THE DONKEY: COPING WITH LOW QUALITY FEED

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Introduction

Donkeys accompany man into the most desolate regions of the world. They follow the herds of Bedouin goats into the extreme deserts of the Middle East. In such harsh environments they serve as transport and pack animals to the shepherds along the steep and nerrow desert trails. During the prolonged dry season donkey shares the meager food resources with the goats. Like those hardy ruminants, the donkey sustains itself on the available dry plant material that is usually high in cell wall constituents and low in protein. Over the past few years, the capacity of the Bedouin goat to utilize such low quality food resources and to meet its energy requirements under desert conditions, have been extensively studied in our laboratory (Silanikove et al., 1980; Silanikove, 1983; Brosh et al., 1986, 1987 and Brosh, 1985). In the present study, the digestive capacity of the donkey, a hind-gut fermenter was studied and compared to data reported for the Bedouin goat.

Materials and Methods

Five female donkeys (body mass 117-129 kg), with pale grey fur and the dark shoulder stripe characteristic of the wild species (*Equus asinus africanus*) indigenous to the North African deserts, were purchased from Bedouin tribesmen. They were maintained outdoors, under midsummer conditions similar to those that prevailed during the study of the Bedouin goats (Brosh et al., 1986) Like the goats, the donkeys were sequentially fed alfalfa hay (47.5 % NDF, 22.5 % crude protein, 8 % water, and 19.1 kJ/kg dry matter) or wheat straw (77.1 % NDF, 2.8 % crude protein, 2 % water and 17.6 kJ/kg dry matter).

Four weeks were allowed for the animals to adjust to a change in the diet. Each trial lasted five days and was repeated twice. Feed and water were offered ad lib once daily.

Oxidative metabolism was assessed as rate of oxygen consumption in quietly standing animals. An open circuit system (Taylor et al., 1982) was employed for this purpose.

Cell wall constituents in dry samples of ground food, orts and feces were determined according to the method of Georing and Van Soest (1970). Energy values were determined by bomb calorimeter (Gallencump CB 370), and nitrogen content was measured using the Kjeldahl technique.

Retention time was assessed for each diet by employing lanthanum as an external particulate marker (Hartnell and Satter, 1979). The marked feed was given as a single dose before the regular daily feed. Feces were collected every 3 h for the first 24 h and then every 8 h until 144 h post dosing. Lanthanum concentration in fecal samples was determined by neutron activation followed by high resolution gamma spectrometry.

Urea kinetics were studied by means of ^{14}C labelled urea according to the method suggested by Cocimano and Leng (1967).

Results and Discussion

Equines, as well as other herbivores that are hind-gut fermenters, are considered to be less efficient utilizers of plant cell wall constituents than ruminants (Hintz et al., 1978). The donkey, however, was found to digest wheat straw, an extremly low quality roughage, as efficiently as the Bedouin goat (table 1), a ruminant highly adapted to adverse nutritional conditions (Brosh et al., 1986). In addition, the donkey, on a metabolic specific weight basis, is capable of consuming greater amounts of the low quality roughage than the Bedouin goat. Consequently, donkeys maintained on a low quality diet gain more digestible energy than the goats that were selected through

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TABLE 1. GROSS ENERGY INTAKE (GEI), ENERGY DIGESTIBILITY (ED) AND O_2 CONSUMPTION IN DONKEYS AND GOATS FED EITHER ALFALFA HAY (AH) OR WHEAT STRAW (WS). VALUES REFERRING TO THE SAME PARAMETER AND MARKED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT

Animals	Diet	GEI ($g/kg^{.75}/d$)	ED (%)	O_2 Consumption ($L/kg^{.75}/d$)
Donkey	AH	1696 ± 110^{a}	67 ± 3^{a}	1.10 ± 0.1^{a}
	WS	1134 ± 236^{b}	49 ± 4^{b}	0.55 ± 0.03^{b}
Goat	AH	1496 ± 43^{c}	64 ± 4^{a}	0.72 ± 0.03^{c}
	WS	538 ± 86^{d}	47 ± 12^{b}	0.45 ± 0.01^{d}

time to utilize the desert's poor food resources.

The efficiency at which donkeys digest the low quality roughage is not likely to result from an efficient utilization of the cell wall constituents; NDF digestibility in the donkey, whether on the high quality or on the low quality feed, is lower than that reported for the goat (table 2). Irrespective of the quality of the diet, the retention time for digesta in the digestive tract of the donkey (MRT), and consequent subjectetion to bacterial fermentation, is compatibly shorter in the donkey than in the goat (table 2). It is concluded that the short MRT recorded in the donkey enables this species to maintain similar NDF intake when fed either one of the diets (table 2). By rapidly passing the digesta through its gut, the donkey is able to maintain a higher rate of food intake than the goat. This higher food consumption results in an increase in the soluble nutrient intake, regardless of the diet quality.

Gross energy intake (GEI) of both donkey and goat is lower when the animals are maintained on wheat straw than when maintained on alfalfa hay (table 1). In the donkey, however, the change is significantly smaller than in the goat (33 % of alfalfa hay's GEI vs. 64 % of GEI of the same diet, respectively). The digestible energy (DE) intake in the donkey fed wheat straw, is only half the amount it gains when on alfalfa hay but it is still twice the value reported for goats maintained on the same low quality diet.

Low quality feed results in both species in a reduced rate of oxidative metabolism. However only in the donkey was the reduced demand for metabolizable energy found to match the change in the DE intake (50 % of the amount measured on alfalfa hay, in both parameters) (table 1).

Low protein content is a common characteristic of high fiber diets (Van Soest, 1982). Herbivores foraging on poor roughage greatly depend on the efficiency at which urea is recycled from their blood into the gut and made available for microbial protein synthesis (Engelhardt et al., 1985). Like the goat, the donkey was able to sustain itself on wheat straw that containing only 3 % of crude protein and to balance its nitrogen economy even on that feed. As a result of a higher intake and a better true digestibility, the digestible N intake was 61 % higher in the donkey than in the goat when fed alfalfa hay and 54 % higher when fed wheat straw. Recycling of N-urea in the donkey occurred at a low rate (16 % of the entry rate vs 40 % of the entry rate, in the goat) when N intake was high. However, when maintained on low protein intake it amounted to 75 % the entry rate, a value similar to that reported for the goat

TABLE 2. NDF INTAKE*, NDF DIGESTIBILITY AND MRT IN DONKEYS AND GOATS FED EITHER ALFALFA HAY (AH) OR WHEAT STRAW (WS). VALUES REFERRING TO THE SAME PARAMETER AND MARKED BY THE SAME LETTER ARE NOT S GNIFICANTLY DIFFERENT

Animals	Diet	NDF intake ($g/kg^{.75}/d$)	NDF Digestibility (%)	MRT (h)
Donkey	AH	40.2 ± 3.5^{a}	54.2 ± 1.4^{a}	37.7 ± 1.7^{a}
	WS	47.6 ± 10.8^{a}	50.9 ± 4.9^{a}	36.4 ± 3.2^{a}
Goat	AH	22.5 ± 0.6^{b}	61.5 ± 2.4^{b}	48.0 ± 3.4^{b}
	WS	12.4 ± 2.0^{c}	59.2 ± 2.2^{b}	70.0 ± 5.0^{c}

*Cell wall constituents were determined as crude fiber, in goats experiments.

TABLE 3. NITROGEN INTAKE (N-INTAKE), TRUE N-DIGESTIBILITY (TDN), N-UREA ENTERY RATE (N-FR) AND N-UREA RECYCLING (N-RE) IN DONKEYS AND GOATS FED EITHER ALFALFA HAY OR WHEAT STRAW. VALUES REFERRING TO THE SAME PARAMETER AND MARKED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT

Animals	Diet	N-intake ($g/kg^{.75}/d$)	TDN (%)	N-ER ($g/kg^{.75}/d$)	N-Re (%)
Donkey	AH	3.4 ± 0.2^{a}	90 ± 1.6^{a}	4.3 ± 1.0^{a}	15.9 ± 10^{a}
	WS	0.2 ± 0.07^{b}	85 ± 6.4^{a}	0.6 ± 0.2^{b}	75.5 ± 13^{b}
Goat	AH	1.7 ± 0.1^{c}	71 ± 2.4^{b}	1.5 ± 0.2^{c}	40.3 ± 5^{a}
	WS	0.2 ± 0.05^{b}	55 ± 4.2^{c}	0.2 ± 0.05^{d}	69.3 ± 10^{b}

on the same diet (table 3).

Donkeys appear to cope as efficiently as ruminants with adverse nutritional conditions. Their demand for gross energy is somewhat higher than reported for the Bedouin goat, a ruminant that is highly adapted to the extreme desert environment (Shkolnik and Choshniak, 1984). However, considering the density at which donkeys are stocked (usually one donkey per 10-100 goats) this demand can easily be met.

(Key Words: Donkey, Mean Retention Time, Urea Recycling)

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