INTAKE AND DIGESTIBILITY OF MIXTURES OF BATIKI GRASS (*ISCHAEMUM ARISTATUM* VAR. *INDICUM*) AND DADAP (*ERYTHRINA VARIEGATA* VAR. *ORIENTAL*) BY CROSSBRED ANGLO-NUBIAN GOATS IN SAMOA

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Six crossbred Anglo-Nubian goats, 8–11 months old and 15.7 ± 2.0 kg live weight were used in digestibility study with 6 diets in a randomised 6 x 6 Latin Square design. An animal was allowed to feed on each dietary treatment for 21 days before the treatment was changed. Two forages, batiki grass (*Ischaemum aristatum* var. *indicum*) and *Erythrina variegata* var. *oriental* (dadap), a browse, were used in the trial. The six experimental diets consisted of 100% batiki grass, 80% batiki grass : 20% dadap, 60% batiki grass : 40% dadap, 40% batiki grass : 60% dadap, 20% batiki grass : 80% dadap and 100% dadap. The crude protein concentrations in batiki grass (11.1%) and dadap (38.6%) were high. Forage intake of 100% dadap was lower than that of other treatments ($P < 0.05$), however, the intakes of the remaining treatments did not differ ($P > 0.05$). Digestibility of nutrients in both batiki grass and dadap was high. Significant differences were observed in the digestibility ($P < 0.05$) of OM; NFE; TDN; and GE. The results demonstrated that any combination of batiki and dadap was suitable for feeding to goats giving higher dry matter intakes and digestibility, but none was better than batiki grass alone.

Anglo-Nubian goats; batiki grass; dadap; forage intake; digestibility; Samoa

INTRODUCTION

In most tropical countries of the world small ruminants are kept mainly by small-scale farmers and are important in the provision of meat and milk to enhance the socio-economic status of the population. Goats, especially, are very important in the farming system of most tropical countries, because they are well adapted to a variety of conditions and feed on a wide range of grasses and browse plants (Mecha, Adegbola, 1980; Becker, Lohrmann, 1992).

Ruminant nutritionists have, over the years, been concerned with the quality of available browses/fodder trees because they are major feed resources for ruminants (Devendra, 1989). In most tropical environments growth and performance of goats are largely limited by forage quality and this is reflected in low voluntary intake and digestibility (Minson, 1990). Fodder trees can overcome to some extent many of the nutritional constraints of poor quality grass.

Batiki grass (*Ischaemum aristatum* var. *indicum*) is the most common propagated pasture grass species for ruminant livestock in Samoa and in other small island countries in the South Pacific region. It can tolerate heavy grazing and poor management. However, because of its competitive nature, it is difficult to use in legume-grass mixtures (Pottier, 1983). The challenge in using pasture as a sole source of forage for animals is determining whether or not the pasture can supply adequate nutrients for maintenance, growth and production.

It has been emphasised that most tropical grass species have low dry matter digestibility and intake (Minson, 1971; Humphreys, 1987). The leaves, shoots and twigs of browse plants can help overcome the nutritional constraints of these low quality feeds (roughage). Leaves from browse and fodder trees form a major part of livestock feed in tropical countries (Woods et al., 1994; Mandal, 1997) and play an especially important role in improving dietary protein (Aregheore et al., 1998; Kaitho et al., 1998).

In Samoa, there are both indigenous and introduced browse species. These are used to supplement confined or grazing animals. One of the indigenous browses in Samoa is *Erythrina*. The genus *Erythrina* contains several species widely used in agroforestry systems in the tropics (Teketay, 1990; Muthuchelian, 1992). *Erythrina variegata* var. *oriental* occurs throughout Samoa and it is generally called 'dadap'. It is widely distributed in wild or semi-cultivated situations especially as a fencing material in paddocks and as a hedge plant in compounds. Although its potential as a mulching material (Weeratha, Asghar, 1990) and a feed resource in South and Central America (Preston, 1986), Asia (Huq, Saadullah, 1987) and Africa (Larbi et al., 1993) has been documented, no scientific information is available on its nutritive value as a browse plant in the diets of ruminant livestock in Samoa, South Pacific region. The extent to which good nutrition and management could improve the productivity of crossbred Anglo-Nubian goats in Samoa is not known, since they are not

reared in large commercial flocks. The objectives of this study are to determine the intake and digestibility of mixtures of batiki grass (*Ischaemum aristatum* var. *indicum*) and dadap (*Erythrina variegata* var. *oriental*) by Anglo-Nubian goats and also to determine the nutritive value of batiki grass and dadap in the tropical wet-dry climate of Samoa.

MATERIALS AND METHODS

Location of experiment

The experiment was conducted at the University of the South Pacific, Samoa (13.5° S, 172.5° W). The dominant grass is batiki grass (*Ischaemum aristatum* var. *indicum*). The trial was carried out during the early dry season period.

Diets

Six experimental diets were used and offered in the following ratios:
(A) – 100% batiki grass
(B) – 80% batiki grass : 20% dadap
(C) – 60% batiki grass : 40% dadap
(D) – 40% batiki grass : 60% dadap
(E) – 20% batiki grass : 80% dadap
(F) – 100% dadap

Batiki was cut daily and offered in fresh chopped form. The leaves and stalks of dadap (*Erythrina variegata* var. *oriental*) were chopped into 3–4 cm lengths and fed fresh with batiki grass. There were two controls in the trial. 100% batiki grass was used as a control 1, while control 2 was the 100% dadap diet.

Animals and experimental design

The goats used in the trial were obtained from a batch of 12 crossbred Anglo-Nubian goats, 8–11 months old, purchased locally in Samoa. Following purchase, they were drenched to control worms (Levicare, Anoare, Birkenhead, Auckland), and allowed free access to fresh clean water, batiki grass and dried brewers' grains.

Six goats were selected for the experiment and had a pre-trial mean live weight of 15.7 ± 2.0 kg. They were allocated to treatment in a randomised 6 x 6 Latin Square design. An animal was allowed to feed on each dietary treatment for 21 days before the treatment was changed. The first 14 days were a preliminary period designed to allow the animals to adjust to the new feeding regime. Animals were weighed prior to being changed to a new dietary treatment.

During this period, they received a daily allotment of 1.5 kg fresh weight of the treatment diet which was fed in two equal amounts at 09.00 and 16.00 h *ad libitum* adjusted daily for increased or decreased intake at approximately 10–20%. Ample drinking water was provided.

Digestibility study

Animals were allowed to adapt to the cages over a 7-day period. This was followed by 7-day collection period. Faeces were collected each morning before feeding. The total daily faecal output for each animal was weighed before 25% of the sample was removed for dry matter determination. Faeces and feed samples were dried in a forced-draught oven at 70 °C for 36 h. Daily samples of faeces and diets were then bulked, separately for each goat and milled with a simple laboratory mill and stored in air-tight bottles until required for analysis.

Analytical procedures

The AOAC (1990) method was used for nutrient analysis of diets and faecal samples. All analyses were done in triplicate. Dry matter was determined by drying at 102 °C for 24 h, ash by placing samples in a muffle furnace at 600 °C for 24 h and protein by the micro-Kjeldahl procedure. Gross energy values were determined by a bomb calorimeter (Adiabatic bomb, Parr Instrument Co., Moline, IL) using thermochemical benzoic acid as a standard.

Statistical analysis

The data obtained from these analyses were used in computing the digestibility of crude protein, crude fibre, organic matter, total digestible nutrients and gross energy (GE MJ/kg). Data on voluntary forage intake and nutrient digestibility coefficients were statistically evaluated according to standard analysis of variance (Steel, Torrie, 1980) and where significant differences occurred, Bonferroni *t*-statistics were utilised for comparisons among treatment means (Gills, 1978).

RESULTS AND DISCUSSION

Table 1 shows data on chemical composition of diets offered to the goats. The crude protein (CP) concentration in batiki grass (11.1%) and dadap (38.6%) was high. The level in dadap used in this study was higher than values reported by Larbi et al. (1993) and Kaitho et al. (1998) for *Erythrina* spp. in Ethiopia. Also, the CP concentration in batiki grass (11.1%) was similar to other values (Solomona, 1988) and also seems higher for dry season but not very different. The high ash concentration in the diets showed that they have high mineral values.

The intake data (Table 2) suggest that dadap alone will not promote good live-weight gain but in combina-

Table 1. Proximate chemical composition of diets offered (batiki grass; different ratios of batiki : dadap and dadap – % DM)

Nutrients (%)	Diets – batiki : dadap ratios					
	100 : 0	80 : 20	60 : 40	40 : 60	20 : 80	0 : 100
Dry matter (DM) %	34.6	32.5	35.0	36.3	38.4	40.2
Analysis of dry matter (%)						
Crude protein (%)	11.1	13.8	14.8	20.6	24.2	38.6
Crude fibre (%)	32.8	31.3	28.4	27.2	26.0	22.2
Ash (%)	10.2	10.7	11.2	11.7	12.2	12.7
Organic matter (%)	89.8	89.3	88.8	88.3	87.8	87.3
Ether extract (%)	2.3	2.0	1.8	1.9	2.6	3.4
Nitrogen free extract (%)	43.6	42.3	43.8	38.6	35.0	23.1
Gross energy (MJ/kg)	15.9	15.7	15.4	15.2	16.0	16.4

Table 2. Feed intake and nutrient digestibility of diets of batiki grass, dadap and different ratios of batiki : dadap and dadap fed to goats

Parameters	Diets – batiki : dadap ratios					
	A	B	C	D	E	F
	100 : 0	80 : 20	60 : 40	40 : 60	20 : 80	0 : 100
Mean average live weight (kg)	16.3 ± 2.6	16.2 ± 2.2	16.4 ± 3.2	16.7 ±1.4	16.6 ± 2.1	17.0 ± 2.9
Mean live weight ($kgW^{0.75}$)	8.1 ± 2.0	8.1 ± 1.8	8.4 ± 2.4	8.3 ± 1.3	8.2 ± 1.7	8.4 ± 2.2
Dry matter intake (g/d)	780 ± 2.1	820 ± 2.6	810 ± 2.3	800 ± 2.0	810 ± 3.2	590 ± 2.8
DM intake ($g/kgW^{0.75}/d$)	96.2 ± 0.3	101.2 ± 0.3	99.5 ± 0.3	96.4 ± 0.3	98.5 ± 0.4	70.5 ± 0.3
Digestibility (%)						
Dry matter	56.2 ± 4.2	58.5 ± 3.6	57.2 ± 3.2	55.7 ± 4.0	55.5 ± 3.8	50.2 ± 2.6
Crude protein	58.6 ± 3.4b	68.7 ± 2.2a	68.5 ± 2.1a	61.6 ± 3.8b	52.0 ± 2.4b	52.4 ± 2.8b
Crude fibre	69.2 ± 1.5	66.0 ± 2.0	68.7 ± 1.4	64.2 ± 1.8	64.4 ± 2.1	62.7 ± 1.7
Organic matter	62.8 ± 2.0a	65.1 ± 2.4a	65.8 ± 2.1a	60.6 ± 3.2ab	58.8 ± 2.4ab	52.7 ± 2.2b
Ether extract	67.5 ± 3.2	66.7 ± 2.6	63.0 ± 2.3	63.8 ± 1.8	66.5 ± 2.0	67.5 ± 2.5
Nitrogen free extract	66.1 ± 1.6a	69.3 ±1.2a	67.3 ± 1.9a	61.5 ± 1.4ab	61.4 ± 1.3ab	56.6 ± 1.3b
Energy	76.8 ± 2.3a	65.8 ± 3.0b	65.5 ± 2.2b	68.3 ± 2.0b	58.4 ± 2.3c	23.9 ± 3.1d
Total digestible nutrient	61.5 ± 2.3a	62.4 ±4.1a	61.7 ± 3.2a	56.6 ± 2.2ab	54.7 ± 2.6ab	52.4 ± 2.0b

a, b, c, d – values within rows not followed by the same letter are different ($P < 0.05$)
± sd – standard deviation

tion with batiki a high intake is achieved. There was a low forage intake of 100 % dadap ($P < 0.05$) but the dry matter intake of 100% batiki grass and the different combinations of batiki and dadap were not significantly different from each other ($P > 0.05$). The NRC (1981) suggested that 11–12% CP concentration in forages was adequate to meet requirements for moderate weight gains in goats. The protein values in all the diets were above the recommended levels.

In vivo digestibility is still the best measure of herbage quality and this was used in this trial to assess the quality of the various forage diets offered to the goats. There was a high digestibility of nutrients in 100% batiki grass and 100% dadap (Table 2). CP digestibility was high in diets B and C than in the others ($P < 0.05$), but between other diets there was no significant difference. Significant differences were observed in the digestibility ($P < 0.05$) of other nutrients (organic matter; nitrogen free extract; total digestible nutrient and energy). In general 100% dadap was the least digestible diet.

This study demonstrated that using dadap to supplement growing goats dependent on natural pasture, such as batiki grass would be feasible. The high nutrient content of batiki grass and its digestibility may be one reason, why it is a prominent grass species for ruminant livestock grazing in Samoa and in other small Island countries in the South Pacific region. The high concentrations of crude protein and other nutrients in the batiki grass and dadap during the early dry season suggest that the dry season does not have a marked effect as in other parts of the world. The digestibility values are higher than values reported by Wilson (1977) for leaves of trees and shrubs fed to sheep and goats in Australia and Larbi et al. (1993) with goats and sheep in Ethiopia.

Throughout the experimental period, there was no incidence of toxicity, forage refusals and/or digestive dis-

turbances in the form of watery faeces. Dadap has a high forage quality and could effectively serve as a cheap source of protein for ruminant livestock. Furthermore, the results demonstrated that any combination of batiki and dadap will be consumed in high quantities by goats and will be highly digestible. In conclusion, the results demonstrated that any combination of batiki and dadap was suitable for feeding to goats giving higher dry matter intakes and digestibility, but none was better than batiki grass alone. However, unsatisfactory intakes may be obtained with a diet of pure dadap (Table 2).

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AREGHEORE, E. M. (The University of the South Pacific, School of Agriculture, Animal Science Department, Alafua Campus, Apia, Samoa):

Příjem a stravitelnost směsí trávy batiki (*Ischaemum aristatum* var. *indicum*) a dadapu (*Erythrina variegata* var. *oriental*) u kříženců anglo-nubijských koz na Samoe.

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V pokusu na stravitelnost bylo použito šest kříženců anglo-nubijských koz ve věku 8–11 měsíců a v živé hmotnosti 15,7 ± 2,0 kg, se šesti krmnými dávkami v náhodném uspořádání latinského čtverce. Každé zvíře bylo krmeno každým druhem krmiva po dobu 21 dnů, než se změnil druh krmiva. V pokusu byly použity dva druhy krmiva – tráva batiki (*Ischaemum aristatum* var. *indicum*) a výhonky dadapu (*Erythrina variegata* var. *oriental*). Šest zkoumaných krmných dávek sestávalo ze 100 % trávy batiki, 80 % trávy : 20 % dadapu, 60 % trávy batiki : 40 % dadapu, 40 % trávy batiki : 60 % dadapu, 20 % trávy batiki : 80 % dadapu a 100 % dadapu. Koncentrace celkových dusíkatých látek v trávě batiki (11,1 %) a v dadapu (38,6 %) byly vysoké. Příjem krmiva 100 % dadapu byl nižší než příjem dalších druhů krmiv ($P < 0,05$), příjmy ostatních krmných dávek se nelišily ($P < 0,05$). Stravitelnost živin u obou druhů krmiva trávy batiki a dadapu byla vysoká. Byly zaznamenány výrazné rozdíly ve stravitelnosti ($P < 0,05$) OM, NFE, TDN a GE. Výsledky ukázaly, že všechny krmné dávky složené z trávy batiki a dadapu byly vhodné pro krmení koz, měly za následek vyšší příjmy sušiny a vyšší stravitelnost, ale žádná z nich nebyla lepší než samotná tráva batiki.

anglo-nubijské kozy; tráva batiki; dadap; příjem krmiva; stravitelnost; Samoa

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