A comparison of rumen function in four Kalahari ungulates

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The ratio's of reticulo-rumen volume to body mass were determined for all four species in addition to rumen pH, fermentation rate and VFA concentration. Information on rumen and faeces dry-matter percentage is also reported. Only the blue wildebeest exhibited a marked decline in body mass in winter. In summer the rumen fermentation on average for eight blue wildebeest studied, was 327 µmol gas/g DM/h, much higher than the other species including springbok with 269 µmol gas/g DM/h. This same trend was seen in winter. The theory that wildebeest are less well adapted to the arid region than the other species investigated is further supported by the fact that in both seasons the DM% was substantially lower than in the other species.

Die verhoudings van reticulo-rumen volume tot liggaamsmassa is bepaal vir al vier spesies bykomend tot die rumen pH, fermentasietempo en vlugtige vry vetsuurkonsentrasie. Inligting oor die persentasie van rumen en fekale droë-materiaal is gerapporteer. Slegs die blouwildebeeste het 'n duidelike afname in liggaamsmassa getoon in die winter. In die somer was die gemiddelde rumen fermentasie vir agt blouwildebeeste wat bestudeer is, 327 µmol gas/g DM/h, wat heelwat hoër was as vir die ander spesies, insluitende die springbok met 269 µmol gas/g DM/h. Dieselfde neiging is in die winter waargeneem. Die teorie dat die wildebees minder goed aangepas is by die droë streek as die ander spesies wat ondersoek is, word verder gesteun deur die feit dat die DM% in albei seisoene aansienlik laer was as in die ander spesies.

Keywords: Springbok, gemsbok, red hartebeest, blue wildebeest, fermentation rate, rumen, VFA

Introduction

The Kalahari Gemsbok National Park is defined as semi-desert and has no natural permanent water. With an average precipitation of 100 mm per year, delicately balanced environmental conditions prevail. Bothma (1972) over a period of three years studied the response in ungulate numbers to rainfall in the eastern dry Nossob river valley. Springbok (*Antidorcas marsupialis*) and red hartebeest (*Alcelaphus buselaphus*) responded immediately to improved grazing as the first green sprouts of the riverbed vegetation appeared. Gemsbok (*Oryx gazella*) only utilized the vegetation later when the grass grew taller.

In order to gain more information to aid in management decisions, and since no information in this regard exists, a study was undertaken on the rumen physiology of the ungulates and the nutritional status and digestibility of the available grazing in summer and winter. Only some aspects of the digestive physiology are reported here.

Methods

Animals were shot in winter (July) of 1978 and 1979 and in the summer (January) of 1980 for rumen-physiological investigations. In the winter months 8 springbok, 8 gemsbok, 6 blue wildebeest and 2 red hartebeest were utilized and in summer another 8 springbok, 6 gemsbok, 8 blue wildebeest and 2 red hartebeest. The animals were shot mainly in the dry Nossob and Auob river valleys and were transported immediately after being shot to a field research station where *in vitro* work was done within 30 minutes of death. Experimental procedure and methods of analysis are according to van Hoven, Prins & Lankhorst (1981).

Results

The results of some rumen parameters determined are given in Table 1. Except for the gemsbok in summer, which on average had a rumen pH of 5,93, all other measurements of pH varied between 6,05 and 6,40. The average body mass in summer of blue wildebeest was found to be higher than that of gemsbok, whilst in winter it was about equal. The blue wildebeest also had a 52%

Table 1 Digestive parameters of four Kalahari ungulates measured in summer and winter*

Digestive parameter	Ungulate species			
	Springbok	Blue wildebeest	Gemsbok	Red hartebeest
Summer	$n = 8$	$n = 8$	$n = 6$	$n = 2$
Rumen pH	6,31 ± 0,31	6,40 ± 0,34	5,93 ± 0,12	6,40 ± 0
Ret.-rum. volume (l)	3,9 ± 0,8	39,5 ± 3,1	26,0 ± 4,6	25,0 ± 1,0
Body mass (kg)	41,9 ± 4,4	253,4 ± 13,3	225,2 ± 8,1	160,0 ± 2,1
Rum. ferm. rate (µmol gas/g DM/h)	269,1 ± 28,4	327,1 ± 22,7	275,3 ± 30,2	262,3 ± 9,2
Rum. VFA conc. (mmol/100 g)	13,3 ± 2,8	12,6 ± 3,0	11,2 ± 2,6	16,1 ± 0,3
Ret.-rum. vol: Body mass	10,7	6,4	8,7	6,4
Rumen DM (%)	21,6	19,5	21,5	22,0
Faeces DM (%)	64,0	44,0	58,6	53,0
Winter	$n = 8$	$n = 6$	$n = 8$	$n = 2$
Rumen pH	6,26 ± 0,30	6,15 ± 0,20	6,22 ± 0,30	6,05 ± 0,15
Ret.-rum. volume (l)	3,4 ± 0,7	29,6 ± 2,6	26,9 ± 4,2	26,5 ± 4,1
Body mass (kg)	46,1 ± 3,1	219,2 ± 12,2	221,8 ± 10,3	177,5 ± 3,5
Rum. ferm. rate (µmol gas/g DM/h)	265,7 ± 23,6	329,0 ± 26,2	230,4 ± 13,5	270,1 ± 8,0
Rum. VFA conc. (mmol/100 g)	15,3 ± 2,7	20,5 ± 3,0	18,8 ± 3,1	18,8 ± 0,1
Ret.-rum. vol: Body mass	13,6	7,4	8,2	6,7
Rumen DM (%)	20,8	12,2	17,2	18,0
Faeces DM (%)	44,6	33,3	49,2	45,0

*Each value in the table is the mean ± SD.

larger reticulo-rumen volume in summer than was found in gemsbok, whilst in winter it was only 10% larger. In summer the rumen fermentation rate in blue wildebeest was found to be 18,8% higher, and in winter 42,8% higher than the rumen fermentation rate in gemsbok. This is due to a significantly lower winter rumen fermentation rate in gemsbok as compared to the rate in summer, while the rate in blue wildebeest remained virtually the same all year round.

No significant differences in the parameters measured were found between summer and winter in both springbok and red hartebeest. This also applied to VFA concentration in the rumen. The latter however did not apply to blue wildebeest and gemsbok which showed a significantly higher rumen VFA concentration in winter.

The ratio of reticulo-rumen size to body mass showed very little difference between summer and winter for all four species. However springbok had a smaller size of rumen plus reticulum as compared to body mass in both seasons. Rumen and faeces dry-matter percentage was found in both seasons to be the lowest in the blue wildebeest.

Discussion

The gemsbok, springbok and red hartebeest are ungulates typically associated with, and as a rule well adapted to, arid zones. This however is not the case with blue wildebeest. They are usually not found in true arid areas and were it not for man-made waterholes in the Kalahari Gemsbok National Park, it is doubtful whether they would have been able to maintain their present numbers. The blue wildebeest is therefore also usually found near the waterholes in larger numbers, ratio wise, than the other ungulates. The numbers of blue wildebeest have also increased about tenfold since the establishment of waterholes.

Rumen size and fermentation rate in relation to body size is discussed in more detail by Prins, Lankhorst and van Hoven (1983) and Hoppe (1983). In general the relationship between rumen size and body size in the Kalahari ungulates fits in well with the pattern since the springbok, in comparison to the other three antelopes investigated, has a markedly smaller rumen size in relation to body size. However, the fermentation rate in springbok is much lower than expected. It is generally accepted that concentrate selectors, which are smaller ungulates such as springbok, compensate for small rumen size with a concentrate diet and higher fermentation rate. In the springbok of this arid region a more rapid rate of passage may compensate more for the smaller rumen size than fermentation rate alone.

The percentage DM of the faeces of blue wildebeest, being on average lower than the other species, further strengthens the argument that they are not as well adapted to an arid region. The success of adaptation to desert conditions depends largely on the animal's ability to conserve water in particular by means of reabsorption from the gut. Of the four species studied, the blue wildebeest seems the least successful in this ability.

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