

FEEDING BEHAVIOUR OF CAMELREVIEW

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Despite being an active member of the food producing family of farm animals, the camel has for a long time remained the most neglected animal in terms of its improvement and scientific research. The versatility of camel to survive and perform in the hard arid and semiarid regions and its unique physiological system should motivate the researchers to study it more closely to further exploit its potential. It is generally agreed that camel is predominantly a browser, although it also grazes on tall succulent young grass. On overall basis, dromedaries graze a broad spectrum of fodder plants, including thorny bushes, halophytes and aromatic species generally avoided by other domestic herbivores. During autumn and winter the camel in desert feeds on *Haloxylon aphyllum*, *H. persicum*, *Salsola gemmaseens*, *S. orientalis*, *Astragalus*, *Aristida karelinii* and *A. pennate* and in spring the desert is covered by ephemerals. In summer camels prefer salty sour plants and shrubs. Camels usually take a variety of vegetation that presumably provides optimal nutrition. On average as percent of 24 hr, 37 AI, 31.70, 26.52 and 4.37 time was spent for grazing, rumination, idling and resting/sleeping respectively. The average frequency of defaecation and urination by camel during day and night time was 5.7 ± 2.0 and 3.0 ± 1.2 and 5.7 ± 1.9 and 4.3 ± 1.5 respectively.

Key words: behaviour of camel, browser or grazer, defaecation, plant preference, rumination, urination

INTRODUCTION

Camel enjoys globally a unique ecological as well as socio-economic status. Its unaccounted for service to the human beings under harsh climatic conditions and within highly marginalized ecosystems continues since ancient times (Altaf, 2000). On global basis there are about 19.5 million camels (FAO, 1998). Despite growing urbanization in several countries, the population of camel has not shown a downward trend. This fact itself speaks of the useful role of one-humped camel (Khan et al., 1998). The camel has numerous unique capabilities and characteristics. Making a mention here of all these is, of course, beyond the scope of this article. It might suffice to indicate that it can be milked, ridden, loaded with baggage, eaten, harnessed to plough and used for other important agricultural operations, traded for goods and exhibited in the zoo (Iqbal, 1999). Despite being an active member of the food producing family of farm animals, it has for a long time remained the most neglected animal in terms of its improvement and scientific research. The versatility of camel to survive and perform in the hard arid and semiarid regions and its unique physiological system should motivate the researchers to study it more closely to further exploit its potential. The review presented here aims at putting together the available information pertaining to feeding habits and preferential selectivity of browsing/grazing material by camel.

Dowler or Grazer: Literally browsing/grazing behaviour is a collection of activities linked to the ingestion of feed (searching, choosing and absorption) (Pagot, 1992). Field (1979) found that the camel is predominantly a browser, although it also grazes on tall succulent young grass. Schwartz et al. (1983) stated that camels are browsers and their feed mainly consists of shrubs, bushes and trees (3.5m above ground level). Sleeper (1985) emphasized that the camels are browsers, not grazers, have long necks and legs that enable them to munch on leaves and fruits of trees beyond the reach of other livestock. Their mouths can accommodate the most prickly plants and Aussie camels

will even eat the orange fruit of the white wood tree—a fruit intolerably bitter to most other creatures. Coppock et al. (1986a) reported that feeding habits of livestock range from the grass dominated (96%) diets of cattle to browse dominated (95%) diets of camels, while sheep, goats and donkeys tend to be mixed feeders for herbaceous and non-herbaceous vegetation. McDowell (1986) observed that camel can survive indefinitely on browse. It has strong prehensile lips and narrow muzzle for its body size which permits it to feed on thorny plants.

Tripathi (1987) reported that camels like to browse rather than graze and they should be allowed to forage for at least 6 hr a day. However, in some countries e.g. Somalia, grass forms the main part of the ration. Yagil (1990) declared camels as 'browsers' by nature, taking a bite from one plant and moving to another, covering vast areas each day in search of feed. It is reported that camels are browsers, with a split upper lip well suited for this purpose. They are selective feeders and eat the freshest vegetation available. They reach remote salt lakes where preferred plants have a high electrolyte and moisture content (*Calandrinia* and *Portulacaeae* sp.) Grasses are eaten primarily after rain and before herbs or forbs are available (Anonymous, 1993). EI-Badawi (1996) found that camels prefer to browse than to graze and they spend long time in consuming and ruminating their feeds. Williams (1996) is of the opinion that camels are browsers adept at eating leaves from the prickliest trees and shrubs.

Feed Preference: Preference was defined by the method of Bell (1959) for two choice tests as the intake of one forage expressed as a percentage of the total intake of both forages on offer. Selectivity was defined as grazing of certain plant species to the exclusion of others. Thus, when animal selects one plant in preference to others, it can be assumed that it is more palatable than the ones that are not selected (Anonymous, 1964).

Arnold and Dudzinski (1978) identified five factors that interact in selection process during grazing: (i) animal

factors including animal species, individuality, physiological condition (feed demand), grazing behaviour, social behaviour and previous experience, (ii) sensory factors, which include sense of sight, smell, touch and taste, (iii) physical environment including topography (slope aspect and site of the plant), distance of plant from water source, distance of plants from track or shade, (iv) plant environment including soil type, soil fertility and plant community, and (v) plant species present, which include their chemical and physical characteristics and their relative availability. Newman (1975, 1979) found that a pair of three year old camels preferred shrub and forb material as their chief dietary components (up to 70%) while pairs of various breeds of cattle and a pair of buffaloes preferred grass material (up to 90%). Camel's way of feeding was found entirely different from that of sheep and goats which graze intensively. Camels rarely overgraze and constantly move taking only small portions of each plant. They cover large areas while foraging even if feed is plentiful. Field (1979) reported that the average diet of camels consisted of dwarf shrubs (47.5%), trees (29.9%), grasses (11.2%), other herbs (10.2%) and vines (1.1%). In their natural habitats, dromedary camels prefer browse of great nutritional value for most of the year in arid zones compared with grasses and herbs which have very short growing season (Mukasa-Mugerwa, 1981). Camels, like other ruminants, are not necessarily entirely vegetarian but they have been seen eating charcoal, bones or even mummified young gazelles, head and all (Gauthier-Pilters and Dagg, 1981). Owen-Smith and Novellie (1982) found that availability of acceptable plant species was an important limitation to the selection process as was diet quality. Camels widen their dietary acceptance range in the dry seasons apparently to compensate the declining forage abundance by eating more grasses, litter, leaves, vines and lignified twigs. Intake is the result of bite size, biting rate and feeding time (Hodgson, 1985). According to Baimukanov (1989), two-humped camels feed on specialized desert vegetation-halophytes, wormwood, shrubs, subshrubs and various thorny plants. Pirzada et al. (1989) stated that camel prefers to have salty bushes which are rich in water. Salts present in such plants help meet the physiological requirement of the animal. Rutagwenda et al. (1990) found that camels and goats spent more than 80% of total feeding time on dicotyledons irrespective of season. Sheep were intermediate between the extremes. Yagil (1990) reported that on typical grazing grounds of the arid tropics and subtropics, the dromedary prefers to browse bushes and trees. Schwartz (1992a) observed that on overall basis, dromedaries graze a broad spectrum of fodder plants, including thorny species, halophytes and aromatic species generally avoided by other domestic herbivores. Schwartz (1992b) remarked that camels are very versatile feeders. On the fringes of the great deserts and in dune country they feed on coarse and perennial grasses and dwarf shrubs having coarse texture and hairy leaves (which are avoided by other livestock). He further stated that if available they prefer broad-leaved plants such as *Cadaba*, *Cordia* or

Maerua sp., which allow bites of large size. He studied camel's feeding behaviour for three years on a semiarid thorn bush savannah in northern Kenya and reported 13 trees and large bushes, four dwarf shrubs and one soft forb which accounted for 81.3% of the total observed feeding time. The camels were mainly harvesting leaves, but also flowers, fruits and during the dry season, the tips of the twigs and branches. After an exceptionally long dry spell they were occasionally found debarking trees. Elmi et al. (1993) indicated that forage plant species consumption was not affected by physical defense structure or by leaf size in relation to the bite dimensions of the animal. Small-leaved deciduous (thorny) plants were as much utilized as large-leaved deciduous or evergreen plants. Iqbal (1999) reported that contrary to the normal practice, during more humid or rainy days, camels of all age groups preferred *Alhaji came/Drum*. which was thought to be due to the small and soft scales of this plant, naturally more acceptable to animals.

Preferred Feeding Time: Camels browse and graze on natural range at any time of the day or night. However, during very hot weather they tend to avoid feeding during the heat of the day and they adopt positions which reduce heat gain and thus conserve energy (Acland, 1932; Qureshi, 1986).

Effect of Season: Field (1979) indicated that during summer season the double-humped camels show a feeding preference for annual and ephemeral plants and only when these dry off or disappear, do shrubs and legumes begin to dominate its diet. Wei (1979) reported that double-humped camels can survive in a natural and semiwild conditions, roaming and grazing in the range all year round, taking coarse, thorny plants and those with unfavourable flavours. In their natural habitat dromedary camels prefer browse of great nutritional value for most of the year in arid zones compared with grasses and herbs which have very short growing season (Mukasa-Mugerwa, 1981). Owen-Smith and Novellie (1982) found that the number of plant species consumed by camels in the dry seasons was not much less than those selected in the wet seasons.

Schwartz et al. (1983) observed that deep-rooted trees and large evergreen bushes are usually the only reliable sources of forage for camels during drought years and in dry season. Abdullahi et al. (1985, 1986) and Nasser et al. (1986) pointed out that during early wet season, the most important feed eaten by the camel was forbs (52%) followed by grasses (26%) and shrubs (22%). Starting mid spring, shrubs dominated the diet of camel. They stated that although camel's diet consisted of forbs and grasses during late winter but was dominated by shrubs throughout the year. Baimukanov (1989) found that in summer two-humped camels mainly depend on drought resistant plants: shrubs, subshrubs, various species of legumes and halophytes. They skillfully pick out the tender and nourishing parts of the plant. Coppock et al. (1986b) opined that only camel diets showed fibre to crude protein ratios that were unaffected by season. Meredov (1989) observed that during autumn and winter the camel in desert feeds on

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Haloxylon aphyllum, *Haloxylon persicum*, *Salsola gemmascens*, *Salsola orientalis*, *Astragalus*, *Aristida karelinii* and *Aristida pennata* and in spring the desert is covered by ephemerals. Abdullah (1998) found that camels

select first annual plants and then perennial trees while sheep feed on annual plants which grow after rainfall. In summer and fall, camels prefer salty sour plants and shrubs which sheep will not graze.

Plant Species Preferred

Feral dromedaries (Australia)	<i>Euphorbia tannensis</i> & <i>Trichodesma zeylanicum</i>	Newman (1975)
Dromedaries (Ethopia)	Pure alfalfa & over-mature <i>Panicum maximum</i> (on irrigated pasture)	Knoess (1977)
Two-humped camel	<i>Salicornia fruticosa</i> , <i>Suaeda fruticosa</i> & <i>Limoniastrum monopetalum</i> ; also <i>Frankenia</i> , <i>Artemisia</i> & <i>Salsola</i> sp.	Field (1979)
Dromedaries	<i>Astragalus</i> sp., <i>Malrea aegyptiaca</i> , <i>Poa bubboza</i> , <i>Salsola spinosa</i> & <i>Sisymbrium bilobum</i>	Nasser et al. (1986)
Dromedaries	Genera <i>Acacia</i> , <i>Salsola</i> & <i>Atriplex</i>	Yil&il(1986, 1990)
Dromedaries (Kuwait)	<i>Rhanterium epapposum</i> , <i>Panicum turgidum</i> , <i>Haloxylon salicornicum</i> & <i>Sovignia perviflora</i>	Ibnoaf (1987)
Two-humped camel	<i>Alhaji camelorum</i>	Baimukanov (1989)
Dromedaries (Pakistan)	Genera <i>Acacia</i> , <i>Albizia</i> , <i>Aristida</i> , <i>Atriplex</i> , <i>Calligonum</i> , <i>Capparis</i> , <i>Gymnocarpus</i> , <i>Helianthum</i> , <i>Parkinsonia</i> , <i>Prosopis</i> , <i>Saheadora</i> , <i>Salsola</i> , <i>Salvadora</i> , <i>Suaeda</i> , <i>Tamarix</i> , <i>Tecoma</i> & <i>Zizyphus</i> .	Mohammad (1989) and Khan (1996)
Dromedaries	Genera <i>Acacia</i> , <i>Atriplex</i> , <i>Boscia</i> , <i>Cadaba</i> , <i>Dobera</i> , <i>Saheadora</i> , <i>Salsola</i> & <i>Zizyphus</i> .	Williamson and Payne (1990)
Dromedaries	<i>Aristida adscension</i> & <i>Duosperma eremophilum</i>	Schwartz (1992b)
Dromedaries	<i>Calandrinia</i> sp & <i>Portulacca</i> sp.	Anonymous (1993)
Dromedaries	Tree fodders (<i>Acacia</i> , <i>Prosopis</i> & <i>Salvadora</i>), bushes (<i>Indigofera</i> , salt bush, wild olive & <i>Zizyphus</i>), greenfodders (<i>Phaseolus aconitifolius</i> , <i>Phaseolus mungo</i> , <i>Mellilotus parviflora</i> & <i>Cyamopsis psoraloides</i>), dryforages (rice and wheat straws and leguminous crops such as moth, mung & guar)	Ranjhan (1997)
Dromedaries	<i>Aristida nubica</i> , <i>Aristida senegal</i> , <i>Aristida seyal</i> , <i>Cybogon nervatus</i> , <i>Ipomoe</i> sp., <i>Maerua crassifolia</i> , <i>Phrogmites mauritanus</i> , <i>Schoenefeldia gracilis</i> , <i>Tortilis</i> & <i>Zizyphus spinachrist</i> .	Mohammad and Eliman (1998)
Dromedaries (Pakistan)	<i>Acacia modesta</i> , <i>Acacia nilotica</i> , <i>Alhaji camelorum</i> , <i>Heteropogon contortus</i> & <i>Olea ferruginea</i> .	Iqbal (1999)

Nutritive Value: According to Leese (1927) about one-third of feed intake of camel should be from saltbush which is high in protein, generally low in cellulose and usually green in summer with succulent leaves. Salty plants together with dry grass supply carbohydrates, forming a well-balanced diet. Leitch (1940) observed that due to the generally adequate mineral content of the browse species consumed by dromedaries, deficiency diseases are not very common. Cook and Harris (1968) indicated that browse, trees and shrubs being the main feed of camel during dry season are usually high in protein, calcium, phosphorus and lignin. McDowell (1986) stated that the camel's feeding behaviour, tolerance to high salt contents and ability to conserve water, make it the best of ruminants for arid and many semiarid areas. Mohammad (1989) remarked that camel is the most economical and efficient animal in the arid and semiarid range lands of tropical and subtropical areas of Pakistan. He further reported that camels browse only on local vegetation and rarely receive any

supplementary feed (except during drought and for the working animal). Grasses are high in crude fibre and are considered good energy sources during certain seasons. Herbs are usually intermediate between browse and grasses. Therefore, preference by camel for certain plant species directly affects the nutritive value of diets. Moreover, camels select certain plant parts that are of high nutritive value (Wardeh, 1990a, 1990b and Wardeh and Farid, 1990). Wardeh et al. (1990) collected 223 samples from 160 plant species preferred by camel from Africa and Asia region to determine their nutritive value. The samples were divided into four groups (i.e. those of trees, shrubs, grasses and forbs). The average values for protein contents were 14.89 ± 5.44 , 11.88 ± 4.97 , 8.54 ± 4.90 and $12.39 \pm 5.80\%$; crude fibre 21.95 ± 12.11 , 29.79 ± 12.46 , 33.87 ± 6.18 and $25.71 \pm 10.89\%$, while ash content averaged 9.85 ± 7.66 , 12.78 ± 7.40 , 11.02 ± 5.02 and $15.80 \pm 8.94\%$ in the four groups respectively. Williamson and Payne (1990) reported that camels feed on plants that have high moisture and salt

contents. Rutagwenda et al. (1990) was of the opinion that camels and goats selected a diet with higher protein than the other animal species. Yagil (1990) observed that camels selected feed which is highly digestible, especially rich in easily fermentable carbohydrates and having high water contents.

Chemical analyses of the most preferred forages by the different farm animals indicated that the highest fibre and lignin contents were reached when dry season ends, while the highest crude protein contents in the beginning of the dry seasons. As a result camels, sheep and goats were found to show very similar disappearance curves, indicating that they are able to select feed of similar quality from the same pasture. Cattle being grazers, select diets of lower quality (Schwartz, 1992c). Contrarily, Qureshi et al. (1993) reported that camels survive on high browse and sheep survive on tree leaf fall, pod fall and ground herbage. However, Abdullahi et al. (1986) indicated that dietary overlap between camel and sheep was found to be 24 to 43%. These two animal species can therefore amicably graze together. It was reported (Anonymous, 1993) that camels eat the freshest vegetation available. They reach remote salt lakes where preferred plants have a high electrolyte and moisture content. Williams (1996) stated that camels tend to select the freshest first but always mix their intake. They prefer plants with high moisture and mineral content and the leaves of trees and shrubs and herbs/forbs to grass. Khan (1996) and Ranjhan (1997) observed that camels usually take a variety of vegetation that presumably provides optimal nutrition. Iqbal (1999) stated that the preference for *Acacia modesta* by adult camels may be due to the presence of high crude protein contents in this plant and its high crude protein contents probably were sufficient to effect decrease in the intake of plants such as *Alhaji came/orum* and *Olea ferruginea*. The findings of Del-Curto et al. (1990); Van Soest (1994) and El-Banna (1995) seem to provide logical explanation for this phenomenon. They are of the opinion that higher dry matter intake takes place in ruminants with increased provision of dietary crude protein.

Browsing/Grazing, Rumination and Resting Duration: Tripathi (1987) reported that camels should be allowed to forage at least 6 hr a day. Khorchani et al. (1992) observed the feeding behaviour of four suckling female camels on arid ranges of Tunisia. The animals were allowed to spend 600 min/day out of the camp (enclosure where they spent night). Of the total time on the range, they grazed for 464 min and spent 135 min in resting (77.3% and 22.5% respectively). Rumination lasted 573 min and occurred only in camp; it took 68.1% of the time spent in the camp, while the remaining time was spent for rest.

Samraus (1994a) found that the dromedaries of India and Kenya spent about 25% of 24 hr time in rumination. The peak time for rumination activity was between 4 and 7 a.m. for both herds. In another study Samraus (1994b) observed the lying down behaviour of dromedaries in two herds. The dromedaries of Kenya were found lying almost exclusively and in India predominantly, at night. In both herds, the

females spent almost half of the 24 hr lying down. Khan et al. (1998) studied certain activity patterns of 12 camels round the clock in Thai area (Punjab: Pakistan). On overall basis, the total time spent for various activities expressed as percent of 24 hr was found to be 37.41, 31.70, 26.52 and 4.37 for grazing, rumination, idling and resting/sleeping respectively. Iqbal (1999) observed the feeding pattern of three groups of camels (adult females, youngstock and sucklers) and found that on comparative basis, adult females spent maximum time in browsing/grazing followed by youngstock and sucklers. The actual feeding time varied from 60.80 to 68.04% (on the basis of 7 hr net time allowed) among the three groups. Time spent in standing idle was 2.40 to 3.10% while 8% was spent for rumination which significantly differs from those of earlier studies.

Defaecation and Urination: Haq and Masood (1966) worked out that the average daily excretion of droppings and urine by camels was about 20 kg and 4 litres respectively. The quantity of droppings of youngstock was taken as half of that excreted by adults. Chapman (1985) stated that defaecation by camel is in the form of compact balls, making their collection and handling feasible. According to Dioli et al. (1992), camels frequently urinate and defaecate especially after rising. Daily output of urine ranges between 0.5 to 5.0 litres, depending to a large extent on the animal's status of hydration or dehydration. Khan et al. (1998) reported that the frequency of defaecation and urination by camel during day and night time was 5.7 ± 2.0 and 3.0 ± 1.2 and 5.7 ± 1.9 and 4.3 ± 1.5 respectively. Iqbal (1999) reported that defaecation frequency in camels was maximum in youngstock (6.2) followed by adults (5.7) and sucklers (4.6). The youngstock also exhibited maximum (10.8) urination frequency followed by sucklers (6.9) and adults (5.2). He further reported that irrespective of their age, they all defaecate/urinate during browsing/grazing and moving. Pregnant females were found to defaecate and urinate simultaneously.

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