DIGESTION, DIGESTA PASSAGE AND CHEWING BEHAVIOR IN BACTRIAN CAMELS

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Introduction

Members of the family *Camelidae* are a source of food, fuel, fibre and traction in a variety of countries world wide, yet little information is available on their digestive capacity. The present study examined the relationship of level of hay intake to digestion, rate of passage and chewing parameters in Bactrian camels (*Camelus bactrianus*).

Materials and Methods

Four multiparous Bactrian camels (687 ± 55 kg) were used in an unbalanced latin square in which three levels (1/3, 2/3 or 1/1 of *ad libitum*) of intake were imposed in a randomized sequential manner. A mixed grass-legume hay was fed in coarsely chopped form and possessed the following composition (g/kg dry matter): Dry matter (DM), 901.0; organic matter (OM), 938.4; total nitrogen (N), 22.0; neutral detergent fibre (NDF), 684.3; acid detergent fibre (ADF), 472.3; lignin, 86.0. Each period lasted 21 days, with the first 7 days being used to establish *ad libitum* (AL) intake followed by 14 days on the assigned level of intake. Data collection for digestion (total collection) and rate of passage studies was accomplished during days 15 to 21, whereas chewing data was collected on days 20-21.

Chromium III mordanted cell wall (Cr-Hay, 52.9 g Cr/kg) and Co-EDTA (Uden et al., 1980) were used as particulate and liquid markers, respectively. One hundred g of both Cr Hay and Co-EDTA sprayed hay (Co-Hay, 28 g Co/kg) were mixed with 300 g of the a.m. meal and offered to the camels on day 15. Feed samples were obtained from 10 to 170 h post dosing. Co and Cr concentrations in markers and faeces were determined by the analysis of ^{51}Cr and ^{60}Co activities induced by neutron irradiation. Faecal excretion curves of Cr and Co were fitted to a two compartment model (Grovum and Williams, 1973) using non-linear procedures (Marquardt method) of the Statistical Analysis System (SAS, 1982).

The time spent per day by each animal in eating or ruminating was ascertained by 24 h continuous observation. A Tandy 102 portable microcomputer (Tandy Electronics Ltd., Barrie, Ontario, L4M 4W5) was used to facilitate observational data acquisition.

A multiple regression approach (SAS, 1982) was used to analyze data in which animals and periods were class variables and intake was a continuous variable.

Results and Discussion

Average *ad libitum* DM intake (4.10 ± 0.247 kg/d; 5.85 ± 0.377 g/kg BW/d) for camels was low in comparison to what might be observed with sheep or cattle consuming a similar diet. No significant ($p > 0.05$) effect of intake on digestibility was observed for any of the feed fractions examined. However, linear regression coefficients for the effect of increasing intake on digestibility were negative. Table 1 presents means for the digestibility of different fractions. When hemicellulose intake was expressed as a proportion of BW (g/kg BW/d; HCELINT1) there was a significant ($p < 0.05$) linear effect on hemicellulose digestibility (HCELDIG) described by: HCELDIG = 0.690 0.054 (HCEL INT1); R^2 = 0.791. There was no significant quadratic effects of intake on digestibility. The coefficient of variation for DM digestibility was 1.63%.

TABLE 1. MEANS FOR THE APPARENT DIGESTIBILITY OF DIFFERENT FEED FRACTIONS[1]

Feed Fraction	Digestion Coefficient	SEM
Dry Matter	0.543	0.0026
Organic Matter	0.563	0.0030
Digestible Energy (Mj/kg)	10.077	0.0572
Nitrogen (N)	0.590	0.0072
Neutral Detergent Fibre	0.571	0.0053
Neutral Detergent Solubles	0.478	0.0112
Acid Detergent Fibre	0.537	0.0085
Hemicellulose	0.647	0.0062
Cellulose	0.633	0.0076
Lignin	0.103	0.0131

[1] Intake (kg/day or MJ/day) of a particular fraction was used as the regressor variable. The effect of intake was not significant ($p > 0.05$) for any of the parameters.

Mean ruminal (K_1) and caecum-proximal colon (K_2) outflow rates, transit time through the intestines (TT) and total mean retention time within the gut (MRT = $1/K_1 + 1/K_2 + TT$) for liquid (Co) and particulate (Cr) digesta fractions are presented in table 2. The two compartment model of Grovum and Williams (1973) appeared to fit the marker excretion data quite well (Co, $R^2 = 0.974$; Cr, $R^2 = 0.954$), even though camels differ from ruminants in forestomach anatomy and motility, especially with regards to the absence of an omasum-like structure. The observed means for passage parameters and shorter retention times with increasing intake are in agreement with data for ruminants. Each 1 hr. decrease in Cr or Co TMR reduced OM digestibility by 0.06 percentage ($p = 0.07$).

TABLE 2. MEANS OF PARAMETERS DESCRIBING THE FAECAL EXCRETION OF Co AND Cr[1].

Parameter		Mean	SEM
K_1	Co	0.063[a,2]	0.0020
	Cr	0.037	0.0016
K_2	Co	0.115	0.0100
	Cr	0.046	0.0030
TT	Co	23.6[b]	0.83
(h)	Cr	34.3	2.48
TMR	Co	50.1[b]	1.20
(h)	Cr	85.2[a]	2.12

[1] DM intake (kg/day) was used as the regressor.
[2] Means followed by letters were significantly affected (a, $p < 0.05$; b, $p < 0.01$) by DM intake.

Means for chewing data are provided in table 3. Increasing DMINT significantly ($p < 0.05$) increased total time spent eating (EATT), ruminating (RUMT), chewing (CHEWT = EATT + RUMT) and the number of chews per bolus during rumination. The average time spent in ruminating, eating and chewing per unit DMINT by the camels is similar to that reported by Balch (1971) for cattle consuming a medium quality hay. At *ad libitum* intake the maximum amount of time spent ruminating was 5-5.5 h/d.

TABLE 3. MEANS OF EATING, RUMINATING AND CHEWING ACTIVITY OF BACTRIAN CAMELS

Parameter	Mean	SEM
Eating (min/d)	96.2[b,1]	5.33
Ruminating (min/d)	220.4[b]	13.17
Chewing (min/d)[2]	316.6[b]	14.64
Eating/Dry Matter Intake (min/g)	0.038	0.0016
Ruminating/Dry Matter Intake (min/g)	0.092	0.0061
Chewing/Dry Matter Intake (min/g)	0.130	0.0063
Number Chews per Bolus in Rumination	29.2[a]	0.80

[1] Means followed by letters were significantly affected (a, $p < 0.05$; b, $p < 0.01$) by level of any matter intake (kg /day).
[2] Chewing (min) = Eating (min) + Ruminating (min).

In agreement with information presented by Foose (1982), data from the present study suggests that camels digest forages to an extent comparable to sheep and cattle, but that this was accomplished at the expense of relatively high retention times. As a general rule the maximum RUMT of sheep and cattle is 8 to 10 h/d. The comparatively lower maximum RUMT exhibited by the camels at *ad libitum* intakes may represent a biological limit for this parameter and may, therefore, be partly responsible for the low *ad libitum* intakes observed.

(Key Words: Camels, Digestion, Chewing Behaviour)

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