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Research Article

Behavior of Camel Browsing Maintained on Vegetation at Desert, Irrigated and Costal Zones of Sindh-Pakistan

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Abstract: Present research focused three major districts viz Mithi, Tando Allahyar and Thatta from Desert, Irrigated and Coastal zones of Sindh Province of Pakistan during the year 2018. Study was subjected to screen and assess the preference pattern of the camel browse vegetations surrounding the study area. Results of present study indicated a total of 16 natural vegetations at Mithi, 16 at Tando Allahyar and 19 at Thatta which were found to be available for browsing by the camels. Further, results reveled *Senegalia senegal* the most preferred vegetation followed by *Cordia sinensis* (Linn.), *Salvadora oleiodes*, and *Ziziphus nummularia* while, *Prosopis juliflora* appeared less preferred ($p<0.05$) followed by *Calligonum polygonoides*, *Orthanthera viminea* and *Prosopis cineraria* at district Mithi. At Tando Allahyar district camel preferred ($p<0.05$) more to browse the *Salvadora oleiodes* followed by *Suaeda fruticosa*, *Haloxylon salicornicum* and *Acacia nilotica* and less the *Prosopis juliflora*, while *Tamarix passerinoides* followed by *Mudhari Tribulus terrestris* and *Melilotus parviflora* were moderately preferred by camels. Further results showed that the *Cordia sinensis* (Linn.) ($p<0.05$) was browsed more by camels at Thatta followed by *Salvadora oleiodes*, *Suaeda fruticosa, Haloxylon salicornicum* and *Prosopis juliflora* preferred less. However, *Alhagi maurorum*, *R.mucronata* and *Timar Avicenia officinalis* are preferred by camels at intermediate level. Study concludes that the coastal zone possess significantly (($p<0.05$) higher number of natural vagetations for camel browsing comparatively desert and irrigated zones. *Senegalia Senegal*, *Salvadora oleiodes*, *Cordia sinensis* (Linn.) are the most favorite vegetations for camel at all zones but the *Prosopis juliflora* is less preferred.

Keywords: Browsing, Nutrient, Preference, Surveillance, Vegetation

1. INTRODUCTION

The camel is one of the typical and the best adopted animals of the desert. It is capable of enduring thirst and hunger for several days and is the most patient among all land animals. For desert nomads of Pakistan, it is a beloved companion, a source of milk and meat, transport facility provider and a racing/ dancing animal, thus, playing an important role in the socioeconomic uplift of the local communities [1]. Most of the camel population exist at mainly four distinct ecological zones of Pakistan i.e. Sandy deserts (Thal and Cholistan in the Punjab and Thar in Sindh), Coastal mangroves (Thatta, Badin and Karachi districts of Sindh) and Irrigated plains (all irrigated districts of Punjab and Sindh) [2].

Feeding behavior and chemical composition of the preferred plants is very important aspect to know the biological availability of the feed stuffs and the efficiency of the camel to digest them. Further, understanding the browsing behavior of camels is also essential in order to predict its impact on their nutrient requirements and the vegetation utilization [3-4]. It has been studied that under open range conditions camels are able to exploit wide variety of plants by rapidly moving from one feeding station to the next. Ingestion rates remain

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higher where preferred or selected vegetations are plentiful but are much lower on thorny species having little leaves. Feeding times usually ranges from 15 to 18 hours/day. Camels over browse rarely and they are constantly moving and taking only small portions of each plant. They prefer to browse early in the morning and late afternoon, which are the coolest times of day for feeding [5]. The camels prefer broad spectrum of fodder plants, including trees, shrubs, and sometimes hard-thorny, bitter and halophytic (salty) plants that naturally grow in the desert and semi-arid areas. They generally browse leaves, young twigs/shoots, fruits, flowers and pods. Under natural conditions camels have capacity to choose their forages efficiently, graze more on forage trees than grasses. An important feature of camels' browsing habits is that they are not in direct competition with other domestic animals either in terms of the type of feed eaten or in the height at which they eat above the ground. The greatest competition for feed resources is found between camels and goats, with 47.5% dietary overlap in the dry season and 12.4% in the green (wet) season [6]. Forage quality influences the feeding patterns in camels and that under adverse pasture conditions, the time available for grazing would be a limiting factor for their total dry matter and nutrients intake.

However, according to Kuria et al [7], camels' total dry matter intake needs to be about 4% of body weight and that require as much as 15 or more hours per day feeding on vegetations. It has been estimated that a mature camel weighing 650 Kg requires approximately 26 Kg of dry matter, which might represent between 80 and 100 Kg of total food intake of plants with high moisture contents. In Pakistan, camel generally depends on the natural grazing rangelands for feed. In a study at Cholistan rangeland desert palatability potential of natural browse vegetations were investigated Abdullah et al [8], whereby *Prosopis cineraria* and *Acacia nilotica* were reported as highly palatable, *Calligonum polygonoides*, *Suaeda fruticosa*, *Salsola baryosma*, *Haloxylon recurvum*, *Capparis decidua*, *Calotropis procera* and *Tamarix aphylla* moderately palatable, however *Haloxylon salicornicum* less palatable. It was also reported that the camel preferred different parts of plants like leaf, shoot, flower, and fruits [9]. Another study was conducted on the effect of age, sex and seasonal variation on forage preference of camel at Sudano-Sahelian zone of north western Nigeria, where Alkali et al [10] reported that the mature camels consumed mostly diversified, thorny and taller plant species which might not be easily accessed by the camel calves. El-Keblawy et al [11] indicated that camels with their unique anatomical and digestive characteristics browse on a broad spectrum of plant species including those which are normally avoided by other domestic herbivores. The majority of the species reported as preferred by camels were trees and shrubs [12]. In another study Dereje and Uden [13] reported the browsing preference of 240 camels to measure time spent on feeding different plants. The camels preferred a total of twenty one species of plants in the dry and thirty in the wet season. Birhane et al [14] at Aba'ala District, Afar Regional State of Ethiopia reported *Acacia oerfota* as ranked first followed by *Acacia etbaica*, B*alanites aegyptiaca* and *Acacia mellifera* camel browse vegetations. Although various studies have been conducted on different aspects of the browsing behavior of the camels but in Sindh province of Pakistan such kind of study has never been reported. Present study was therefore planned in order study the availability and preference pattern of different camel browse vegetations at desert, irrigated and coastal zones of Sindh province of Pakistan.

2. MATERIALS AND METHODS

2.1 Location of Study

Current study was conducted in Three different districts viz Mithi, Tando Allahyar and Thatta from Three ecological camel habitat zones like sandy desert, irrigated and coastal mangroves zones of Sindh province [15]. A flow diagram of experimental area is shown in Fig.1

2.2 Experimental Procedure

Present research was conducted during the year 2018 whereby investigation was subjected to comprehensive survey performed at three different districts like Mithi, Tando Allahyar and Thatta of Sindh province as shown in Fig. 1 in order to gather the data regarding availability and preference pattern of different camel browse vegetations. A total of 90 respondents (30 from each district) were randomly selected and interviewed face to face through a uniform pre-tested questionnaire duly divided into

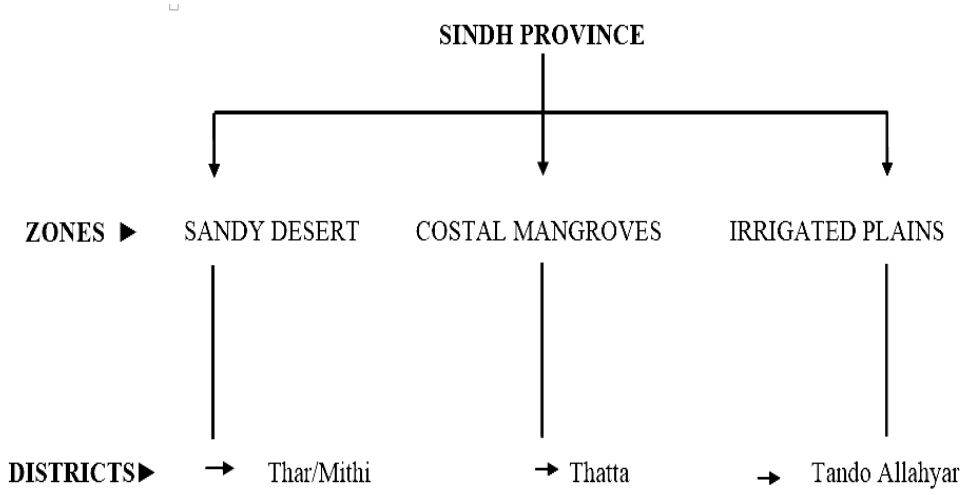

Fig. 1. Flow diagram showing camel habitat zones and vicinities of study area

several parts. The data regarding different camel browse vegetations and their preference pattern were generated and gathered in the current study.

2.3 Statistical Analysis

A computerized statistical package i.e. Student Edition of Statistix (SXW), Version 8.1 (Copyright 2005, Analytical Software, USA) was applied to assess the data. Statistical procedure of completely randomized analysis of variance (ANOVA) under linear models was used to observe the significant variations among the variables within district as well as between vegetations.

3. RESULTS

In order check the surveillance of different camel browse vegetations at Mithi, Tando Allahyar and Thatta districts survey was performed. By using comprehensive questionnaire camel herders were interviewed regarding the availability and preference pattern of different camel browse vegetations at their respective locations.

3.1 Surveillance of Camel Browse Vegetations and their Preference by Camels at Mithi

A total of 30 camel herders were interviewed from district Mithi to record the different camel browse vegetations at the area. Farmers were asked different questions as per questionnaire to gain information about different camel browse vegetations and their rank of preference for camel browsing. According to camel herders a wide range of vegetations are found surrounding the area of Mithi, while their year round availability vary season to season. Acacia nilotica, *Ziziphus nummularia, Acacia jacquemontii, Prosopis juliflora, Cyamopsis tetragonoloba, Cordia sinensis Linn., Indigo pauciflora, Prosopis cineraria, Salvadora oleiodes, Acacia catechu, Orthanthera viminea, Capparis deciduas, Senegalia senegal, Sesamum indicum, Simmondsia chinensis* and *Calligonum polygonoides* were vegetations which were mostly used by camels for browsing at Mithi district (Table 1). Among all vegetations Senegalia senegal preferred significantly more ($p<0.05$) followed by *Cordia sinensis* (Linn.), Salvadora oleiodes, and Ziziphus nummularia while, Prosopis juliflora appeared significantly less ($p>0.05$) preferred followed by *Calligonum polygonoides*, *Orthanthera viminea* and *Prosopis cineraria* (Fig. 2).

3.2 Surveillance of Camel Browse Vegetations and their Preference by Camels at Tando Allahyar

Camel browse vegetations noted during the interviews of camel herders at district Tando Allahyar are illustrated in the Table 2. Table indicates *Acacia nilotica*; *Trifolium alexandrinum; Ziziphus nummularia; Acacia jacquemontii; Prosopis juliflora; Alhagi maurorum; Prosopis cineraria; Salvadora oleiodes; Capparis deciduas; Suaeda fruticosa; Haloxylon salicornicum; Tamarix passerinoides; Zea mays; Tribulus terrestris; Melilotus parviflora; Brassica campestris commonly* browsed by camels at district

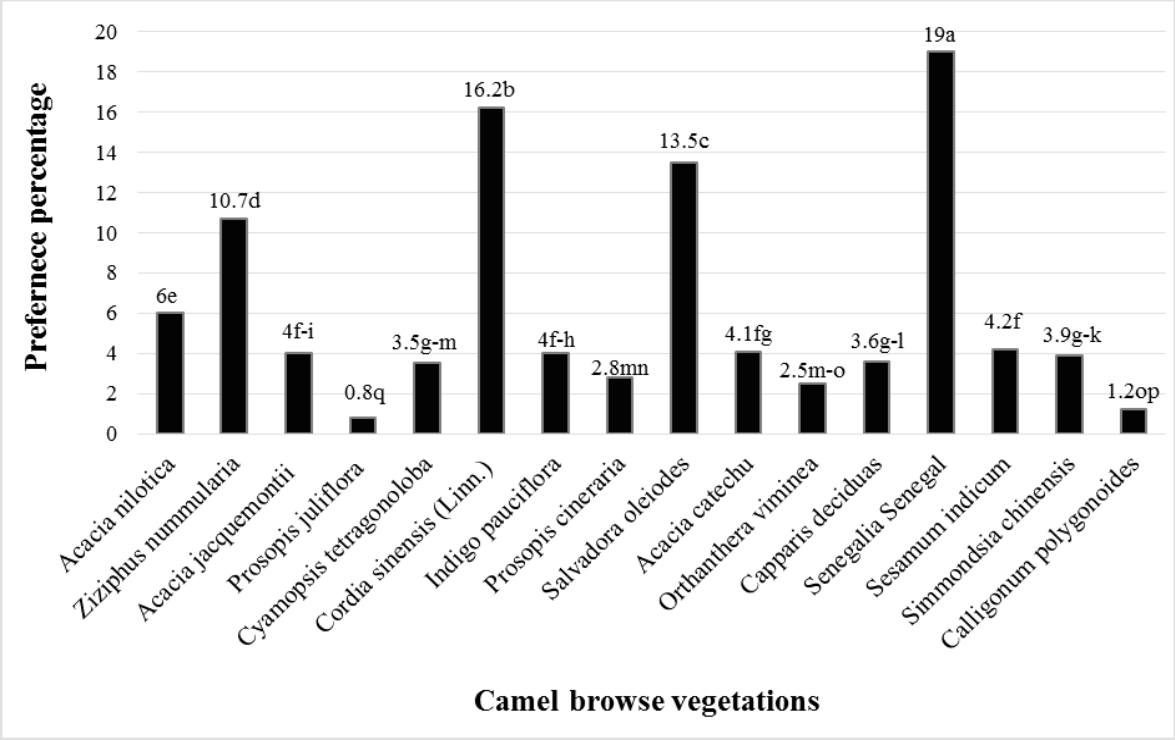

Fig. 2. Preference percentage of different camel browse vegetations at Mithi distirct (desert zone)

Table. 1. Survillence of camel browse vegetations at Mithi district (desert zone)

S. No.	Local Name	Botanical Name
1	Babur	*Acacia nilotica*
2	Ber	*Ziziphus nummularia*
3	Bhair/bairi	*Acacia jacquemontii*
4	Devi	*Prosopis juliflora*
5	Guar Kutti	*Cyamopsis tetragonoloba*
6	Jaar	*Cordia sinensis (Linn.)*
7	Jhil	*Indigo pauciflora*
8	Kandi	*Prosopis cineraria*
9	Khaber	*Salvadora oleiodes*
10	Khair	*Acacia catechu*
11	Khip	*Orthanthera viminea*
12	Kirir	*Capparis deciduas*
13	Kumbatt	*Senegalia Senegal*
14	Krur Kutti	*Sesamum indicum*
15	Morari	*Simmondsia chinensis*
16	Phog	*Calligonum polygonoides*

Table 2. Survillence of camel browse vegetations at Tando Allahyar district (irrgated zone)

S. No.	Local Name	Botanical Name
1	Babur	*Acacia nilotica*
2	Barseem	*Trifolium alexandrinum*
3	Ber	*Ziziphus nummularia*
4	Bhair/bairi	*Acacia jacquemontii*
5	Devi	*Prosopis juliflora*
6	Kandairo	*Alhagi maurorum*
7	Kandi	*Prosopis cineraria*
8	Khaber	*Salvadora oleiodes*
9	Kirir	*Capparis deciduas*
10	Lani	*Suaeda fruticosa*
11	Lano	*Haloxylon salicornicum*
12	Layee	*Tamarix passerinoides*
13	Makai	*Zea mays*
14	Mudhari	*Tribulus terrestris*
15	Sainji	*Melilotus parviflora*
16	Sarin/ Sarson	*Brassica campestris*

Table 3. Survillence of camel browse vegetations at Thatta district (costal zone)

S. No.	Local Name	Botanical Name
1	Babur	*Acacia nilotica*
2	Bago Lano	*Salsola foetida*
3	Barseem	*Trifolium alexandrinum*
4	Ber	*Ziziphus nummularia*
5	Chanar	*Ceriops tagal*
6	Chor	*Aegiceras corniculata*
7	Devi	*Prosopis juliflora*
8	Jaar	*Cordia sinensis (Linn.)*
9	Jhil	*Indigo pauciflora*
10	Kandairo	*Alhagi maurorum*
11	Khaber	*Salvadora oleiodes*
12	Kirir	*Capparis deciduas*
13	Kumri	*R.mucronata*
14	Lani	*Suaeda fruticosa*
15	Lano	*Haloxylon salicornicum*
16	Lao	*Tamarix orientalis*
17	Layee	*Tamarix gallica*
18	Makai	*Zea mays*
19	Timar	*Avicenia officinalis*

Tando Allahyar. However, their occurrence is seasonal. Among the above vegetations camel preferred significantly more ($p<0.05$) to browse *Salvadora oleiodes* followed by *Suaeda fruticosa*, *Haloxylon salicornicum* and *Acacia nilotica* and less the *Prosopis juliflora* ($p>0.05$), while *Tamarix passerinoides* followed by *Tribulus terrestris* and *Melilotus parviflora* were moderately preferred by camels (Fig.3).

3.3 Surveillance of Camel Browse Vegetations and their Preference by Camels at Thatta

Vegetations browsed by camels recorded during the interview of camel herders at district Thatta are mentioned in the Table 3. It was noted that the *Acacia nilotica, Salsola foetida, Trifolium alexandrinum, Ziziphus nummularia, Ceriops tagal, Aegiceras corniculata, Prosopis juliflora, Cordia sinensis* (Linn.)), *Indigo pauciflora, Alhagi maurorum, Salvadora oleiodes, Capparis deciduas, R.mucronata, Suaeda fruticosa, Haloxylon salicornicum, Tamarix orientalis, Tamarix gallica, Zea mays* and *Avicenia officinalis* were commonly browsed by camels at district Thatta. Among the all vegetations, *Cordia sinensis* (Linn.) was browsed significantly more ($p<0.05$) by camels followed by *Salvadora oleiodes, Suaeda fruticosa* and *Haloxylon salicornicum* and *Prosopis juliflora* preferred less ($p>0.05$). However, *Alhagi maurorum*, *R. mucronata* and *Avicenia officinalis* are preferred by camels at intermediate level (Fig.4).

4. DISCUSSION

Current study was conducted in order to monitor and assess different camel browse vegetations at Mithi (Desert), Tando Allahyar (Irrigated) and Thatta (Costal). Survey of above said districts was made, and the camel owners were interviewed to collect the data regarding the vegetations for camel browsing. At all three districts a total of 51 vegetations were recorded as being suitable for camel browsing though found 6 fold less than that of reported by Margaret [16], who noted 300 species of trees with potential use as fodder. Nevertheless, he only concentrated on a few (< 10) numbers of species. While in another study, 21 species of plants in the dry, and 30 in the wet season were reported as camel loving vegetations [17-18]. In the present study over camel favored vegetations *Senegalia senegal* at Mithi, Salvadora oleiodes at Tando Allahyar and *Cordia sinensis* (Linn.) at Thatta appeared most preferred and the *Prosopis juliflora* less favored. Reason behind prefer ability of camels towards these plants could be attributed with palatability, nutrients composition and availability of these vegetations. It could be noteworthy that frequent consumption of *Senegalia senegal* by camels might be due to its palatability which might be because of taste and nutrients composition, although *Salvadora oleiodes* and *Cordia sinensis* (Linn.) were also found in

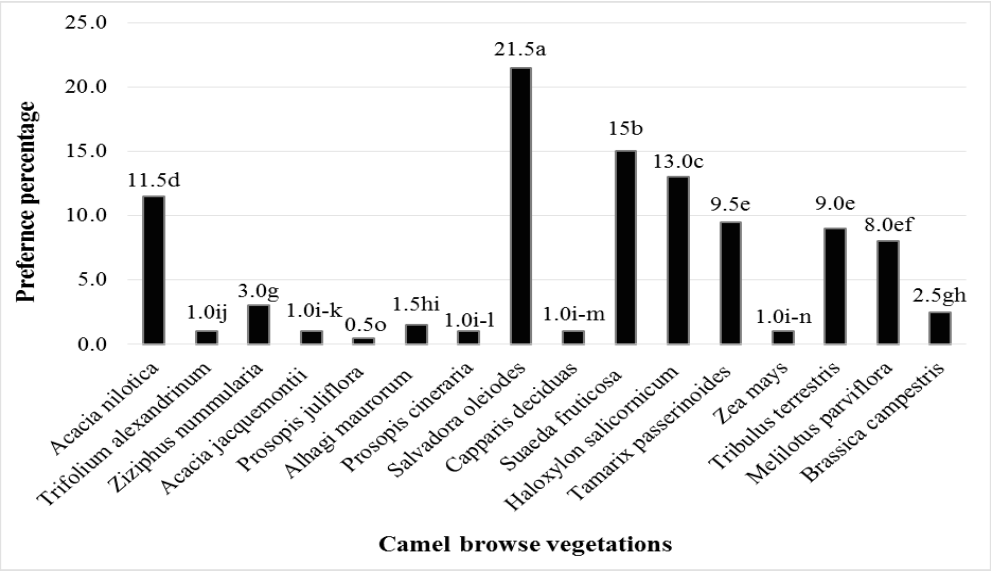

Fig. 3. Preference percentage of different camel browse vegetations at Tando Allahyar district (Irrigated zone)

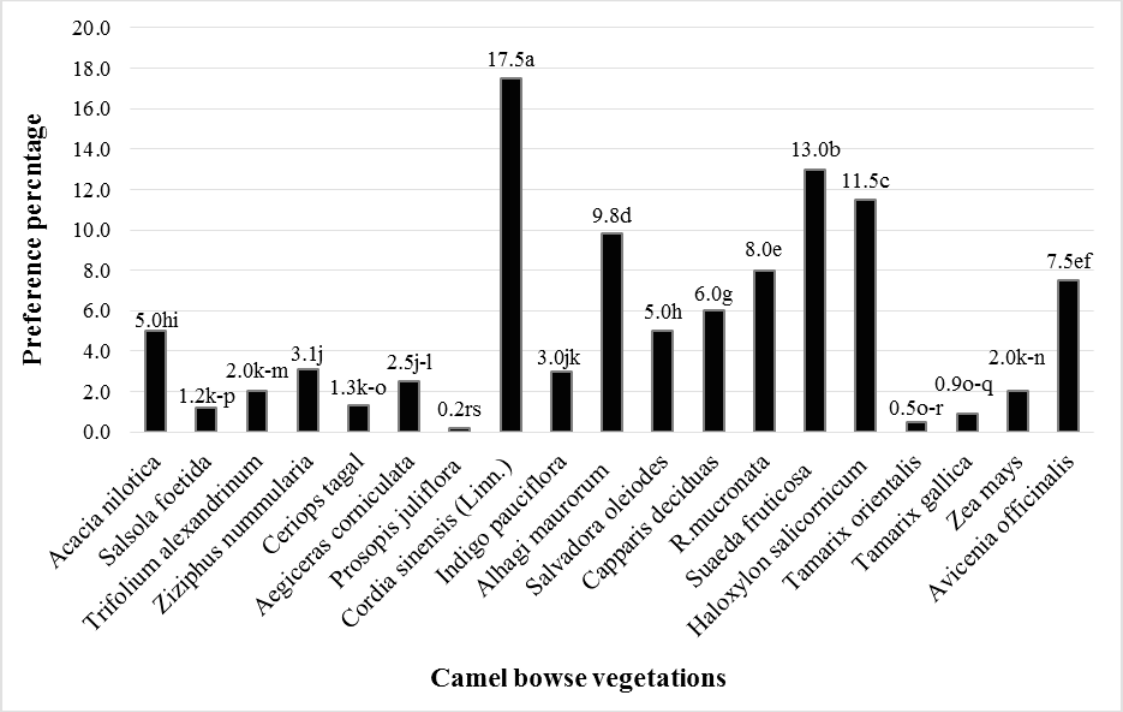

Fig. 4. Preference percentage of different camel browse vegetations at Thatta district (costal zone)

significant manner surrounding the area of Mithi. Further, *Senegalia senegal* rarely found at Tando Allahyar and Thatta, where *Salvadora oleiodes* and *Cordia sinensis* (Linn.) were most preferred vegetations for camels. It was interest to note that *Prosopis juliflora* was not most palatable vegetation for camels though its consumption proceeded only in scarce time when availability of other vegetations is limited. In contrast to present study, *Prosopis cineraria* and *Acacia nilotica* reported to be highly and *Haloxylon salicornicum* the less palatable camel browse vegetations investigated at Cholistan rangeland desert [8].

5. CONCLUSIONS

Current concludes that the coastal zone possess higher number of natural vagetations for camel browsing comparatively desert and irrigated zones. *Senegalia senegal, Salvadora oleiodes, Cordia sinensis* (Linn.) are the most favorite vegetations for camel at all zones but *Prosopis juliflora* is less preferred compare to all other vegetations.

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