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Assessment of the Food Base and Eating Behaviour of Camels in Different Regions of the World

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Abstract

Present study was planned in order understand the surveillance, browsing behavior and nutritive value of camel browse vegetations. Review of literatures indicated that camel is mostly found at arid and semi-arid areas of the world where average rain fall becomes less than 350 mm per year. The estimated population in the world is 19 million, among which 17 million are supposed to be one-humped dromedary camels (Camelus dromedarius) and 2 million two-humped Bactrian camels (Camelus bactrianus). There is limited documentation on the availability and distribution of camel brows vegetation. They prefer broad spectrum of fodder plants, including trees, shrubs, and sometimes hard-thorny, bitter and halophytic (salty) plants that grow naturally in the desert and semi-arid areas. In most of the cases camels preferr succulent feed to dry feed and leafy feed over stem feed. Browsing remains dominant activity during day time followed by walking, resting, ruminating other activities. Studies on nutrients composition showed that nutrients percent of camel vegetations vary with plant species and location. Prominent impact of location was noted on most of the nutrients of different vegetations in current study. The desert areas have negative effect on the moisture and positive on dry matter, inorganic matter and ether extract contents. The organic matters and crude protein contents are favored at irrigated arease, however nitrogen free extract, crude fiber and total carbohydrate contents are favoured by coastal as well as irrigated areas.

Keywords: Browsing; Habitat; Nutrients; Monitor

Introduction

The camel has a vital role in the subsistence economy of rural pastoral communities and are mainly used as pack/draft animal with milk, meat, hair and hides as minor by-products [1]. It has been estimated that total population of camels (dromedaries) in Pakistan is about one million that ranks Pakistan 8th in the world and 1st in Asia [2]. Camel population is unevenly distributed over the country mainly in the different ecological zones of Pakistan. The highest population of one-humped camels (dromedaries) is in Balochistan (41%), followed by Sindh (30%), Punjab (22%) and Khyber Pakhtunkhwa (7%). Camels have ability to survive in the difficult arid, drought-stricken areas and mountainous regions where the long-term survival of other livestock animals seems impossible [3]. Under transhumant and nomadic camel farming systems, camel has almost no competition for feed with other animals as it is a hardy animal and comparatively eats less. As, most of the time camels maintain themselves by browsing the tops of trees and shrubs thus camels contribute significantly to the food security of the farmer households in these regions [4].

Camels prefer to browse the broad spectrum of forage plants including trees, shrubs and hard-thorny, bitter and halophytic (salty) plants that grow naturally in the desert and other semi-arid areas. Diets of camels also include herbs, forbs and grasses [5]. More often camels tend to be non-selective in their diet during the wet season when forage is plentiful but it become indiscriminate in their forage choices during the dry seasons due to forage scarcity [6]. Under natural conditions, camels take the largest percentage of their diet from forage trees than grasses. These woody plants are mildly affected by seasonal variations, due to their extensive and deep root system and longer life spans and are consequently available all year round. They often bear green foliage even in the dry season, and/or highly nutritious flowers and fruits are available [7].

The camel forage preferences and nutritive value of consumed forages have been reported by many scientists throughout the world. Like other livestock, pasture preference in camels depends on the species present in the range, amount of forage available and the nutritional quality of the plant [8]. Additionally, the physical environment, plant environment and animal behavior all interact to

influence selection process during grazing. Environmental and anthropogenic factors influence the composition and structure of grazing land and thus affect the availability of forage for the livestock species. Moreover, information on forage availability, quality, composition, behavioral activities are important in understanding the camel forage relationship [9]. As nutritional requirement of camel influences the production and performance of camels, therefore understanding the camel forage array is of utmost importance for the growing sphere of camel herders in the world. Keeping in view these fact in mind current review was planned in order to focus surveillance, browsing behavior and nutritive assessment of camel browse vegetations worldwide.

Habitat and Browsing Behavior of Camels

Camel habitation is mostly found at arid and semi-arid areas of the world where average rain fall becomes less than 350 mm per year. The estimated population in the world is 19 million among which vast majority (about 15 million) is being reported in Africa and in Asia (4 million). Among estimated world population, 17 million are supposed to be one-humped dromedary camels (*Camelus dromedarius*) and 2 million two-humped Bactrian camels (*Camelus bactrianus*). Somalia (with over 6 million camels) has the largest camel population in the world, perhaps representing one-third of all dromedary camels [10]. It has been reported that the Somalia, Sudan, Ethiopia and Kenya have a combined camel population (99%) of the camels in the Greater Horn of Africa (GHOA), 97% of all camels in Africa and 75% of all camels in the world. Habitation of camels in varying number also reported at North African countries (Morocco, Libya, Tunisia, Algeria, Mauritania, Niger, Mali). In Asia, camels are mainly found in the middle-eastern countries of Saudi Arabia, Jordan, Syria, UAE, Iraq, Yemen, Oman, Lebanon, and also India and Pakistan [11].

In Pakistan, camel (dromedaries) population is estimated as 1.2 million heads. And Pakistan teems with highest population of one-humped camels (dromedaries) spread over Baluchistan (41%) followed by Punjab (27%), Sindh (25%) and NWFP (7%), while a few herds of two-humped camels (Bactrians) are also habitat at extreme northern areas. However, most of the camel population existed in mainly four distinct ecological zones of Pakistan i.e. Mountainous tracts (all of Baluchistan, the D.G. Khan and D.I. Khan districts of Punjab and NWFP, respectively), Irrigated plains (all irrigated districts of Sindh and Panjab), Sandy deserts (Cholistan and Thal in the Punjab and Thar in Sindh) and Costal mangroves (Thatta, Badin and Karachi districts of Sindh) [12]. It has been reported that in Panjab Province most of the camel herders kept Marecha, Campbelpuri and Brela camel breeds at Faisalabad, Attock and Bhakkar zones, where their major source of income were sale of milk and meat, sale of animals and crop cultivation.

Figure 1: Camels browsing the natural vegetations in costal area

Figure 2: Camel browsing the natural vegetations in desert area

Majority of the herders kept their camels in open air system and take their camels for grazing from morning till evening at all the zones; however, at Faisalabad zone comparatively the trend of supplementation was more [13]. Figures 1 and 2 showing the camels browsing some natural vegetations. Feeding behavior (plant species preference) and chemical composition of the preferred plants is very important to know the biological availability of the feed stuffs and the efficiency of the camel to digest them. Understanding the foraging behavior of camels is very essential in order to predict its impact on the vegetation and their nutrient requirements [14]. The digestive system of the camel (Tylopoda) lacks omasum but the rumen contains glandular sacs having similar function like omasum and that make the camel different from the true ruminants. Camels have ability to utilize protein from low quality plants better than sheep and goats due to urea recycling. Very limited studies have been conducted on feeding behavior in Pakistan, however; it is well studied in other parts of the world [15]. Various studies have reported on different aspects of the browsing behavior of the dromedary camel (*Camelus dromedarius*). According to the reported a study dromedary camel consume 1.4 to 12.5 kg dry matter and are selective browsers that move up to 70 km daily to obtain forages instead of focusing any single area [16]. 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 found rapid where preferred or selected browse are plentiful but are much slower on thorny species having little leaves. Feeding times required may be 15 or more hours/day, as recent studies have shown that the total dry matter intake needs to be about 4 percent of the body weight. Camels rarely overbrowse and 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. They obtain approximately 44 percent of their feeding requirements from forages averaged over the whole year [17]. In another study it was reported that the heat exposure did not affect the basal metabolic rate and feed intake of the camel. Under dry climate conditions, camels were able to maintain their appetite up to 15 percent of body weight loss and allow their basal metabolism to decline for maintaining the positive energy balance. Compared to adults' young camels spent more time on browsing. While adult camels spent more time on resting and other activities compared to the young camels in eastern Ethiopia [18].

Browsing was the dominant activity during day time followed by walking, resting, ruminating other activities. Significantly less time was spent on feeding and walking during the green season compared to the dry season. On the contrary, idling and ruminating times were significantly higher during the growing season contrast to the dry season. Feeding patterns dovetailed seasonal changes in forage quality. Feeding time was significantly negatively correlated with the dietary CP and DMD levels but significantly positively correlated with NDF, ADF and ADL [19]. Another study conducted in inner Mangolia, indicated that browsing time spent by Bactrian camel was 10.3, 12.2, 11.4, and 12.0 hours during winter, spring, summer, and autumn season, respectively. Total rumination time among all seasons was longer during autumn than spring and summer season [20]. Other study conducted on five camels fed on a hay-based diet on stall feeding, revealed 8.3, 5.6 and 10.1 hours/ 24 hours rumination, feeding and resting duration, respectively. The camels spent 29% of their time for eating, 32% resting and 39% ruminating. However, 97% of the eating activity occurred in the day time against 44.4% ruminating and 45% resting [21]. Study conducted in Balochistan revealed that camels take 30 to 70 of their diet from the rangelands while average daily intake was 6 to 7 kg dry matter. In the same province, camels thrived for months by eating only 5 kg dry matter/day. Starvation and malnutrition of animal is probably not an important factor for mortality issues of camels, as it is in small ruminants often fall substantially in dry years such as 1987-88 [22].

The feeding behavior of young and adult female camel in the canal irrigated areas under stall-feeding was investigated where camels were fed on unconventional feed resources comprising of tops of carrot, potato and spinach. They reported that animals preferred succulent feed to dry feed and leafy feed over stem feed. However, there was comparatively more selection for feed in adult females as compared to young animals (70 vs. 63.33%). The Frequency distribution regarding herd matesí behavior indicated that for most of the time, animals showed unresponsive behavior (81.11%), irrespective of the age factor towards the activities of other herd mates. The animals did not pay attention to other animals of the herd while feeding. Both in case of adult female and young animals there was pronounced unresponsiveness towards the other herd mates (83.33%) and this figure was still high (76.67%) when compared with the behavior of senior members (adult females) of the herd to junior (calves) at feeding time [23]. The feeding behavior of camel in Raya-Azebo district was searched for browsing at distant fields. In that environment, the camels were mostly reared on range land areas (92.5%). Only few herders (22.5%) used to purchase feed for their animals although they gave them mineral salts as supplementary feed (69.1%) at home or resting focal sites in the field, particularly in the dry season when camels were fed only on succulent feed during wet season of the year. Unherded and migratory form of the herders was reported to be common during the dry season. In their findings, they reported that camels were move freely to the range land moving from one place to the other without restrictions during the dry season in areas of northern Kenya [24].

The camel prefers broad spectrum of fodder plants, including trees, shrubs, and sometimes hard-thorny, bitter and halophytic (salty) plants that grow naturally 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 [25]. Feeding observations in five different range types in Marsabit County of northern Kenya indicated average composition of camels' diet as: Trees (25%), Dwarf shrubs (50%), Herbs (14%) 16 and Grasses (11%). The predominant forage species consumed by camels in northern Kenya included *Acacia, Cordia, Duosperma, Euphorbia, Grewia, Indigofera* and *Salvadora* [26]. It was reported that during wet season the dominated diet for camel browse are trees, shrubs and dwarf shrubs while their percentage noticeably declined during the dry season when most of these species shed off their leaves. During drought season, there was a tendency for camels to concentrate on evergreen shrubs and trees such as *Dobera glabra, Salvadora persica* and *certain Euphorbia species* [26]. In a study conducted it was stated that 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 nutrient intake [27]. However, according few others, camels' total dry matter intake needs to be about 4% of body weight and that feeding times required to satisfy this requirement may be as much as 15 or more hours per day. Consequently, a mature camel weighing 650 Kg would require about 26 Kg of dry matter, which might represent between 80 and 100 Kg of total food intake of plants with high moisture contents [28]. In Pakistan, camel generally depends on the natural grazing rangelands for feed. They are fed green fodder and hay straw in the irrigated plains along with concentrate feed. In mountainous areas top feeds like *Acacia nilotica, Morus alba, Zizyphus jujuba* etc are also offered. Vegetations preferred by camels are generally high in moisture, Nitrogen, electrolytes and oxalates. *Acacia, Balanites, Salsola* and *Tamarix* are important constituents of the dromedary camels' diet wherever these plants are found [29]. There is a common saying in Rajasthan for camel and goat feeding that the camel eats everything except Aak (*Calotropis procera*) but the goat eats everything except Dhak (*Butea frasdosa*). Generally, camels eat such species of plants which are rich in moisture content such as *Prosopies sineraria, Zizyphus nummularia, Callygonum polygonodes* during summer season, while during the rainy season the plants though are high in electrolytes and oxalate content like *Capparis deciduas* and *Lasirus sindicus* are preferred. Experimental study showed that the camels selected a total of 30 species in the wet and 21 species of plants during the dry season. On average, 0.79 and 0.83 of the camels' diet was comprised of perennial woody plants in the dry and wet season [30].

In another study at Cholistan rangeland desert palatability potential of natural browse vegetations were investigated. *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. They also noted that the camel preferred different parts of plants like leaf, shoot, flower, and fruits. Forage quality assessment indicated significant differences ($p<0.05$) in nutrients values among preferred species. The mean values for dry matter, crude protein, ether extract, crude fiber, total ash, nitrogen free extract, neutral detergent fibers, acid detergent fibers, hemicellulose and acid detergent lignin were found 93.58, 11.54, 1.87, 4.36, 13.44, 48.79, 40.17, 23.47, 16.70, and 7.22%, respectively which indicate fair level of nutrients. This preface study has shown that identified browses have good palatability and feeding potential for camels in the arid rangelands of Cholistan [31]. Further it was observed that dromedaries take as much as 90% of their diet from browse plants, many of those were being leguminous trees, shrubs and salt bushes. Feeds selected by camels were usually high in moisture, Nitrogen, electrolytes and oxalates [32]. In an Australian study it was stated that *Euphorbia tannenis* & *Trichodesma zyelanicum* as the preferred camel's plants [33], while few others reported *Aristida adscension* and *Deuosperma eremophiluim* as preferred by camel browse vegetations at East Africa [34]. In another study a researcher revealed that *Acacia prosopis, salvadora, wild olive, zizyphus, indigofera,* salt bush, green fodders and dry forages (straws) were the camel liked plant at India. In Kuwait, *Rhanterium eppaposum, Penicum turgidum, Haloxylon salicornicum* and *Sovignia perviflora* appeared the ice cream species for camel [35]. Furthermore, some oether researchers indicated that the highest percent of bite counts for dwarf shrubs especially in Kargi and Korr in the wet season, while herbaceous and grass species were more preferred by the camels during the dry season. Shrubs had the highest percent of bite counts in both dry and wet seasons in Ngurunit. Whereas forage species like *Indigofera spinosa* and *Duosperma eremophilum* were browsed in significant amounts during both dry and wet seasons in all the study vicinities. *Heliotropium studineri* and *Cordia sinensis* were grazed during dry and wet seasons in Korr and Ngurunit, respectively. The rest of the forage species were either eaten during dry or wet season in some of the sites [36].

Study conducted on the effect of age, sex and seasonal variation on forage preference of camel at Sudano-Sahelian zone of north western Nigeria. Few others reported that the matured camels consumed mostly diversified, thorny and taller plant species which might not be easily accessed by the camel calves. They recorded *Leptadania hastata* as the most preferred vegetation during the rainy season, while *Ziziphus mauritiana* during dry season with mean feeding time of 87.33 and 46.66 min/day, respectively. However, the least preferred forage during the rainy and dry seasons were *Acacia sieberiana* and *Bauhinia rufescens* with mean feeding time of 0.11 and 15.00 min/day, respectively [37]. In another study it was 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 [38]. Some other authors reported that camels' inclination towards these woody plants stems is due to their anatomical traits such as the mobile and prehensile split

upper lips, the long tongue, the stretched neck and extended heads. These make them preferentially browsers than grazers [39]. In another study it was reported the browsing preference of 240 camels to measure time spent feeding on different plants. Each camel was followed for a maximum of 3 min in both the wet and dry season. The camels preferred a total of Twenty One species of plants in the dry and Thirty in the wet season an average, 0.79 and 0.83 of the camels' diet was comprised of perennial woody plants in the dry and wet season, respectively and the Ten most preferred vegetation species occupied 0.87 and 0.80 of the total feeding time in the dry and the wet season, respectively. The highest ranked plant was *Opuntia* (0.18) in the dry season and *Acacia brevispica* (0.22) in the wet season. Birhane et al. (2014) at Aba'ala District, Afar Regional State of Ethiopia reported Acacia oerfota as ranked first (3.77) followed by *Acacia etbaica* (3.88), *Balanites aegyptiaca* (4.55) and *Acacia mellifera* (4.88) camel browse vegetations [40,41]. The dominant species in the area were *Acacia oerfota*, *Acacia mellifera* and *Acacia tortilis* [42].

Figure 3a: Some common camel browse vegetations

Tamarix passerinoides	*Alhagi maurorum*

Acacia jacquemontii	*Ziziphus nummularia*

Figure 3b: Some common camel browse vegetations

Zea mays	*Trifolium alexandrinum*

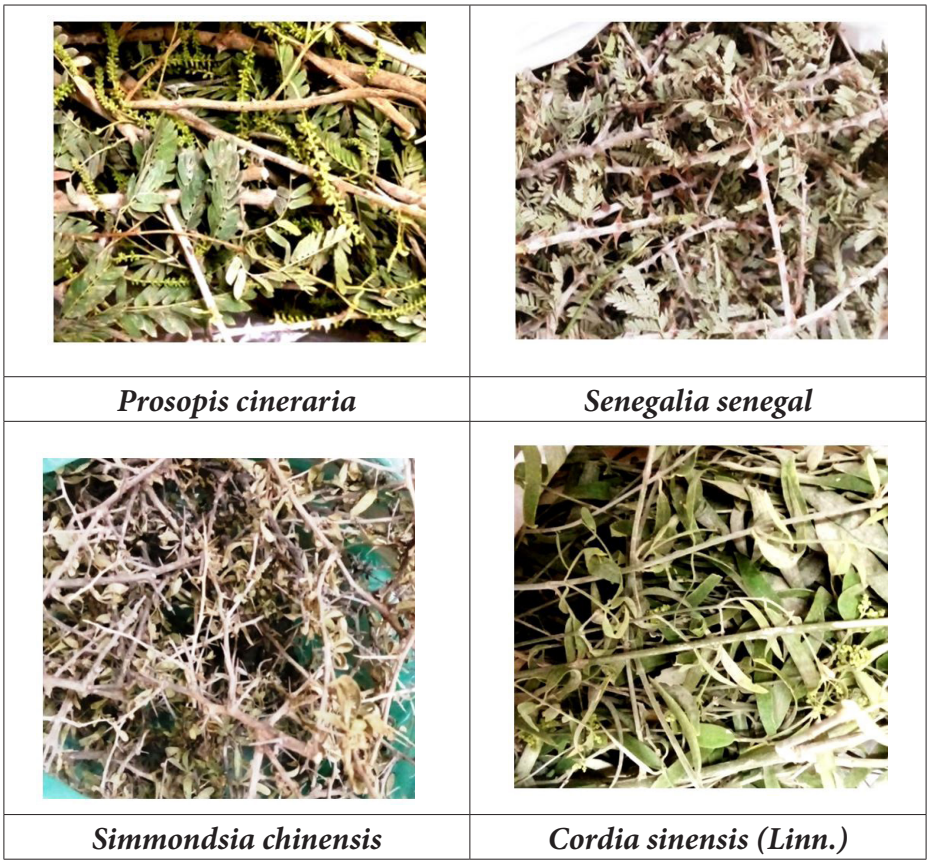


Figure 3c: Some common camel browse vegetations

Surveillance of Camel Browse Vegetations

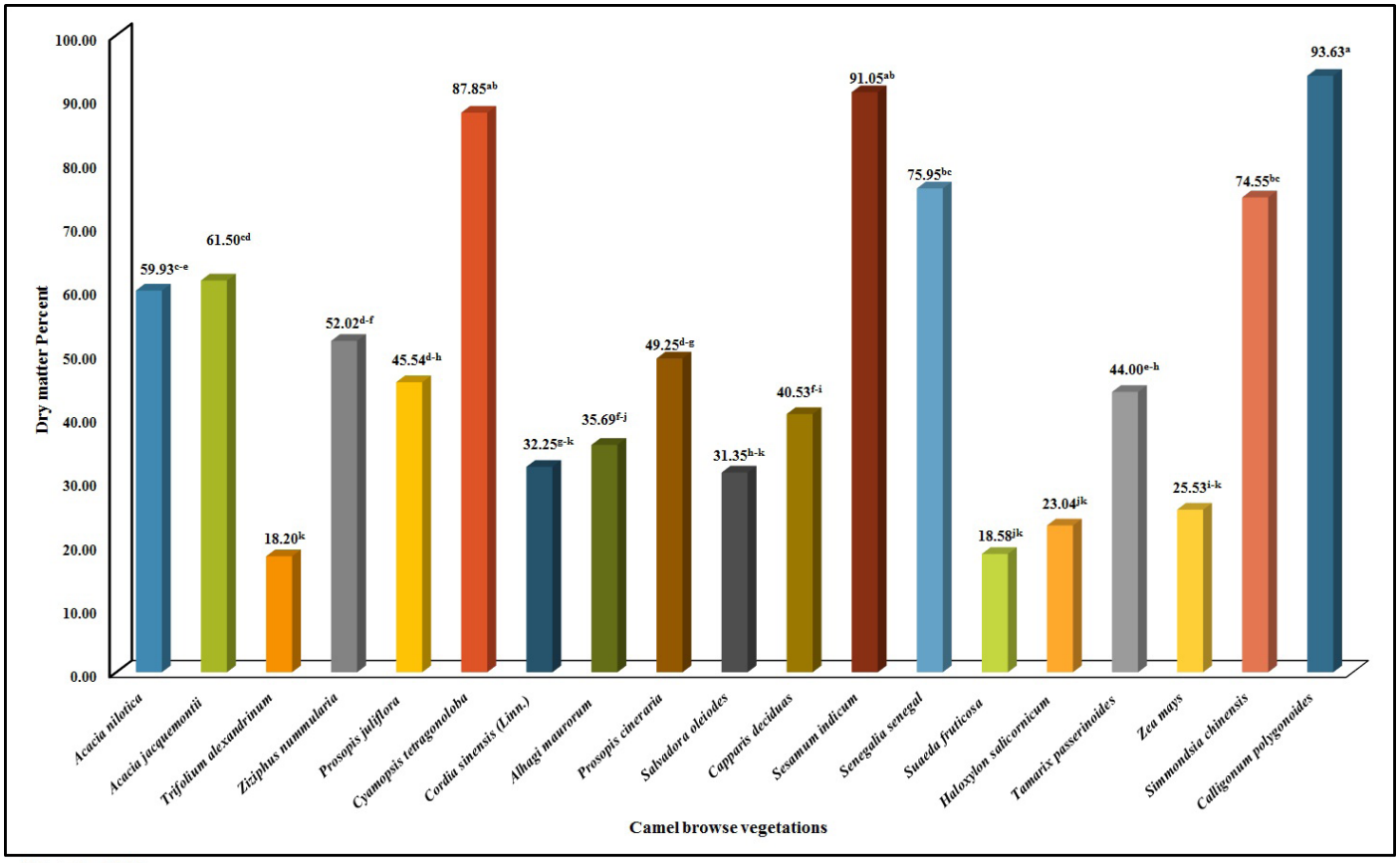
There is limited documentation on the availability and distribution of camel brows species. In Karamoja sub-region in Uganda, a wide range of plant species were reported to be preferred by camels i.e. 50 in Moroto and 63 in Amudat districts respectively, with several *Acacia Balanites, Euphorbia* species taking primacy [43]. Some other reseacrhers reported more than 300 species of trees with potential use as fodder but research has concentrated on a few (< 10) numbers of species only [44]. According to few other researcheres, out of more than 5000 trees and shrubs listed as being suitable for feeding livestock in Africa, only 80 are of real fodder value while five may be recorded as good. This probably underscores the lack of information on the values of many of these local trees and shrubs. Surprisingly little is known about most of the traditionally utilized indigenous forage species [45]. In another it was identified potential browse species at Hamelmal area of Eritrea for sustainable camel production. A total of 22 household from 4 districts at Hamelmalo were interviewed to identify locally important browse species. Thirty-One different browse species were identified, which were commonly used by camels for feeding. The most widely utilized browse species as indicated by the interviewed herders, were Acacia Albida, Acacia etbaica, Cadaba farinose and Salvadara persica (95.5%) followed by Acacia tortilis (90.9%); Acacia Senegal, Acacia laeta, Balnites aegyptica, Albizia amara, Capparis deciduas, Dalbergia melanoxylon, Ziziphus spina-christi (86.4%); Adansonia digitata (81.8%); and Dichrostachys cinerea, Tamarindus indica, Dobera glaba and Olea europaea (77.3%) were vegetations which are commonly used by camels [46]. Another author documented Acacia asak, Acacia lahai, Balanites aegyptiaca, Terminalia brownie and Ziziphus spina-christi the most commonly utilized and distributed browse species in the Deberke district of northern Ethiopia [47]. From mid rift valley of Ethiopia a researcher reported *Acacia tortilis* (95.8%), *Balanites aegyptica* (79.2%), *Ficus gnaphalocarpa* (77.5%), *Olea europaea* (77.3%), *Grewia bicolour* (75.0%) and *Dichrostachys cinerea* (70.0%) species for camel feeding while Beyene, (2009) in south western Ethiopia indicated, *Acacia seyal Bauhinia farea, Deinbollia kilimandscharica, Grewia ferruginea, Rhus natalensis* as the common browse species in the Gembella region [48]. Figure 3a, 3b and 3c is showing some common camel browse vegetations.

Nutritional Variation in Camel Browse Vegetations

A wide range of non-conventional vegetations are found in camel habitat regions. Some of them are screened in Land for their nutritional quality. Study showed that nutrient compositions of these vegetations varied plant to plant. Chemical composition of many feed stuffs has been analyzed from different ecosystems in the Arab region in Asia and Africa. In India, nutritive value of green loucern fodder and different tree leaves for camel were analyzed in north semi-arid zone. They suggested that tree leaves were palatable to camel and can serve as good and nutritive fodder [49]. It has been reported that there was significant variation in dry matter (DM) between *C. gayana* (11.38%) and *C. dactylon* (28.36%), while crude protein (CP) in *C. ciliaris* (11.3%) varied from *P. colunum* (7.90%). Higher ash content (13.70%), hemicellulose (28.5%) and NDF (70.7%) contents were notified for *C. dactylon*. Gross energy value

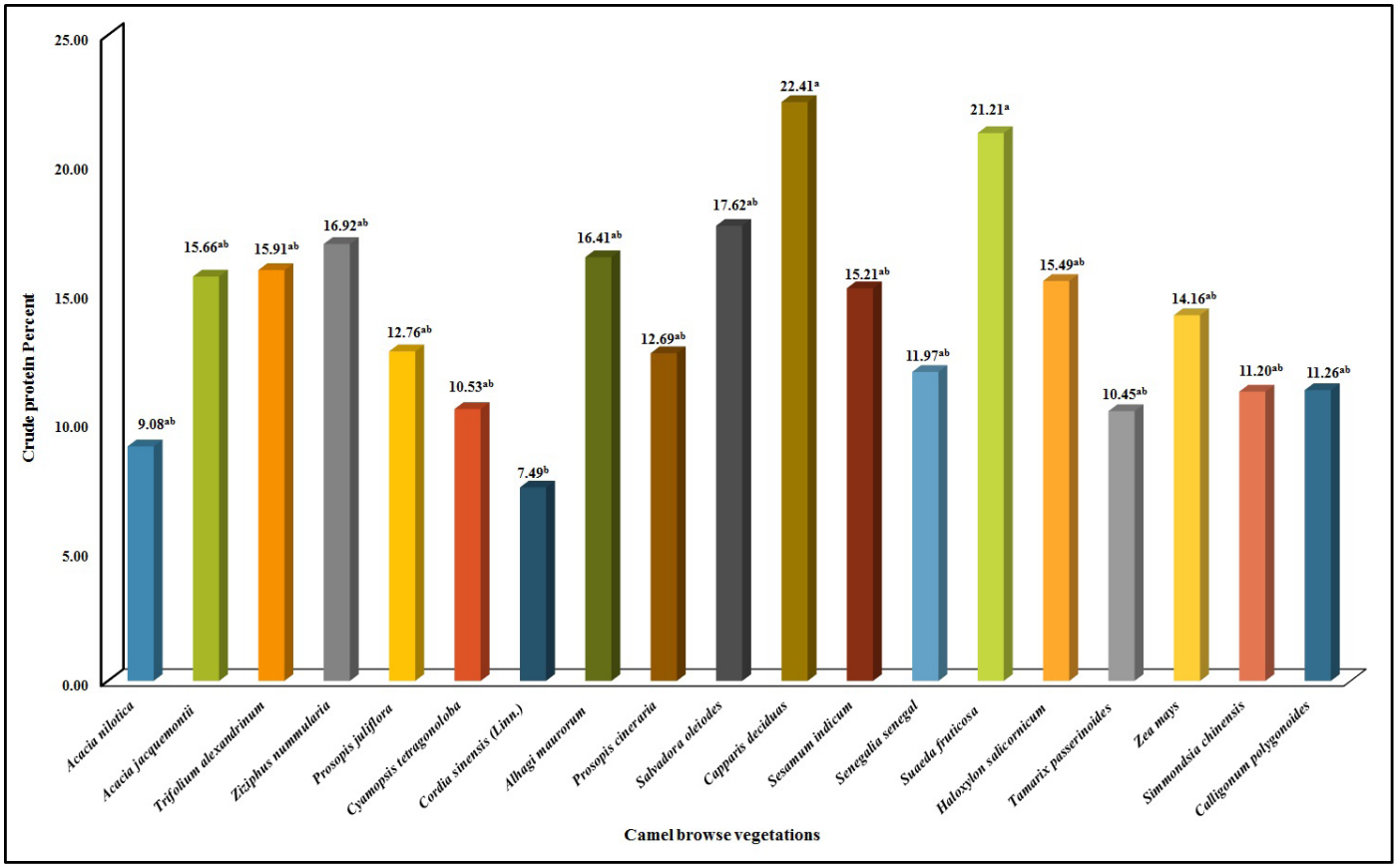
was optimum (3412.2 Kcal/kg) for *C. gayana* but minimum (2812.1 Kcal/kg) for *L. fusca.* Maximum in-situ DM digestibility (73.3%) and NDF digestibility (62.67%) were reported for *C. ciliaris,* while minimum in-situ DM digestibility (32.8%) and NDF digestibility (27.37%) were in *L. fusca* (Manzoor *et al.* 2013). Further, compositional variation in some fodder species from Harboi rangeland, Kalat, Balochistan was also reported whereby grasses found high in DM, CF, carbohydrates, NFE, NDF, ADF and hemicelluloses than shrubs, and vice versa for CP, EE, N, GE, ADL contents. There was no significant difference in TDN, DE and ME between grasses and shrubs. However, there were increase in DM, CF, NDF, ADF, ADL, carbohydrate and hemicellulose content decrease in ash, CP, EE, N and ME with maturity of plants. Some parameters like NFE, GE, DE and TDN did not differ among various phenological stages [50].

Moreover, the variations in nutritive value of locally available 10 free rangeland grasses identified in valley of Chagharzai in Bunair district, Malakand Division (NWFP) were reported varied in different stages. At early bloom stage, the average percent of dry matter (DM), organic matter (OM), ash, crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), hemicellulose and lignin were reported as 33.1±0.69, 30.6±0.55, 7.4±0.42, 7.8±0.33, 54.7±2.08, 24.7±0.89, 30.0±2.11 and 3.9±0.22%, respectively, and at mature stage these were reported to be 43.6±1.03, 41.4±0.86, 7.1±0.42, 5.5±0.25, 61.9±1.44, 29.4±1.16, 31.5±2.14 and 4.7±0.17, respectively. In free grazing rangeland grasses the highest potential intake rate (PIR) was reported for *Heteropogon contortus* (53.80±15.82 g/4 minute) and lowest for *Cymbopogon schoenanthus* (35.8±12.16 g/4 minute) [51]. In another study on nutritional composition of some top fodder tree leaves and shrubs of district dir (lower), Pakistan was carried by Khan, (2014). A total of 13 tree leaves, shrubs and browse plants such as *Eleusine coracana*, *Cyperus rotundus, Sorghum halepense, Tike mimosa, Populus Euphratica, Morus nigra, Sorghum bicolor, Oryza sativa, Prunus persica, Cynodon dactylo,* Cotton seed cake, *Ficus carica* and wheat straw were identified and analyzed for proximate composition. The dry matter, crude protein and Ash contents of the foliages varied from 88.45 to 96.26, 6.90 to 26.68 and 4.64 to 21.90% respectively [52]. Few other assessed the nutritional composition of some indigenous and exotic rangeland grass species. Ten (n=10) native and exotic grass species were analyzed to find the different nutritional characteristics such as moisture, protein, crude fiber and ash content on dry matter percent basis in the field area of department of Forestry, Range Management and Wildlife, UAF. Higher moisture percentage was reported in *P. purpureum* (79.42), while minimum moisture percentage recorded in *F. arundinacea* (20.86), Maximum and minimum ash content was noted in *C. ciliarus* (10.62%) and *L. codensatus* (4.39%), respectively. Higher concentration of crude protein was recorded in *B. pertursa* (9.70%) and lower was reported in *L. codensatus* (3.05%). Mean maximum and minimum crude fiber percentages were depicted in *B. pertursa* (29.83) and *C. gayana* (0.56) respectively. They further reported that *B. pertursa* can be a useful supplement for the maintenance and enhancing the livestock productivity because it has higher crude protein and fiber percentage [53]. Figures 4,5 and 6 are showing nutrients variation among some common camel browse vegetations.



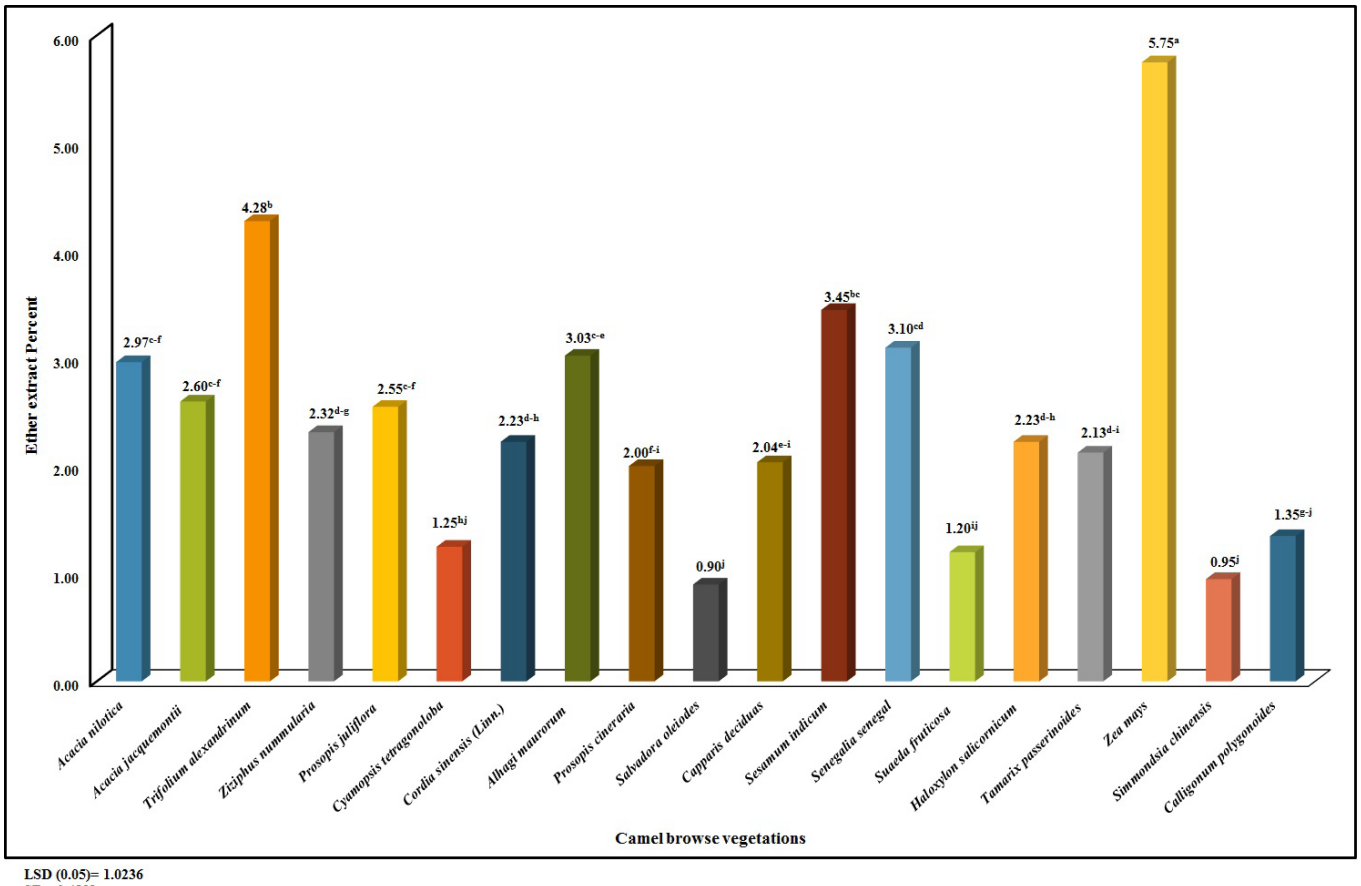
LSD (0.05)= 17.279
SE± 8.2555

Figure 4: Variration in dry matter content among some camel browse vegetations



LSD (0.05)= 13.593
SE± 6.4944

Figure 5: Variration in protein content among some camel browse vegetations



LSD (0.05)= 1.0236
SE± 0.4891

Figure 6: Variration in ether extract content among some camel browse vegetations

Nutrients compositions of *Cenchrus ciliaris, Leptochloa fusca, Chloris gayana, Cynodon dactylon* and *Panicum colunum* grasses were evaluated in a study conducted by [54]. They found that dry matter (DM) content varied from 11.38 to 28.36% in *C. gayana* and *C. dactylon* respectively. Maximum crude protein concentration (11.3%) was recorded in *C. ciliaris* while minimum (7.90%) was in *P. colunum*. Higher ash content (13.70%), hemicellulose (28.5%) and Neutral detergent fiber (70.7%) contents were observed in *C. dactylon.* Gross energy value was optimum (3412.2 Kcal/kg) for *C. gayana* but minimum (2812.1 Kcal/kg) for *L. fusca*. Another author reported nutritive value of some vegetations for dromedary camels in Iran. Several plants species such as *Alhagi persarum, Artemisia seiberi, Atriplex letiformis, Hammada salicornica, Haloxylon ammodendron, Saueda fruticosa, Salsola tomentosa, Salsola yazdiana, Seidlitzia rosmarinus, Tamarix kotschyi* and *Tamarix aphylla* were focused. Nutrients composition of samples included Dry Matter (DM), Crude Protein (CP), Crude Fiber (CF), Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), Ether Extract (EE), Total Ash (TA). The highest CP (18.3%) and the lowest NDF (40.4%) and ADF (35.4) were recorded in *Tamarix aphylla*, however in *Artemisa sieberi* lowest CP (5.5%) and highest NDF (72.8%) and ADF (59.6%) were observed [55]. Some other researchers reported nutritional composition of some forage species consumed by one-humped camels (camelus dromedarius) in the sub-humid region of Nigeria know as Zaria. The nutritional compositions of leaves from eight different forage species like *Dalbergia sisso, Ziziphus mauritania, Khaya senegalensis, Lephatadenia hastala, Ziziphus var-spinachristi, Acacia hoskii* and *Dichrostachys cineria* was assessed in term of dry matter, crude protein, crude fiber, ether extract, neutral detergent fiber, Acid detergent fiber and Nitrogen free extract. The dry matter level of the selected forage plants ranged from 94.99 to 97.34% and 89.72 to 97.77% with a mean value of 96.42 and 94.55% in wet and dry season, respectively. The crude protein content ranged from 9.44 to 23. 56% and 9.21 to 18.87% with mean value of 16.99 and 15.27% in wet and dry season, respectively. The ash contents varied from 4.23 to 7.99% and 3.49 to 6.28% with a mean of 5.98 and 4.84% in wet and dry season, respectively. The ether extract content obtained in this study was in between 0.94 to 7.96% and with the mean value of 4.18% in the wet season and 1.03 to 7.66% with a mean of 4.04% in dry season. The crude fiber content ranged from 26.54 to 38.22% and a mean value of 31.21% in wet season and 22.63 to 36.40% with the mean value of 28.8% in dry season.

In Semnan Province of Iran, the chemical composition of nine different plants species for dromedary camels were studied by [56]. They reported the order of usefulness of plants as *Salsola arbuscula, Seidlitzia rosmarinus, Suaeda fruticosa, Alhagi camelorum, Haloxylon ammodendron, Halostachys spp., Tamarix tetragyna, Tamarix stricta* and *Hammada salicornica.* No correlation was observed between the organic matter digestibility in dry matter and chemical composition, and there was no consistent relationship between either of these variables and palatability. The highest crude protein content was reported in *Alhagi camelorum*, and the lowest fiber content (NDF, ADF) in *Haloxylon ammodendron*. The lowest crude protein was recorded in *Hammada salicornic*a, and the highest fiber (NDF, ADF) in *Halostachys spp*. Furthermore, nutritive value of 109 camel browse forage species were examined by [57] from marsabit district, Kenya for crude protein; Ash and fiber content. The mean crude protein and neutral detergent fiber concentration in preferred forages species were found as 13.9+5.0 and 53.6+13.7 of dry matter (DM), respectively. Fiber content of the forages declined; however crude protein increased from dry to wet season. Shrubs were lower in Neutral detergent fiber (51.0+12.6%) and ash content (15.5+7.2%) and higher in dry matter (50.0+18.2%) and crude protein (14.7+4.9%) compared to grasses (NDF = 60.4+14.3%, ash = 18.5+5.2%, DM = 49.7+17.8%, CP = 12.0+5.0%).

Nutritive compositions of different rangelands at Southern Darfur, Sudan have also been studied by [58]. Eleven range forages were focused at their flowering stage and their chemical composition was checked accordingly. The crude protein (CP) concentration was recorded as 6.8% in *Oxygonum atriplicifolium* with lowest digestible crude protein (DCP) 2.8% while in *Zornia diphylla* highest DCP (11.73%) was observed. The highest crude fiber (CF) value was seen in *Commelina spp* (56.4%) while lowest in *Sesamumalatum* (25.9%). Neutral detergent fiber values were maximum and minimum for *Zorniadiphylla* (44.9%) and *Alysicarpus glumaceus* (35.3%), respectively. The total digestible nutrients (TDN) were found 57.1% in *Blepharis linariifolia* and 69.3% in *Tribulus terrestris* with highest digestible energy (DE) in later while the lowest DE was noted in *Commelina spp* (2.4%). Moreover, nutritive value of camel browse species in the rangelands of Afar, Northern Ethiopia was studied by Birhane *et al.* (2014). They reported 35.52% dry matter, 10.79% crude protein 27.67% ADF, 20.1 4% Crude fiber and 5.16% Fat in young *A. mellifera* while in old their reported dry matter, crude protein ADF, crude fiber and Fat percentage were 52.26, 11.56, 17.20, 16.81, and 5.77%. Regarding *A. oerfota* they revealed 28.51% dry matter, 17.91% crude protein, 20.85% ADF, 17.58% crude fiber and 11.22% fat at young stage, however at older stage they recorded 30.39, 23.12, 21.22, 17.44 and 13.15% dry matter, crude protein ADF, crude fiber and fat, respectively [59].

Conclusions and Recommendations

Study themed that camel is the most neglected animal in the world. This animal has ability to survive in sandy desert, irrigated and coastal areas. A large number of natural vegetations have been recorded at camel habitat regions of the world and their nutrients composition and browsing preseferance vary with plant to plant and location to location. *Acacia nilotica, Ziziphus nummularia, Acacia jacquemontii, Cyamopsis tetragonoloba, Cordia sinensis Linn., Prosopis cineraria, Salvadora oleiodes, Capparis deciduas, Senegalia senegal, Sesamum indicum, Simmondsia chinensis, Calligonum polygonoides, Suaeda fruticosa, Haloxylon salicornicum, Tamarix passerinoides* were recorded as most common vegetations for camels, however *Senegalia senegal, Cordia sinensis Linn., Prosopis cineraria, Salvadora oleiodes* and *Acacia nilotica* are the vegetations which camel prefer most.

On the basis of findings of present review, it is recommended to investate the preference of camels towards some specific vegetations. Application of modern education tools should be launched at door-step for camel herders to reduce the illiteracy at camel habitat areas of the world regarding the camel browse vegetations. Further efforts should be taken towards improvement of quality characteristics of camel browse vegetations at sandy as well as at coastal mangroves camel habitat areas.

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