS+RGS;T_3:FBPWS+CFM+RGS; T_4:FBPWS+SBM+RGS;T_5;FBPWS+Maize+SRNP+RGS; T_6FBPWS+Wheat bran+RGS

concentrates. However, to improve DMI of FBPW and its silage, RGS was incorporated into diets of all the groups along with concentrate supplements except in T_2 group. Goats of all the groups consumed more DM from RGS than FBPW or FBPWS. The purpose of incorporation of RGS to improve intake of FBPW or FBPWS was defeated as animal had shown more inclination towards RGS intake than high moisture containing FBPW and FBPWS. The same trend was also observed in the intake of OMI. The CPI was significantly higher ($P<0.01$) in T_4 group due to supplementation of SBM followed by T_1, T_5, T_3 and T_6. The NDFI and ADFI among the groups were related to the roughage intake in the respective groups. Similar observations were noticed by Gupta *et al*. (2001) for banana plant waste and Khattab *et al*. (2000) for banana plant silage.

The digestibility of DM, OM and CP was significantly ($P<0.01$) lower in T_2 group than the other groups which had almost similar digestibility. However, NDF and ADF digestibility was lower in T_5 group which was due to addition of maize; NDF and ADF digestibility were comparable in T_2 group to other group even though T_2 was not supplemented with any

Table 2. Intake(g/d), nutrient digestibility (%), body weight gain, nutrient density (%) and nitrogen balance (g/d) in experimental goats

Phase	T_1	T_2	T_3	T_4	T_5	T_6	SEM
Nutrient intake (g/d)							
FBPW/S intake	67.68^{ab}	188.94^{c}	56.82^{a}	95.48^{ab}	99.94^{b}	66.50^{ab}	4.22
RGS intake	239.32	195.80	143.59	239.32	143.59	174.05	-
Concentrate	247.07^{c}	-	247.07^{c}	156.66^{a}	244.73^{c}	239.07^{b}	0.49
Total DMI	554.07^{d}	384.75^{a}	447.49^{b}	491.46^{c}	488.26^{bc}	479.62^{bc}	4.44
OM intake	516.41^{d}	345.24^{a}	416.18^{b}	441.45^{bc}	454.63^{c}	437.78^{bc}	3.76
CP intake	63.73^{c}	23.79^{a}	54.24^{b}	95.57^{d}	62.32^{c}	53.42^{b}	0.28
NDF intake	273.77^{b}	270.36^{b}	199.60^{a}	271.46^{b}	204.60^{a}	273.07^{b}	3.02
ADF intake	155.00^{cd}	185.33^{e}	115.04^{a}	168.90^{de}	123.83^{ab}	137.60^{bc}	2.30
Digestibility of nutrients(%)							
DM	73.46^{b}	54.97^{a}	73.07^{b}	68.65^{b}	65.77^{ab}	64.38^{ab}	0.77
OM	75.92^{b}	59.03^{a}	76.49^{b}	71.68^{b}	68.89^{ab}	67.74^{ab}	0.71
CP	56.34^{a}	48.30^{a}	58.23^{ab}	69.87^{b}	50.39^{a}	53.71^{a}	0.82
NDF	59.99^{b}	54.38^{b}	54.22^{b}	57.46^{b}	35.18^{a}	51.07^{ab}	1.10
ADF	54.31^{c}	51.66^{bc}	42.71^{abc}	49.95^{bc}	31.87^{a}	33.92^{ab}	1.10
BW gain (g/d)	66.67^{b}	16.05^{a}	38.72^{ab}	45.62^{ab}	33.29^{ab}	23.90^{a}	3.51
Nutrient density							
DCP (%)	6.52^{b}	3.08^{a}	7.77^{b}	15.13^{c}	6.95^{b}	6.25^{b}	0.16
TDN (%)	72.71^{cd}	54.87^{a}	75.21^{d}	65.91^{bcd}	58.79^{ab}	64.21^{abc}	0.66
ME, (MJ/kg DM)	10.99^{cd}	8.30^{a}	11.37^{d}	9.97^{bcd}	8.89^{ab}	9.71^{abc}	0.16
N balance (g/d)							
N intake	9.98^{d}	2.98^{a}	8.14^{b}	14.54^{e}	9.30^{c}	8.15^{b}	0.04
Fecal N	4.42^{b}	1.71^{a}	3.63^{b}	4.60^{b}	4.78^{b}	3.72^{b}	0.12
Urine N	3.79^{bc}	0.95^{a}	2.82^{b}	7.22^{d}	2.73^{b}	4.03^{c}	0.08
N balance	1.77^{ab}	0.32^{a}	1.68^{ab}	2.72^{b}	1.78^{ab}	0.40^{a}	0.17

^{a,b,c}Means with different superscripts in a row differ significantly ($^{*}P<0.01$); T-1;FBPW+CFM+ RGS; T-2;FBPWS+RGS; T3:FBPWS+CFM+RGS; T-4:FBPWS+SBM+RGS;T-5;FBPWS+Maize+SRNP+RGS;T-6FBPWS+Wheat bran+RGS

concentrate feed. It is indicated that FBPWS had good quality digestible fractions.In all groups, the digestibility of different nutrients obtained in the study were higher than the values reported by Hambade and Patel (2004) for banana plant leaves and lower than the values reported by Ginni (2014) for banana pseudostem based diets in goats.

DCP and TDN of FBPWS based diet was slightly higher than roughages commonly used in ruminant feeding. Diet comprising of silage alone had lower (P<0.01) digestible crude protein (DCP) (3.08%) like any other roughage diet, but T_4 had DCP value of 15.13 % due to higher CP content in SBM. The silage based diet (T_3) had better DCP value as compared to T_1 which was supplemented with same CFM. The FBPWS based diet had TDN of 54.87 % which was similar to TDN content of any roughage. It is clear that the TDN value of any feedstuff depends on the intake of digestible nutrient. The TDN level in diets T_1 and $T_3$was higher (P<0.01) than other concentrate supplemented groups possibly due to associative effect of feedstuffs. The T_2 diet had supported slightly above maintenance level (16 g/d) of nutrient requirement of goats whereas the FBPW supplemented with CFM supported for around 66 g/d and silage supplemented with either CFM or any concentrate ingredients supported 80% of gain that was achieved in FBPW fed group.Among different treatments T_1 and T_4 have achieved highest weight gain.This was well supported by positive nitrogen balance in all groups. Several studies that fed different level of FBPW and its silage in different experiments in bullock and bulls reported positive nitrogen balance (Gupta *et al*., 2001; Rahman and Haque, 2002).

Data pertaining to serum total protein, albumin, globulin,albumin: globulin and serum urea nitrogen are presented in Table 3. Different levels of concentrate supplements included to FBPW and FBPWS based diet could not influence any of the serum biochemical parameters in experimental goats. All values were in the normal range which suggested that the experimental diet had little influence on serum biochemical parameters. Similar findings were also reported by Khattab *et al.* (2000) for silage and Ally and Kunzikutty (2003) for fresh banana plant waste.

CONCLUSIONS

It was concluded that FBPW based diet can be

Table 3. Serum biochemical parameters in different groups of experimental goats

Parameter	T_1	T_2	T_3	T_4	T_5	T_6	SEM	P
Total protein (g/dl)								
Initial	7.55	6.76	7.31	7.04	7.16	7.13		NS
Final	7.40	6.99	7.54	7.16	7.21	7.26	-	NS
Albumin (g/dl)								
Initial	2.07	2.14	1.86	2.13	2.08	2.18	-	NS
Final	2.22	2.25	2.15	2.21	2.29	2.27	-	NS
Globulin (g/dl)								
Initial	5.48	4.62	5.45	4.92	5.08	4.95	-	NS
Final	5.17	4.74	5.38	4.95	4.92	4.98	-	NS
Albumin: globulin								
Initial	2.67	2.19	3.06	2.33	2.48	2.30	-	NS
Final	2.36	2.14	2.50	2.27	2.16	2.23	-	NS
Serum urea nitrogen (g/dl)								
Initial	13.08	12.73	13.19	13.67	13.09	13.51	-	NS
Final	13.30	13.26	13.20	14.00	13.10	13.60	-	NS

T-1;FBPW+CFM+ RGS; T-2;FBPWS+RGS;T3:FBPWS+CFM+RGS; T-4:FBPWS+SBM+RGS;T-5;FBPWS+Maize+SRNP+RGS; T-6FBPWS+Wheat bran+RGS

comparable to conventional diets with respect to crude protein except T_2 which was a sole roughage diet and T_5 diet which had SBM as a source of protein. FBPW and FBPWS based diet can support slightly above maintenance requirement, when it was supplemented with RGS. Supplementation of FBPW with CFM and FBPWS with SBM based diets were superior over remaining silage based diets in terms of achieving higher body weight gain. Further, silage consumption either alone or as proportion of diet can be increased by incorporating more cereal grain and dry roughage as moisture absorbents.

REFERENCES

Ally, K. and Kunjikutt, Y, N., 2003. Effect of level and nature of tannins in tree leaves on feed intake and digestibility of nutrients in goats. *Anim. Nutr. Feed Technol*. 3: 75-81.

AOAC. 2005. *Official Methods of Analysis,* 18th edn. Association of Official Analytical Chemists. Washington D.C.

Dewar, W.A. and McDonald, P. 1961. Determinationof dry matter in silage by distillation with toluene. *J. Sci. Food Agric*. 12: 790-795

Fawcett, J.K. and Scott, J.E. 1960. A Rapid and precise method for the determination of urea. *J. Clin. Pathol*. 13: 156-159.

Ginni, J. 2014. Effect of Banana Pseudostems (*Musa sapientum*) Silage supplemented with urea and maize grain on the performance of Osmanabadi kids. M.V.Sc thesis. Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar, India.

Goering, H.K. and Van Soest, P.J. 1970. *Forage Fiber Analysis*. Agricultural Handbook. Agricultural Research Services, US Dept. of Agriculture, Washington D.C.

Gornall, A.G., Bardawill, C.J. and David, M.M. 1949. Determination of serum proteins by means of the biuret reaction. *J. Biol. Chem.* 177: 751-766.

Gupta, R.S., Devalia, B.R., Patel, G.R., Nayak, J.B. and Pande, M.B. 2001.Nutritional evaluation of whole banana plant in cattle. *Indian J. Anim. Nutr.*18: 383-384.

Hembade, A.S. and Patel, P.M. 2004. Green banana (*Musca sp*s) leaves in the ration of kids. *Indian J. Anim. Nutr*. 21: 5-7.

Khattab, H.M., Kholif, A.M., EL-Alamy, H.A., Salem, F.A., EL-Shewy, A.A. 2000. Ensiled banana wastes with molasses or whey for lactating buffaloes during early lactation. *Asian-Australas. J. Anim. Sci*. 13: 619-624.

Mohapatra, D., Mishra, S. and Sutar, N. 2010. Banana and its by-product utilization: an overview. *J. Sci. Ind. Res*. 69: 323-329.

Marie-Magdeleine, C., Boval, M., Philibert, L., Borde, A., Archimede, H. 2010. Effect of banana foliage (*Musa paradisiaca)* on nutrition, parasite infection and growth of lambs. *Livest. Sci*. 131: 234-239.

Rahman, M.M. and Huque, K.S. 2002. Study on voluntary intake and digestibility of banana foliage as a cattle feed. Online *J. Biol. Sci*. 2: 49-52.

SAS., 2012.User's guide, Statistical Analysis Systems Institute, Inc; version 9.3.1, Cary, NC.

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