**Browsing Behavior of Camels** (*Camelus dromedarius*) **in Katsina State, Nigeria**

**Abstract**

The objective of this study was to identify the preferred plant species by browsing camels and the impact of seasons (wet, cold dry and hot dry) on the frequency of bite and time per bite. A total of seventeen (17) plant species were identified as the most preferred browse species identified during this study. Plant species were ranked based on the frequency of bite. Camels were followed to the browsing area and their feeding behavior was carefully monitored and obtained the information on the preferences and frequency of bite. In wet season, the longest time taken for a bite was recorded for *Acacia nilotica* (*Bagaruwa*) with 3.80 seconds per bite while the shortest 2.33 seconds per bite was for *Dichrostachys cineria* (*Sarkakkiya*). The time taken per bite of 2.25 seconds was obtained from *Piliostigma reticulatum* (*Kargo*) in both the cold dry and hot dry seasons while the shortest times of 1.40 and 1.42 seconds per bite were obtained for *Leptadenia hastata* (*Yadiya*) and *Azadirachta indica* (Neem) respectively. In conclusion, despite camel’s selective feeding behavior when browsing, time variations were observed based on preferences.

**Key words:** browse plants, camels, herbivores, frequency of bite, time spent per bite

**Introduction**

Dromedary camels (Camelus dromedarius) are browsing herbivores exceptionally well adapted to the harsh environmental conditions of the Arabian sandy deserts and the arid and semi-arid lands (ASALs) of other regions worldwide. Their unique physiological and behavioral adaptations enable them to thrive on a diverse range of desert vegetation, particularly thorny plant species commonly found in these ecosystems (Wilson, 1998b and Rutagwanda *et al*., 1990).

Camels primarily consume shrubs and forbs, which can constitute over 70% of their daily diet. They typically spend 8 to 12 hours per day browsing, depending on the availability and distribution of forage, with additional time dedicated to ruminating (Nkrumah et al., 2006 and Wilson, 1998b). During browsing, camels traverse extensive areas, selectively feeding on succulent leaves and twigs. This selective and wide-ranging foraging behavior helps minimize browsing pressure on individual plant species, thereby reducing ecological stress on vegetation communities and limiting competition with other livestock, particularly goats, in marginal environments (Coppock et al., 1986; Pagot, 1992 and Bekele *et al*. 2011). However, Browse plants species have high potentials as important feed resources for ruminants during the dry season and are quite palatable also less susceptible to a climate fluctuation in the Sudan Savannah zone of Northern Nigeria Samuel, (2018).

From a nutritional standpoint, the broad dietary range of camels may help mitigate the ingestion of toxic plant species, as suggested by El‑Badawi et. al. (2021) and Wako *et al*. (2023). Although camels may experience weight loss during periods of drought due to reduced forage quality and quantity, they are capable of rapidly regaining body condition when favorable conditions return, particularly during the wet season (Tezera *et al.,* 2010).

Despite the problems associated with feed shortages, most ruminants' keepers in Northern Nigeria rarely offer supplements to their camels, even though it is one of the most important factor affecting performance of the animals but the utilization of browse forages is yielding a significant return in terms of utilization Rutagwanda et al. (1990). Also, the intensifying high cost and competitive demand of conventional feed resources especially grains between man and his livestock have further limits their quantity to be used in ruminant feeding since the animals are discovered to utilize available feed resources despite poor in quality and less productive. These and other challenges necessitate the search for alternative indigenous feed resources which are readily available and cheaper than the conventional supplement to achieve desired livestock productivity Ogunbosoye et al. (2015).

While numerous studies have documented camel browsing behavior in various regions, there remains a paucity of data specific to the area under investigation in this study. Therefore, this research was undertaken to generate and provide region-specific insights into the browsing ecology of dromedary camels.

**Material and methods**

**Type of the Study**

The study was conducted in Dutsi, Mani, and Mashi Local Government Areas (LGAs) of Katsina State (Figure 1). These areas are characterized by a diverse array of plant species commonly browsed by camels. To observe feeding behavior, camels were accompanied to their grazing sites with the assistance of local pastoralists. Direct observations were made to systematically record their foraging patterns and plant species selection.

**Description of the study area**

The study was conducted in Katsina State, located in northwestern Nigeria. Katsina State was carved out of the former Kaduna State in 1987. The three selected Local Government Areas (LGAs)—Dutsi, Mani, and Mashi—are contiguous and collectively cover an estimated land area of 49,895 square kilometers. Notably, Mashi LGA shares a northern boundary with the Republic of Niger.

According to the 2006 National Population Census, Katsina State had a population of 5,792,578 (NPC, 2006). The northern part of the state experiences predominantly hot and dry climatic conditions for most of the year. The hottest months are typically from March to May, with temperatures ranging between 23°C and 42°C. Annual rainfall ranges from 700 mm to 1,000 mm, with the rainy season usually occurring between June and September (KTARDA, 2001).

The region supports various types of livestock, including cattle, camels, sheep, and goats. The vegetation consists of a mix of annual, biennial, and perennial plant species, providing a diverse forage base for grazing and browsing animals.

**The inventory of the plant species**

Camels were followed to the grazing areas. A total of one hundred and nine (109) camels constituted the herd used for the study. There were 52 adults and 57 calves. Males and females were 31 and 78 respectively. A careful monitoring was performed to identify the browse plant species selected by the camels. Names of the plants species selected and frequency of bite by the camels were observed and recorded. The selected plant species were ranked and ranked on a scale of 1–5 as shown in Table 1. The ranking was based on the frequency of bite which indicated how camels cherished and adequately utilized the browses. The local guides used in the study were trained on the technicalities of the research procedures. The study was conducted across the three seasons of the year – wet season (June–October), cold dry season (November–February) and hot dry season (March–May) respectively.

**Table 1: Ranking method**

|  |  |
| --- | --- |
| **Preferences** | **Scale** |
| Most preferred | 1st |
| Preferred  | 2nd |
| Fairly preferred | 3rd |
| Rarely preferred | 4th |
| Poorly preferred | 5th |

**Source: Field work, 2015**

**Experimental design / data analysis**

The data were analyzed using the Statistical Package for the Social Sciences (SPSS) with simple descriptive statistics. Differences observed across various time periods and the number of bites were recorded based on results obtained from field observations.

**Results**

**Vegetation species utilized by camels during the three seasons (wet, cold dry and hot dry)**

Table 2 presented the results of inventory of common browse plant species utilized by the camels across the three seasons (wet, cold dry and hot dry) respectively. A total of seventeen (17) plant species were identified and utilized by camels were recorded. The plant species were ranked based on preferences by the camels.

**Table 2: Inventory of the plant species utilized by Camels in three seasons (wet, cold dry and hot dry) of the year**

|  |  |  |  |
| --- | --- | --- | --- |
| **Common/English Name** | **Scientific Names** | **Family** | **Ranking based on Preferences (All seasons)** |
| *Sarkakkiya*  | *Dichrostachys cinerea* | *Mimosoideae* | 1st |
| *Kargo*  | *Piliostigma reticulatum* | *Leguminosae-caesalpinioideae* | 2nd |
| *Yadiya*  | *Leptadenia hastata* | *Asclepiadaceae*  | 3rd |
| *Dashi*  | *Commiphora Africana* | *Nyctaginaceae*  | 4th |
| *Marga*  | *Cassia arereh* | *Leguminosae-caesalpinioideae* | 5th |
| *Sabara*  | *Gueira senegalensis* | *Capparidaceae*  | 6th |
| *Bagaruwa*  | *Acacia nilotica* | *Mimosoideae* | 7th |
| *Aduwa*  | *Balanites eagyptiaca* | *Balanitaceae*  | 8th |
| Neem  | *Azadirachta indica* | *Meliaceae*  | 9th |
| Mango  | *Mangifera indica* | *Anacardiaceae*  | 10th |
| *Tsatstsagi*  | *Bauhinia rufescens* | *Leguminosae*  | 11th |
| *Dundu*  | *Dichrostachys cinerea* | *Fabaceae*  | 12th |
| *Magarya*  | *Ziziphus mauritianus* | *Ramnaceae*  | 13th |
| *Baure*  | *Ficus sycomorous* | *Sycomoroceae*  | 14th |
| *Dinya*  | *Vitex doniana* | *Lamiaceae*  | 15th |
| *Geza*  | *Phyllanthus pentandrus* | *Euphorbiaceae* | 16th |
| *Marke*  | *Anogeissus leocarpa* | *Combretaceae*  | 17th |

Source: Field work, 2015

**Time taken for a bite during browsing by camels in wet season**

Table 3 presented the results of time taken for a bite during browsing on plant species by camels in wet season. The longest time taken for a bite was recorded for *Acacia nilotica* (*Bagaruwa*) with 3.80 seconds per bite while the shortest time of 2.33 seconds per bite was recorded for *Dichrostachys cinerea* (*Sarkakkiya*). This is followed by the longest mean time of 4.21 seconds per bite obtained from *Acacia nilotica* (*Bagaruwa*) and the shortest mean of 2.93 seconds per bite for *Dichrostachys cinerea* (*Sarkakkiya*).

**Table 3: Time taken for a bite during browsing by Camels in wet season**

|  |
| --- |
| Plant species |
| Statistics  | *Dichrostachys cinerea*(*Sarkakkiya*) | *Commiphora africana*(*Dashi*) | *Cassia arereh* (*Marga*) | *Acacia nilotica*(*Bagaruwa*) | *Gueira senegalensis* (*Sabara*) |
| Minimum (Sec/Bite) | 2.33 | 3.14 | 3.15 | 3.80 | 3.40 |
| Maximum (Sec/Bite) | 3.53 | 4.68 | 3.71 | 4.62 | 3.89 |
| Mean  | 2.93 | 3.91 | 3.43 | 4.21 | 3.65 |

**Source: Field work, 2015**

**Time taken for a bite during browsing by camels in cold dry season**

Time taken for a bite during browsing by camel in cold dry season are presented in Table 4. The longest time taken for a bite was obtained for *Piliostigma reticulatum* (*Kargo*) with 2.25 seconds per bite while the shortest time of 1.40 seconds per bite was recorded for *Leptadenia hastata* (*Yadiya*). This is followed by the highest mean average of 2.85 seconds per bite obtained from *Dichrostachys cinerea* (*Sarkakkiya*) and the lowest mean of 1.49 seconds per bite from *Leptadenia hastata* (*Yadiya*).

**Table 4: Time taken for a bite during browsing by Camels in cold dry season**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | Plant species |  |  |
| Statistics  | *Piliostigma reticulatum*(*Kargo*) | *Dichrostachys cinerea*(*Sarkakkiya*) | *Leptadenia hastata*(*Yadiya*) | *Gueira senegalensis*(*Sabara*) | *Azadirachta indica*(Neem) |
| Minimum (Sec/Bite) | 2.25 | 2.15 | 1.40 | 1.79 | 1.60 |
| Maximum (Sec/Bite) | 3.32 | 3.54 | 1.57 | 2.63 | 1.79 |
| Mean  | 2.79 | 2.85 | 1.49 | 2.17 | 1.70 |

**Source: Field work, 2015**

**Time taken for a bite during browsing by camels in hot dry season**

Mean values for time taken for a bite during browsing by camel in hot dry season are presented in Table 5. The longest time taken for a bite was obtained for *Piliostigma reticulatum* (*Kargo*) with 2.54 seconds per bite while the shortest 1.42 seconds per bite was obtained from *Azadirachta indica* (Neem). This is followed by the longest mean time of 2.81 seconds per bite recorded for *Piliostigma reticulatum* (*Kargo*) and the shortest mean of 1.50 seconds per bite for *Azadirachta indica* (Neem).

**Table 5: Time taken for a bite during browsing by Camels in hot dry season**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | Plant species |  |  |
| Statistics  | *Piliostigma reticulatum* (*Kargo*) | *Leptadenia hastata*(*Yadiya*) | *Balanites agyptiaca* (*Aduwa*) | *Azadirachta indica*(Neem) | *Mangifera indica*(Mango) |
| Minimum (Sec/Bite) | 2.54 | 1.47 | 1.64 | 1.42 | 1.50 |
| Maximum (Sec/Bite) | 3.08 | 1.56 | 1.78 | 1.58 | 1.75 |
| Mean  | 2.81 | 1.52 | 1.71 | 1.50 | 1.63 |

Source: Field work, 2015

**Discussion**

**Inventory of Plant Species Utilized by Camels Across Seasons**

A total of seventeen (17) plant species were identified as being utilized by camels across the three seasons: wet, cold dry, and hot dry. These species included both thorny and non-thorny types, comprising trees, shrubs, and grasses. Although camels are primarily classified as browsers, they may rely on grazing under certain conditions, particularly when browse is limited Wilson, (1998b) and Field, (2005).

The vastness of the study area and the diversity of vegetation types posed challenges in standardizing the identification of feed resources consumed by camels. This observation is consistent with earlier reports by Hashi *et al.* (1995), Wilson, 1998a and Bekele *et al*. (2011). Camels typically spend a significant portion of the day foraging and can cover long distances while selectively feeding from one plant to another. Their selective feeding behavior enables them to choose from a wide variety of plant species, often focusing on the most preferred ones. These findings agree with those of Moaeen-Ud-Din et al. (2004), Farid *et al.* (2010), who emphasized the camel’s ability to adapt its diet based on availability and preference.

**Bite Duration on Plant Species Across Seasons**

Five dominant plant species were ranked based on the time camels spent per bite in each of the three seasons. During the wet season, the longest mean bite duration was recorded for *Acacia* *nilotica,* a member of the family *Mimosoideae*. Despite its thorny structure, the anatomical features of camels—such as their mouth, tongue, nostrils, and facial configuration—are well adapted to handle such vegetation without impeding feed intake. This observation supports the findings of Abdel-Razek et al. (1988) and Al-Jaloud *et al.* (1994).

Abdel-Razek *et al.* (1988), Field (2005), and Heneidy (1996) also noted that during the wet season, the camel diet is dominated by trees and shrubs. However, the proportion of these plant types typically declines during the dry seasons, as many species shed their leaves.

In both the cold dry and hot dry seasons, *Piliostigma reticulatum* (locally known as Kargo) recorded the longest bite duration. This species is a non-thorny, medium-sized tree (3–5 meters in height) that thrives in semi-arid zones and is highly drought-resistant. It retains its green foliage and produces ripe pods throughout the year, making it a critical forage resource during periods of feed scarcity. Camels utilize this plant extensively due to its year-round availability, especially during the dry seasons. These findings are consistent with Wilson (1989), who highlighted that camels’ browsing habits reduce direct competition with other ruminants due to differences in diet composition, feeding height, and forage selection.

Camels typically consume a variety of plant parts, including leaves, young shoots, twigs, fruits, flowers, and pods. Under natural conditions, they exhibit a high degree of selectivity, favoring browse species—particularly trees—over grasses. However, the most significant competition for browse resources occurs between camels and goats, both of which are efficient browsers. This observation aligns with the findings of Field (2005), Wilson (1998a), and Yagil and Etzion (1980).

Furthermore, Elmi *et al.* (1993) and Farid *et al.* (2010) reported that the consumption of forage plant species by camels is not significantly influenced by physical defense mechanisms such as thorns or by leaf size relative to the animals’ bite dimensions across different seasons.

**Conclusion**

The study identified the preferred plant species utilized by camels within the study area. The feeding behavior observed does not appear to have a negative impact on the plant community, largely due to the selective nature of camel browsing. Additionally, the findings confirm that camels utilize a wide range of plant species during their browsing periods, demonstrating their adaptability and efficient foraging strategies in arid and semi-arid environments.

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

Author(s) hereby declares that NO generative AI technologies such as Large Language Models

(ChatGPT, COPILOT, etc.) and text-to-image generators have been used during writing or editing of this manuscript.

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