Research Note

CONSUMPTION AND CHEMICAL COMPOSITION OF SHRUB AND HERBACEOUS SPECIES WITH POTENTIAL TO FEED SMALL RUMINANTS UNDER GRAZING CONDITIONS[1,2]

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Small ruminant production is a growing newcomer industry in Puerto Rico Most of our small ruminant farmers are presently dedicated to the production of meat.The main sheep breeds in use are Dorper, Saint Cross, and Cathadine. As to goat breeds, the Boar and local genotypes are among the best known. Meat from both sheep and goats commands the highest prices in the local market of about $9 to $11 per kilogram. However, even though it is growing this is still a small industry on the islandwith an annual gross production of only 136,000 kilograms . At present, one of the industry' s most difficult problems is the high cost of concentrate feeds, about $20 per 23 kilogram bag. The introduction of woody forage species suc h as the shrubs *Morus alba* (Morera) and *Hibiscus rosa-sinensis* in small ruminant production systems could be a possible alternative for reducing the high cost of concentrate feeds used on Puerto Rican farmsAt the Tropical Agricultural Research and Higher Education Center (CATIE) in Turrialba, Costa Rica, high digestibility of these shrubs was demonstrated in studies with lactating goats An in vivo digestibility of 79% w as found for Morera, and 64.2% for Amapola (*Malvabiscus arboreus*). The in vitro digestibility (89%) of Morera w as also higher than that of seven other shrub species native to Costa Rica (Jegou et al., 1994). Rhizoma perennial peanut has demonstrated a nutritive value higher than that of tropical grasses in Puerto Rico . Mean in vivo digestibility of Florigraze peanut was between 61.7 and 64.4% when fed to Holstein heifers (Ruiz et al., 2007).

More research is needed on the possible use of the above mentioned plant materials because of the high nutritional potential of these forages for ruminants. The objective of this study was to evaluate the effects of adding *Morus alba* leaves and soft twigs (MA), *Hibiscus rosa-sinensis* leaves and soft twigs (HB) and *Arachis glabrata* (AG) chopped foliage to the diet of young lambs grazing on Guinea grass (*Panicum maximum)* pastures, and to evaluate these forages in terms of quality and of dry matter consumption.

The study was conducted at the CorozalAgricultural Experiment Station of the University of Puerto Rico, where the facilities included a small ruminant stable divided into six cages, each provided with salt and water for free choice consumption and a feeder for forage placement. Next to these facilities , in an area of 0.6 ha, there were nine fenced plots of Guinea grass available for grazing. Additional areas of 0.18, 0.14 and 0.12 ha of *Morus alba*, *Hibiscus rosa-sinensis* and *Arachis glabrata*, respectively, were used for har-

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vesting the supplemental forages offered during stable confinement after Guinea grass grazing.

The initial experimentation took place between 4 September and 17 December 2007. During this period forage consumption and forage quality were evaluated. The animals grazed the Guinea grass plots between 7:00 a.m. and 2:30 p .m. daily. Thereafter they were placed by pairs in four of the stable cages and supplied cut or c hopped forages according to the following treatments:

MA – Cut *Morus alba* leaves and soft twigs
HB – Cut *Hibiscus rosa-sinensis* leaves and soft twigs
AG – Chopped *Arachis glabrata*
GG – Chopped Guinea grass (control)

The quantity of supplemental forage provided daily under eac h treatment w as equivalent to 1.5% of animal body weight on a dry matter basisThe two young lambs per cage (16 to 18 kg body weight) were used to determine the level of forage consumption of each treatment during a two-week cyc le. After every cycle, the four groups of animals were rotated, so that each one was fed twice during a total of eight cycles.

All forages were harvested at regrowth intervals from the 16th week to the 31st week. During the first week of eac h cycle the animals were adapted to the new diet offered. In the second week, daily 200-g samples of the offered forages were taken and combined to produce a 7-day composite per treatment. The forages were air-dried in an oven at 65° C for two weeks. The sampling dates chosen as representative of typical forage offerings were 13 to 20 November and 11 to 18 December.

Laboratory evaluations of forage quality were based on determinations of crude protein (% CP), percentage acid detergent fiber (% ADF), and neutral detergent fiber (% NDF) content, and calculated values of total digestible nutrients (% TDN), and net energy for lactation (NEl), for maintenance (NEm), and for gain (NEg).

Daily forage consumption proportional to the amount offered, and expressed as a decimal fraction, was determined according to the formula:

$$\text{Proportional Forage Intake} = \frac{\text{offered forage} - \text{refused forage}}{\text{offered forage}}$$

The statistical evaluation of forage consumption employed an ANOVA with diets and cycles as fixed effects, and animals as random effect. A T test (LSD) w as used for mean comparisons. For the determination of CP, ADF, NDF, TDN, NEl, NEm, NEg of the supplemental forages, an ANOVA with LSD tests w as used for mean comparison (SAS, 1990).

Figure 1 presents the daily proportional forage consumption by pair of lambs during the period between 4 September and 17 December 2007. Significant effects ($P<0.01$) of the cycle were detected throughout the whole experiment. Consumption of lea ves and soft twigs of the shrubs MA and HB w as significantly ($P < 0.01$) higher than that of the chopped forage of AG and GG in the period between mid October and December The distribution of forage consumption points in the graph is seen to be more consistent in most of the periods with the MA diet rather than with the diets of other forages.

Table 1 presents the mean Tukey-Kramer least square mean (LSM) of the four forage treatments under evaluation over the whole experimental period. We found significantly ($P < 0.01$) higher mean proportional consumption of forage shrubs MA and HR (leaves and soft twigs) than of GG and AG as chopped herbage. The high proportion of stems observed in GG andAG might have caused the low consumption rates obtained for

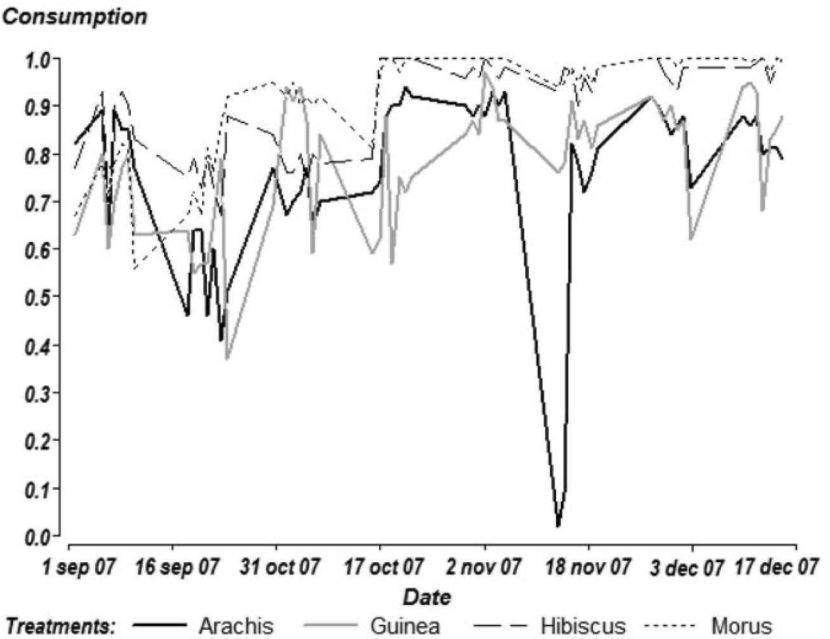

FIGURE 1. Daily proportional forage intake under each treatment.

these forage species. Because the level of plant maturity in both shrub species was high, the use of leaves and soft twigs was more pertinent for this evaluation.If these shrub species were used to feed small ruminants under an energy or protein bank of browsing system, excellent forage consumption could be expected based on the present results.

Table 2 presents a comparison of the least square means for the different criteria of chemical composition and energy values of the supplemental forages. No significant ($P < 0.01$) differences were observed among the three non-gramineous species MA, HB and AG in contents of CP, NDF, TDN, or the three net energy values. The three non-gramin-

TABLE 1.—*Mean proportional consumption of* Morus alba *(MA) and* Hibiscus rosa-sinensis *(HB) (leaves and soft twigs) and* Arachis glabrata *(AG) and* Guinea grass *(GG) (chopped) offered as supplemental forage between 4 September 2007 and 17 December 2007.*

Treatment (Diet)	Consumption
MA	0.92 a[1]
HB	0.90 a
AG	0.76 b
GG	0.78 b

[1]Means with different letters are significantly different ($P < 0.05$).

TABLE 2.—*Comparison of the Least Square Means of percentage content of CP, ADF, NDF, and TDN, NEl, NEm and NEg values of the supplemental forages on the dry basis.*

Forage species (Treatment)[1]	CP%	ADF%	NDF%	TDN%	NEl Mcal/kg	NEm Mcal/kg	NEg Mcal/kg
MA	25.5 a[2]	21.5 c	43.6 b	64.0 a	1.43 a	1.23 a	0.73 a
HB	18.4 a	16.1 c	33.5 b	66.0 a	1.54 a	1.96 a	0.79 a
AG	17.7 ab	35.3 b	48.0 b	62.0 a	1.36 a	1.19 a	0.66 a
GG	7.0 b	48.2 a	79.0 a	53.5 b	0.62 b	0.88 b	0.37 b
Mean	17.1	30.3	51.0	61.4	1.23	1.14	0.64
LSD	11.2	9.7	21.2	6.3	0.33	0.22	0.20

[1]Means of two collection periods: 13 to 20 November, and 11 to 18 December 2007.
[2]Means in the same column for each parameter with different letters are significantly different ($P < 0.01$).

eous species (MA, HB and AG) showed significantly ($P < 0.01$) higher energy values and lower fibrous fractions than GG.

The present findings of high consumption and forage quality of MA and HB point to the desirability of using these forages in the diets of small ruminants in Puerto RicoThe high level of acceptance of the shrub species MA and HB , given to young lambs as supplements under grazing conditions, was noteworthy. The significantly ($P < 0.01$) higher mean forage consumption of these two shrubs offered as lea ves and soft twigs was over that of AG and GG consumption when offered as chopped forage, thus indicating a preference in young lambs for leaves and soft twigs. This difference should also be related to the lower ADF content of the two shrub species and the higher stem proportions of AG and GG. Further research is needed in relation to the use of these forage shrubs under more extensive farm conditions , where complex management factors need to be addressed.

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