Session 4 Comparative herbivore nutrition

In vitro digestibility of plants normally consumed by the kudu, *Tragelaphus strepsiceros*

Elizabeth A. Boomker* and W. van Hoven
Eugene Marais Chair of Wildlife Management,
University of Pretoria, Pretoria 0002, Republic of South Africa
*To whom correspondence should be addressed

Leaves of 10 different plant species utilized by the kudu were collected, dried and ground. This material was used to determine DM digestibility, gas production and VFA production during *in vitro* fermentation with rumen fluid obtained from kudu. Plants preferred by the kudu had a higher IVDMD and VFA energy yield than those not eaten so readily. *Peltophorum africanum* produced less VFA energy than the control, probably due to inhibition of fermentation by phenolic compounds.

Die blare van 10 verskillende plantspesies wat deur die koedoe gevreet word, is versamel, gedroog en gemaal. Die materiaal is gebruik om die DM verteerbaarheid, gasproduksie en die produksie van vlugtige vry vetsure tydens die *in vitro* fermentasie te bepaal, met rumenvloeistof verkry van koedoes. Die plante wat die koedoe verkies, het 'n hoër IVDMD en vlugtige vry vetsuuropbrengs as dié wat hulle nie so geredelik vreet nie. *Peltophorum africanum* het minder vlugtige vry vetsuur energie geproduseer as die kontrole, waarskynlik as gevolg van die inhibisie van die fermentasie deur fenoliese verbindings.

Keywords: Rumen, kudu, digestibility, volatile fatty acids

Introduction

Few studies on the digestibility of plants normally consumed by South African antelope have been attempted. Even less is known of the digestibility of browse utilized by the kudu, *Tragelaphus strepsiceros*. Hofmann (1973) lists *Rhus*, *Grewia*, *Euphorbia* and *Aloe* spp. among the plants consumed by the kudu in East Africa, while Hitchins (1968) records various plants eaten in the Hluhluwe Game Reserve, including 3 *Acacia* spp, *Dichrostachys*, *Strychnos*, and *Syzygium*. In the Kruger National Park, leaves, fruits flowers and pods of a wide variety of plants are consumed (Van der Schijff, 1959).

The present study was conducted using plant material utilized by kudu in the study area (S. Cooper, pers. comm.) and is part of a survey on digestion in this species. *In vitro* digestibilities were used to determine the extent of plant utilization by the kudu.

Methods

This study was carried out in March 1982 on the Provincial Nature Reserve, Nylsvley, in the Transvaal, South Africa. Culled kudu were used as a source of rumen fluid.

Prior to the field work, leaves of 10 different plant species were collected and dried at 60°C in a draught oven. The dry plant material was ground through a 1 mm screen using a hammermill. A small amount of the plant material (1g) was weighed into each fermentation flask. Two duplicate sets of flasks were prepared. These were used in the field for the *in vitro* digestibilities (Tilley & Terry, 1963). The first set was used to measure DM disappearance and gas production, while the second was used to determine volatile fatty acid (VFA) production.

Each flask containing buffer, rumen fluid and the plant material was placed in the waterbath at 39°C. Anaerobic conditions were ensured by bubbling CO_2 through the mixture for 1 min and then sealing with a rubber stopper. Gas production was measured using a well lubricated 10 ml syringe (glass) and metal needle passed through the rubber stopper. Gas volume was recorded every hour for 20 h. Gas samples were stored in evacuated test tubes (Bide, 1978) and analysed for methane in the laboratory using a gas chromatograph fitted with a thermal conductivity detector. From this analysis the volume of methane produced in 20 h was calculated.

Samples for VFA production were taken prior to and then after 2, 8, and 20 h of incubation. Each sample (1 ml) was placed in a test tube containing 0,1 ml 5N-NaOH to stop fermentation, and analysed according to the method of Boomker (1983).

After 20 h, the incubations were stopped using 1 ml $HgCl_2$. In the laboratory the plant samples were filtered into tared crucibles. The residue was dried to constant mass and then weighed. The mass digested was then calculated.

Results and Discussion

Each plant species studied differed in the amount of VFA and methane produced, as well as in the amount of dry matter digested (Table 1). Plants prefered by the kudu such as *Grewia flavescens* and the *Acacia*'s have a higher volatile

Table 1 *In vitro* dry matter disappearance (IVDMD) and energy produced from VFA and methane during a 20 h incubation of plants consumed by the kudu

Plant species	IVDMD (%)	VFA (J)*	CH_4 (J)**
G. flavescens	221	2038	522
A. nilotica	164	2948	291
A. tortilis	160	2811	348
D. cinerea	167	2247	389
Z. mucronata	193	2741	492
P. africanum	76	1279	275
B. africana	101	1916	310
Control	—	1721	200

* Calculated using the method of Allo, Oh, Longhurst and Connolly (1973).

** 1*l* methane = 39,54 kJ.

fatty acid energy yield, and those not eaten so readily, such as *Peltophorum africanum*, have a lower energy production. In fact *Peltophorum africanum* produced less VFA energy than the control, which contained buffer and rumen fluid, but no plant substrate (Table 1). This may be due to inhibition of fermentation as a result of phenolic compounds in the plant material. When the amount of plant material digested was related to the VFA energy produced, a correlation coefficient of 0,65 ($P < 0,05$) was found. The correlation between the amount digested and the methane energy produced, was smaller ($r = 0,61$;NS). When a multiple regression analysis was applied to the data the following equation was obtained:

$$Y = 0,054X + 0,354Z - 99,39$$

where Y is the mg substrate digested, X is the VFA energy produced (J), and Z is the methane energy produced (J).

The coefficient of determination (r^2) for this equation was 0,84. This shows that the amount of plant material digested is closely related to the amount of energy produced in the form of VFA and methane.

If the X and Z values respectively, are fixed at the levels found in the control, 2 two-dimensional regression equations are obtained:

$$Y = 0,0509X + 50,27$$

$$Y = 0,329\ Z + 38,04.$$

These equations do not, however represent the true relationship and are only useful in obtaining a graphic representation.

References

ALLO, A.A., OH, J.H., LONGHURST, W.M. & CONNOLLY, G.E., 1973. Volatile fatty acid production in the digestive systems of deer and sheep. *J. Wildl. Manage.* 37, 202.

BIDE, R.W., 1978. Evacuated blood collecting tubes as containers for taking and storing gas samples. *J. Chromat.* 161, 315.

BOOMKER, E.A., 1983. Volatile fatty acid production in the grey duiker, *Sylvicapra grimmia*. *S. Afr. J. Anim. Sci.* 13, 33.

HITCHINS, P.M., 1968. Records of plants eaten by mammals in the Hluhluwe Game Reserve, Zululand. *Lammergeyer.* 3, 31.

HOFMANN, R.R., 1973. The ruminant stomach. East African Monographs in Biology, 2. East African Literature Bureau, Nairobi.

TILLEY, J.M. & TERRY, R.A., 1963. A two-stage technique for *in vitro* digestion of forage crops. *J. Br. Grassl. Soc.* 18, 104.

VAN DER SCHIJFF, H.P., 1959. Weidingsmoontlikhede en weidingsprobleme in die Nasionale Krugerwildtuin. *Koedoe.* 2, 98.