The Effect of Mulberry Leaf Meal on the Growth Performance of Weaner Goats in Jamaica

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Abstract

The ever increasing cost of commercial concentrates, formulated from imported grains, makes supplementation in goat rations very expensive. This has given rise to the need for less dependence on concentrates and for more emphasis to be placed on forages of high nutritive value for use in weaner production systems. Twelve growing male goats (6 Boers and 6 crossbred Nubians), 3 – 4 months old with mean body weight of 19.68 ± 2.08 kg were used to evaluate the effect of mulberry leaf meal as a substitute for commercial concentrates on the growth of young stall-fed goats in Jamaica. The animals were randomly assigned to three treatment diets (T1, T2, and T3) and fed in individual stalls for 100 days. They were each given a basal diet of pangola grass hay. The treatments were (mulberry: concentrate ratio, on dry matter basis as a percentage of body weight) 0:2, 1:1 and 2:0 for T1, T2 and T3, respectively. The parameters measured included average daily gain (ADG), dry matter intake (DMI), crude protein intake (CPI) and feed conversion. There was no significant difference ($P>0.05$) between the three treatment groups for ADG. Actual results showed ADG of 123.0, 125.0 and 121.0 g/d for T1, T2 and T3, respectively. DMI increased with increasing levels of mulberry from 1.01 kg/d to 1.21 kg/d for goats on T1 and T3 diets, respectively. The DMI for T3 was significantly ($P = 0.037$) higher than for T1. This could be attributed to the bulkiness of the mulberry leaf meal compared to the commercial concentrate. There was no significant ($P>0.05$) difference between treatments for CPI or feed conversion rate. Based on the data it can be concluded that dried mulberry leaves can be used to substitute commercial concentrate as a supplement in the feeding of weaner goats fed pangola grass hay. Further research is, however, needed to determine the economics of such a feeding regime.

Introduction

Goat production in Jamaica is carried out under systems ranging from small-scale fully intensive management to large-scale extensive range type systems. In most of these systems various types of commercial and on farm concentrate mixes are used with varying degrees of success; and in some systems forages represent the sole source of sustenance for the animals.

Commercial concentrates are formulated essentially from imported raw materials and as a result come at a high and ever increasing cost. In these systems where forage alone is utilized there is a tendency toward low levels of productivity. There exists therefore a need to reduce the dependence on concentrates and also to increase output levels in all forage production systems. The introduction and utilization of superior forage species such as the mulberry could assist in achieving these goals.

Mulberry is a shrub or tree traditionally used in sericulture in various countries. It belongs to the order Urticales, the family ***Moraceae*** and the genus Morus. There is an estimated 68 species of the genus Morus with the majority of them occurring in Asia (Datta, 2001), and in China there are over 1000 varieties under cultivation (Sanchez, 2001a).The most common species are **M. alba,** the White Mulberry, **M. nigra**, the Black Mulberry, **M. rubra**, the Red Mulberry and **M. indica**. The plant is not native to Jamaica but was introduced in 1997.

The nutritive value of mulberry is one of the highest found in products of vegetable origin and is far superior to traditional forages and is comparable to concentrates (Benavides, 2001). The foliage of the mulberry is highly digestible and of excellent crude protein (CP) content reaching levels of 20 – 24% (Gonzalez and Milera, undated). After evaluating the nutritive value of this plant Boschini (2002) concluded that leaf and cell wall contents, together with structural carbohydrates and ash indicate that mulberry is an excellent feed for high yielding animals and can be offered fresh or dried in compound feeds. Sanchez (2001b) also came to this conclusion and proffered that mulberry foliage can be used as a supplement to poor quality forage based diets or as the main component of a ration in livestock production systems.

Animal production studies have shown the great potential of mulberry as a supplement in the diet of ruminants. Benavides (2001) reported liveweight gains of 60, 75, 85 and 101 g/animal/day when mulberry was fed to Blackbelly sheep at 0, 0.5, 1.0 and 1.5 percent of body weight on a dry matter basis with King grass as the basal ration. In this study, rather than a substitution effect, there was an additive effect of mulberry on total dry matter intake. Mulberry has been used successfully in the feeding of dairy cows. The yield of lactating dairy cows did not decrease significantly when 75% of grain concentrates was replaced by mulberry (Esquivel et al, 1996 cited by Sanchez, 2001b).

Schmidek et al (2001) using goats fitted with rumen cannula evaluated the degradation rate of mulberry leaves. They concluded that the high values of the soluble and potentially degradable fractions as well as the potential and effective degradation of leaves of the mulberry clones studied, confirmed the high nutritive value of the plant and its great potential as a feed for goats.

In the humid northern highlands of Tanzania mulberry leaves are used in their cut and carry feeding systems for sheep and goats (Shayo, 1997). The usefulness and potential of the mulberry plant in animal production systems have been demonstrated in many other countries around the world. The increased need for efficiency and improved productivity in the local livestock sector warranted the investigation of this species in Jamaica.

The objective of the present study was to evaluate the effect of mulberry leaf meal as a substitute for commercial concentrates on the growth of young stall-fed goats in Jamaica.

Materials and Methods

Management of materials and animals

The present study was conducted at the Goat Research Unit of the Bodles Agricultural Research Station, Old Harbour, Jamaica. The animals for the trial consisted of 12 male weaner goatlings (6 Boers and 6 crossbred Nubians), 3 to 4 months old with mean body weight of 19.68 ± 2.08 kg. The feeds used included Pangola grass (*Digitaria decumbens*) hay, dried mulberry leaves and a commercial grain concentrate formulated for goats. The Pangola grass was produced on farm, mechanically harvested and baled. Mulberry leaves were harvested manually, sun dried on a concrete barbeque, then bagged and stored for feeding. The commercial concentrate was purchased from a local feed mill. Samples of offered feeds were taken fortnightly at time of feed adjustment and stored for bulk sampling and chemical analysis at the end of the trial.

The experimental animals were individually housed in partitioned pens with wooden sides, concrete floors and zinc roof. The pens had wooden sleeping palettes and were well ventilated. The animals were randomly assigned to three treatment diets (T1, T2, T3), each treatment with 2 Boers and 2 crossbred Nubians. Mean body weights were similar for the goats in all treatment groups. The goats were dewormed with Benvet 10% (Albendazole) at the beginning of the adjustment period (1 week prior to starting the experiment). They were also sprayed with Triatix at that time to control external parasites and again 14 days afterwards. The trial started on March 15, 2004 and continued through to June 23, 2004.

The goats were fed Pangola grass hay *ad libitum* as a basal diet and three levels of dried mulberry leaves in combination with a commercial goat ration offered as a percentage of the body weight on dry matter basis as follows:

	Percentage of body weight	
Treatment	Mulberry	Commercial Concentrate
T1	0	2
T2	1	1
T3	2	0

Each animal was provided with a trace mineralized block and fresh water was made available daily. The animals were fed once per day at 8:30 am and the refusals collected the next day and weighed prior to providing fresh feed. Feeding continued for 107 days including the 7 day adjustment period. The goats were weighed fortnightly to determine average daily gain (ADG) and the amount of feed offered adjusted to reflect body weight changes. Voluntary feed intake was determined daily for each goat (offerings minus refusals). Feed conversion was calculated from dry matter intakes and daily gains.

One goat (replicate 1) in T3 died from overeating just prior to the second weighing and was treated as a missing value. The diagnosis by the veterinarian was based on the presence of rumen fluid in the oesophageal tract at time of death.

Chemical analysis

Chemical composition of the feeds was determined using proximate analysis to determine crude protein (CP), ether extract (EE) and ash content. Neutral detergent fibre (NDF) was analysed using the procedure outlined by Goering and Van Soest (1970).

Experimental Design and Data Analysis

The study took the form of a completely randomized block design. Each treatment had four goats/replicates (2 Boers and 2 crossbred Nubians). The data were analyzed using Genstat 5 Release 3.2 statistical software (Lawes Agricultural Trust 1996). The missing values were calculated as per Cochran and Cox (1957)

Results and Discussion

Nutritive value of experimental diets

The nutritive values of the treatment diets are shown in Table 1. The mulberry leaf meal had a higher CP (16.01%) value than the pangola grass (*Digitaria decumbens*) hay (6.98%) but was slightly lower than the commercial concentrate (17.69%). The three feed ingredients had similar dry matter content. The CP value of 16.01% falls within the range of 15.0 – 28.0% as stated by Sanchez (2001b). Leaf crude protein content varies according to variety, age of plant and growing conditions (Sanchez, 2001b). Yao et al. (2000) found mulberry leaf CP values to be slightly higher in spring than in the fall (21.1% vs 20.9%). The NDF value of 24.0% in the current study is similar to the 24.6% determined by Shayo (1997) but lower than the 32.83% and 38.8 – 41.1% found by Malamsha et al. (1997) and Yao et al. (2000), respectively. These differences, however, could be due to maturity of the plant, as it is known that cell wall constituents of forages increase with age. The higher NDF value (69.13%) of the pangola grass hay suggests a lower digestibility than the mulberry leaf meal. High protein and relatively low fibre content of the mulberry is indicative of its suitability as a supplement for goats fed a basal diet of pangola grass hay. The ash content of 14.0% is consistent with that reported by Malamsha et al. (1997), Shayo (1997), and Sanchez (2001b).

Table 1: Chemical composition of the treatment diets

Parameter	Pangola grass hay	Commercial concentrate	Dried mulberry leaves
(% DM)			
DM	91.86	91.08	92.04
CP	6.98	17.69	16.01
Ash	7.10	8.12	14.00
NDF	69.13	20.00	24.00

Voluntary feed intake and growth rate of goats on the trial

Feed intake, growth rates, mean initial live weight, final weights and gains with standard errors for goats in the various treatments are shown in Table 2. There were no significant (P>0.05) differences in live weight and gains between goats in T1, T2 and T3. There was also no significant difference (P>0.05) between the three treatment groups for average daily gain (ADG). The ADG of 121.0 g for T3 (100% mulberry at 2% live weight DM basis) is higher than the 86.2 g realized by Gonzalez and Milera (undated) for goats fed mulberry at 2.5 % live weight DM basis. The lower ADG could, however, have been due to the shorter feeding period (29 days) by Gonzalez. The 121.0 g/d is also higher than the 76 g/d and 43 g/d reported by Yates and Pangabean (1988), cited by Malamsha et al (1997), for Katjang goats supplemented with concentrates and *Leucaena leucocephala*, respectively on Napier grass based rations.

In the present study voluntary dry matter intake (DMI) increased with increasing levels of mulberry from 1.01 kg/d to 1.21kg/d for goats on T1 and T3 diets, respectively. Gonzalez and Milera (undated) observed a similar trend with goats fed Guinea grass supplemented with mulberry. Malamsha et al (1997) fed goats Napier grass supplemented with mulberry leaves and obtained similar results. The DMI for T3 was significantly higher (P= 0.037) than for T1. This could be due to the mulberry leaves being more bulky than the commercial concentrate and the animals need to satisfy their nutritional requirements. There were no significant (P>0.05) differences in DMI between goats in treatments 1 and 2 and 2 and 3.

Neither crude protein intake (CPI) nor feed conversion rate showed any significant difference (P>0.05) between treatments. The CPI of 130 g/d for goats on the T3 (100% mulberry) diet proved adequate for maintenance and growth at 121.0 g/d ADG. The NRC (1981) protein requirement for maintenance is 4.15 g CP/kg $W^{0.75}$ plus an additional 14 g CP for 50 g/d gain for growth. This means that a growing goat at 32.2 kg live weight and gaining 121.0 g/d would require 89.98 g CP/d. The above results suggest that dried mulberry leaves can be used as a substitute for commercial grain concentrates in the feeding of goats fed a basal diet of pangola grass hay.

Table 2: Mean live weight, gain, feed intake, average daily gain and feed conversion values of goats on three treatment diets.

	Levels of mulberry/concentrate in dry matter						
	0/100 (T1)	50/50 (T2)	100/0 (T3)	Mean	s.e.d (6 d.f.)	P	LSD
Init. Lwt (kg)	19.05	19.55	20.45	19.68	2.08	0.798	5.08
Final Lwt. (kg)	31.3	32.0	33.1	32.2	2.93	0.829	7.17
Gain (kg)	12.3	12.5	12.1	12.3	2.47	0.988	6.05
Daily gain, g	123.0	125.0	121.0	123.0	24.7	0.988	60.5
DMI/d, Kg	1.01	1.12	1.21	1.11	0.057	0.037	0.14
CPI/d, Kg	0.12	0.13	0.13	0.13	0.008	0.516	0.02
Feed conversion, kg DM/kg gain	8.42	9.98	10.32	9.57	2.151	0.662	5.26

s.e.d. = standard error of the differences
LSD = least significant difference

Conclusion

The findings of the present study suggest that dried mulberry leaves are high in protein, highly digestible and comparable to commercial grain concentrates as a supplement to growing goats fed a basal diet of pangola grass hay. The mulberry leaf meal produced ADG's similar to that produced by the commercial grain concentrate. Its high digestibility and nutritive value make it an excellent feed for goats in a stall fed production system. It can be used effectively as a substitute for commercial grain concentrate in the diet of growing goats.

Studies to assess the economics of production and the cost of gain are needed to properly evaluate the place of mulberry in commercial goat production systems. Carcass evaluation studies are also needed.

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