Food selection by giraffes in relation to changes in chemical composition of the leaves

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Food preferences and food selection by giraffe have been extensively investigated but little data concerning the chemical composition of the preferred species are available. The aim of the present study was to determine whether the differences and seasonal changes in the chemical composition of the leaves of preferred food plants influence food selection. Protein content and moisture seem to be the important fractions that influence food selection most when evaluating this food selection criterion.

Voedselvoorkeure en voedselseleksie van kameelperde is goed bestudeer; min data is egter beskikbaar oor die chemiese samestelling van die voorkeur voedselplante. Die doel van die huidige studie was om vas te stel of die chemiese samestelling van die voorkeurvoedselplante en die seisoenale verandering daarvan, enige invloed het op die kameelperde se seleksie van die blare van die besondere plantsoorte. Dit wil voorkom asof die proteïen- en voginhoud die belangrikste fraksies is wat op grond van hierdie kriterium voedselseleksie beïnvloed.

Keywords: Food preference, giraffe, seasonal utilization, chemical composition, crude protein, moisture

Introduction

Food preferences of giraffe, *Giraffa camelopardalis,* have been extensively investigated but little data concerning the chemical composition of the preferred plant species are available (Foster & Dagg, 1972; Kok & Opperman, 1980). The aim of the present study was to determine whether the differences in the chemical composition of leaves of the preferred food plants influence food selection. Availability of the 54 preferred plant species studied was also considered.

Methods and Materials

Sampling

Samples of the 54 preferred food plants selected by giraffe in the Timbavati Private Nature Reserve (TPNR), Jack Scott Nature Reserve (JSNR) and Koos Meintjies Nature Reserve (KMNR), as determined by Hall-Martin (1974), Van Aarde & Skinner (1975) and Sauer, Theron & Skinner (1977) where collected at eight six-weekly intervals throughout 1976. The methods of collection simulated the feeding behaviour of the giraffes.

Chemical analysis

Duplicate quantitative chemical analyses of each sample were performed for moisture content, crude protein, ether extract, crude fibre, ash and nitrogen free extract in accordance with the standards of the Association of Official Agricultural Chemists (Horwitz, 1965). All values for the fractions determined on a DM basis where converted to an 'as is' basis.

Statistical methods

Percentage utilization of a specific plant species was correlated with all the different wet and dry chemical fraction values of the same plant species throughout the year to determine if seasonal changes in any of the fractions correlated with the variation in utilization of that plant species selected by giraffe using the Kendall Partial Rank coefficient (t).

Results and Discussion

Chemical composition

The results presented in this paper concern those plants whose seasonal changes in chemical composition showed a significant relationship ($P<0,01$) with the variation in utilization by giraffe (Table 1). In 62,5% of the plants studied there was no significant relationship between utilization and the changes in chemical composition of the leaves (Sauer *et al.*, 1982). Data on the chemical composition of all species have been reported (Sauer, 1977).

Protein content

In the following plant species percentage utilization by giraffe was significantly correlated with the seasonal changes in protein content: *Acacia caffra* ($\tau = 0,67$) *A. karroo* ($\tau = 0,98$) *A. senegal* ($\tau = 0,91$) *Combretum apiculatum* ($\tau = 0,67$) *C. zeyheri* ($\tau = 0,73$) *Dichrostachys cinerea* ($\tau = 0,90$) *Terminalia prunioides* ($\tau = 0,60$) *Ziziphus mucronata* ($\tau = 0,82$) (Table 1).

Crude fibre

In the following three *Combretum* species percentage utilization by giraffe was significantly correlated with the seasonal changes in the crude fibre content; *Combretum apiculatum* ($\tau = 0,67$) *C. hereroense* ($\tau = 0,65$) and *C. imberbe* ($\tau = 0,65$) (Table 1).

Availability and preferences

Acacia caffra (Thund.) Willd.

A. caffra is the most important and preferred food plant of giraffe in the JSNR and is utilized most during all seasons (Van Aarde & Skinner, 1975). *A. caffra* is abundant in this reserve (Wells, 1964).

The protein content in the dry matter was highest in the new growth sampled during October 1975 (18,6%). It then gradually decreased until September 1976 (Sauer, 1977).

Acacia karro Hayne

A. karroo is also a preferred food plant of giraffes, and a dominant plant species in the JSNR (Wells, 1964). However, only a few trees could be found in the KMNR, all of which were heavily browsed (Sauer *et al.*, 1977).

Acacia senegal (L.) Willd.

A. senegal is possibly the most preferred food plant of giraffes in the TPNR and is utilized throughout the year (Hall-Martin, 1974). The average protein content of *A. senegal* (mean = $\bar{x}$ = 28,6%) exceeds that of all other plants studied.

Table 1 The relationship (τ) between percentage utilization of the leaves of preferred food plants by giraffe and the different important food analysis fractions

	Food analysis fractions						
Plant species	Moisture	Nitrogen Free Extract	Crude Protein Wet	Crude Protein Dry	Crude Fibre	Ether extract	Ash
Acacia caffra			0,67		−0,67	0,67	
Acacia karroo	0,66	−0,68	0,98		−0,98		−0,98
Acacia senegal			0,91				0,66
Combretum apiculatum	−0,67		0,67	0,59	0,67		
Combretum hereroense			0,59		0,65		
Combretum imberbe				0,59	0,65	1,00	
Combretum zeyheri				0,73	−0,62		−0,73
Dichrostachys cinerea	0,81			0,90			
Terminalia prunioides		0,38	0,60				
Ziziphus mucronata				0,82	−0,69		
No. of significant τ	3	2	6	5	7	2	3

Combretum apiculatum Sond

C. apiculatum is an important food plant of giraffes in the TPNR and KMNR (Hall-Martin, 1974; Sauer *et al.*, 1977). It is mainly utilized during the dry season.

C. apiculatum trees are numerous in both localities and a dominant plant species in at least one plant community (Hall-Martin, 1974; Sauer *et al.*, 1977).

Combretum hereroense Schniz

Although *C. hereroense* is one of the less important food plants of giraffes in the TPNR and is only utilized from February to September (Hall-Martin, 1974), it is the second most important food plant during the dry season in the KMNR (Sauer *et al.*, 1977). It is one of the dominant plant species in the KMNR and is not widely distributed in the TPNR (Hall-Martin, 1974). Thus it seems that availability of the food plant may be a more important food selection criterion than the chemical composition of the food selected by giraffe.

Combretum imberbe Wawra

C. imberbe is one of the less important food plants in the diet of giraffes and is only utilized during the dry season when feeding stress forces the giraffe to feed on *C. imberbe* (Sauer *et al.*, 1977). Although percentage utilization of the leaves was significantly correlated with the changes in the ether extract fraction ($\tau = 1{,}00$) in the KMNR, it is unlikely that giraffes utilize *C. imberbe* to provide for their energy requirements. The mean ether extract content ($\bar{x} = 1{,}39\%$) of *C. imberbe* is relatively low when compared with the leaves of the other plant species sampled in the KMNR (Sauer, 1977). It is therefore possible that the correlation is fortuitous or giraffes may be attracted by the aromatic flavour.

Combretum zeyheri Sond.

C. zeyheri is also one of the less important food plants of giraffes and is utilized from September to February (Hall-Martin, 1974). Utilization in relation to availability is quite low, for *C. zeyheri* is a dominant plant species in the TPNR.

Dichrostachys cinerea Wight & Arn.

D. cinerea is an important food plant of giraffes in the TPNR and less important in the KMNR (Hall-Martin, 1974; Sauer *et al.*, 1977). Utilization is in direct relation to availability and *D. cinerea* could thus be seen as a preferred food plant. Since percentage utilization was significantly correlated with the changes in protein content ($\tau = 0{,}90$) and moisture content ($\tau = 0{,}81$) (Table 1), it seems that the giraffe utilize this plant species because of the relatively high protein content ($\bar{x} = 15{,}9\%$), but it is more likely selected owing to the succulence of the leaves.

Terminalia prunioides Laws

T. prunioides is an important food plant species of giraffes and is extensively utilized from November to June (Hall-Martin, 1974). In the TPNR this plant species is abundant and many trees and shrubs could be found in all plant communities. With the exception of the protein and moisture fractions, the percentage utilization by giraffes correlated negatively with all the other chemical fractions. It thus seems as if this plant species was specifically utilized owing to the relatively high protein content of the leaves in comparison with the other plant species studied in the TPNR ($\bar{x} = 16{,}06\%$ through the year).

Ziziphus mucronata Willd.

Z. mucronata is one of the important preferred food plants of giraffes and is extensively utilized during the wet warm season when food in general is abundant in all three study areas (Hall-Martin, 1974; Sauer *et al.*, 1977; Van Aarde & Skinner, 1975).

Explanation of food preferences

The percentage utilization of the leaves of the different plant species browsed by giraffe was mostly significantly correlated with the crude protein content (Table 2). Compared with the other fractions, however, this does not mean that the giraffes select the food plant species for their protein content, for they are unable to taste or determine the protein content. The giraffes seem to prefer the new growing shoots when they are available.

Table 2 Total number of different correlations (τ) between percentage utilization of the tree leaves by giraffe and the different nutrient analytical fractions in the three game reserves studied

	Correlations[a]		
Food analysis fractions	A	B	C
Crude protein	19	20	15
Crude fibre	12	21	21
Ether extract	9	23	22
Ash	11	20	23
Nitrogen free extract	12	21	21
Moisture	10	19	25

[a]A = Significant positive correlations ($P < 0{,}01$)
B = Non-significant positive correlations
C = Negative or no correlations

These food parts may be more succulent and have a relatively high protein content. Furthermore, chemical composition is only one of the selection criteria that may influence food selection by herbivores. In fact, only 35,2% of the species studied showed significant correlations between utilization and the crude protein content of the leaves (Table 2).

In the TPNR which is a better habitat for giraffe and where monthly data on utilization were available for a full year, percentage utilization positively correlated with the changes in crude protein in 13 of the 18 plant species studied and the moisture content in 9 out of the 18 cases studied (Sauer *et al.*, 1982). This is an indication that succulence of the leaves may well have an important influence on food plants selected by giraffe.

In future we would like to expand this study to include *in vitro* fermentation with giraffe rumen liquid to ascertain which plant species ferment most rapidly and are easily

digested. Gas production and IV DMD could be used as criteria. Fermentation end products (VFA) could also be determined which could then be used to calculate efficiency of ruminal fermentation and also the energy metabolism of the giraffe itself.

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