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# Desert Dwelling Trees: Forage Suitability and Ethnobotany, Pakistan

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## Abstract

Phytochemicals are primary and secondary compounds naturally occurring in the plants and trees that have defensive and protection mechanism from various diseases. Plant chemistry has been an integral component for man service as evident from history, providing substantial, entho-botanical and chemical remedies for locals in any subject area. The phyto-chemical profile of five desert dwelling tree species i.e. *Salvadora oleides, Acacia nilotica, Prosopis cineraria, Tamarix aphylla* and *Ziziphus mauritiana* was analyzed in Cholistan desert, Punjab, Pakistan. Photochemical analysis of air dried leaves/twigs powder confirmed the presence of alkaloids, flavonoids and saponins but no steroids during extraction. Moreover Chemical analyses revealed that crude fiber (CF) content was 16.67% and 6.67% in *Prosopis cineraria* and *Acacia nilotica* respectively, crude protein was found highest (2.62%) in *Zizyphus mauritiana,* slightly lower in Salvadora oleoides (2.36%) and minimum in *Acacia nilotica* (1.43%). *Salvadora oleioides* had highest (41.67%) ash content, while minimum in *Prosopis cineraria* (8%). Fat content (EE) was limiting as 5.33% in *Acacia nilotica* and lowest value in *Salvadova oleoides* (2.33%). Whereas, nitrogen free extract (NFE) was found maximum in *Zizyphus mauritiana* (72.22%). Results revealed species have high nutritional and medicinal values for livestock and local people.

**Keywords:** Phytochemicals; Chemical remedies; Desert dwelling trees; Nutrition values

## Introduction

Phytochemicals are plant-derived chemicals that are not only essential nutrients but known to have protective or disease preventive properties [1]. Plants abundant in these chemicals play a substantial role in the prevention from microbial, insecticidal or herbivorous predation [2]. Plants and plant products are being used as medicine from the ancient time. As estimated by the World Health Organization, approximately 75-80% of the world's population uses plant medicines either partly or entirely as medicine. Interest in plant derived drug increases mainly due to the increasing use and misuse of existing antibiotics which increases the development of resistance in microbes. This poses the need for search and development of new and effective drugs to cure diseases [3].

Secondary metabolites like alkaloids, flavonoids, terpenoids, tannins, phenols and glycosides contain antimicrobial, anthelmintic, anti-diarrhoeal activities while saponins and polypeptides are considered to contain anticancer and antiviral activities respectively [2,4,5]. These metabolites present in fruits and herbs may also protect human from a range of diseases [6]. Water-soluble flavonoid-glycosides and phenolics have been isolated from the plants [7]. Flavonoid-glycosides have shown to possess analgesic and anti-inflammatory activity.

Plants are an essential component for life in the universe. After various observations and experimentations many plants were identified as source of important medicine [8]. Medicinal plants have been used since prehistoric period for the cure of various diseases. Since these are commonly used by the local people and are of great importance that's why a lot of people are engaged in the trade of important medicinal herbs throughout the world. Especially, people living in villages have been commonly using indigenous plants as medicines [9].

Western Thar Desert is rich in varieties of plants. *Prosopis cineraria*, a member of the family *Leguminosae* is one of boon plants of Western Rajasthan that provide valuable natural resources to the people. It is native to arid portion of Western and South Asia. *Prosopis cineraria* are one of the highly valued plants in the Indigenous System of Medicine. It is also known to possess anthelmintic, antibacterial, antifungal, antiviral, anticancer and several other pharmacological properties [10].

*Tamaricaceae* is relatively a small family of 4 genera and 120 species [11] whereas *Tamarix* is the largest genus of the family with approximately 50 species wide spread throughout the world. A few species of *Tamarix* are employed in traditional medicine in Asia and Africa [12]. They are used as astringent, aperitif, stimulus of perspiration and diuretic. It has a variety of names including Salt cedar (English), Farash (India), Tamaris (French), Tamariske (German), Taray (Spanish) and Woestyn tamarisk (Afrikaans). Extract from leaves of the plant is used to treat toothache [13]. *Tamarix aphylla* is traditionally used for the treatment of rheumatism [14]. The aerial parts of *Tamarix* species are used for treatment of chronic diseases such as diarrhea and dysentery while the bark is used as an astringent tonic [15]. A decoction of this plant is observed to possess antinociceptive activity and roots have antinociceptive, cytotoxic and diuretic properties [16].

*Prosopis cineraria* (Linn) is a medium to large sized tree, belonging to the family *Mimosaceae*. This plant is used in pregnancy as a safeguard against miscarriage. The smoke of the leaves is good for eye troubles. The bark is used as a remedy for rheumatism, cough, common cold, asthma and scorpion stings [17]. Different parts of the plant are useful for the treatment of many diseases like skin diseases, piles, worms, vertigo and dyspnoea [18], protection from miscarriage, Eye diseases, Snake bite, asthma, bronchitis, dysentery, leucoderma, leprosy, muscle tremors and piles [19]. *Prosopis* sp. has been reported to contain levels of anti-nutrients such as tannins, known to affect the availability of nutrients by formation of soluble and insoluble complexes. Their effects on the digestibility of nutrients will vary depending on tannin content and astringency [20].

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*Salvadora oleoides* locally known as *'Jal'* is evergreen small tree, grows in habitats having medium to fine textured soil, belongs to family *Salvadoraceae*. The fruit of this plant is edible and liked very much by the local inhabitants [21]. *S. oleoides* is a salt tolerant tree [22,23] with low economic value but it has applications in multiple fields i.e., provides sweet and edible fruits, fodder, fuel, timber and has pharmaceutical value. *S. oleoides* improves the soil quality, stabilizes the fragile arid area, and provides shelter to livestock and wildlife [24]. *Salvadora oleoides,* Peelon (dried fruit) is used to treat rheumatism in animals. Dried fruit is given to animals after parturition during winter to facilitate the expulsion of lochia [22].

*Z. mauritiana* belongs to the family *Rhamnaceae*, locally known as jujuba or beri, with two major domesticated species, *Z. mauritiana* and *Z. jujuba*. These two Species have been cultivated over vast areas of the Old World. Fruit are iron tonic and digestive. The plant is used as folk lore especially for goat. Branches are used in fencing. Leaves of this plant especially young leaves are used by the diabetes patient [25].

*Acacia nilotica* (Family-*Mimosaceae*) is a medium size thorny tree found in the drier parts of India. The powdered bark of the plant with little salt is used for treating acute diarrhea. The bark is also used extensively for colds, bronchitis, diarrhea, bleeding piles and leucoderma [26]. The tender twigs are used as tooth brushes. The powdered bark of the plant with little salt is used for treating acute diarrhea [27]. The Egyptians believe that diabetics may eat carbohydrates as much as they want if they consume powdered pods of *A. nilotica* [28]. Polyphenols decrease the blood glucose levels [29]. Supplementation of *A. nilotica* (proanthocyanidins) is reported to be a potentially powerful nutritional approach for management of cardiovascular disease risk in individuals with both metabolic syndrome and elevated low density lipoprotein cholesterol [30].

Various screening methods have been used to assess these compounds through extraction in solvents with similar polarity [31]. Decoctions from different parts of a plant usually contain diverse mixture of phytochemicals [2]. Variability in the concentrations of these extracted substances depends upon the choice of plant part, the extraction procedure and the extractant used [31-33]. Mainly the solvent employed in such studies accounts for the complexity and diversity of the compounds being extracted [34]. This paper is an attempt to identify, isolate and quantify each phytochemical compound present in desert dwelling tree species which are primary source of food and medication for both human race and livestock of the Cholistan desert.

## Materials and Methods

### Study area

The world's seventh largest desert "Cholistan" extends toward India from the southern boundary of Punjab, Pakistan comprising 26,000km² area lies among 27° 42' to 29° 45' North and 69° 52' to 75° 24' East [35] with 112 m altitude (Figure 1) [36]. The desert is sub-divided into two distinct regions: the Lesser Cholistan and the Greater Cholistan covering about 7770 km² and 18,130 km² respectively contain negligible amounts of organic matter. Soils of interdunal flats vary in structure, texture, surface, the amount of sodicity and salinity with pH range from 8.2 to 9.6 [37]. The climate of Cholistan desert is harsh, hot, arid and sub-tropical and influenced by seasonal monsoons. Annual and still daily temperature varies greatly. Winter temperature varies from 15 to 30°C while 35 to 50°C in the months of May-June [35]. Annual rainfall is low, ranging from 100-250 mm, with its maxima during January to March in winters and July to September during monsoons [38].The Xeromorphic species found in Cholistan vegetation are adapted to a diversity of environmental stressors, particularly to low nutrients high salinity, aridity, and high temperature fluctuations.

### Methods

**Extraction:** Uniform dry powder of air dried leaves using four solvents: ethanol (70%), methanol (70%), acetone (70%) and distilled water, was used to have extracts. For each solvent, 100 g dry powder was extracted with 1000 ml solvent by maceration at room temperature for 48 hours. Then two filtrations of each mixture through N°1 Whatman paper and filter paper (0.45Fm porosity) were done. The collected filtrates were dried separately at 50°C using a Laborota 4000 rotary evaporator. The residue of each solvent extract was dissolved in water, frozen and lyophilized (CHRIST-ALPHA 1-4Lyophilizator). Aqueous acetone, aqueous methanol and aqueous ethanol were air dried to extract crude powder to investigate phytochemical compounds, total phenol content and for antioxidant screening.

### Phytochemical analysis

**Tests for alkaloids:** Methanol extract (2 ml), 1 ml hydrochloric acid and 6 drops of Wagner's reagent were taken in a test tube. The brownish-red precipitates confirmed the alkaloids in extract. In another test tube, 2 ml of MeOH was taken and 6 drops of Dragnedrff's reagent was added to it. The appearance of yellow precipitates indicated the presence of alkaloids. Analysis was done following Suthar Singh et al. [39].

**Test for saponins:** In a test tube 0.5 ml water, 1 ml glacial acetic acid, 3 ml $FeCl_3$ soln. and 3 ml conc. $H_2SO_4$ were taken. Greenish-blue color indicated the presence of saponins. Analysis was done following Khan et al. [25].

**Test of steroids:** In a test tube, 1ml chloroform, 2 ml acetic anhydride and 1 ml conc. $H_2SO_4$ were added. No Bluish-green ring formation indicated the absence of steroids.

**Test of flavanoid:** In a test tube 2 ml methanol, 5 ml conc. HCl and 0.5 mg Mg ribbon were added. Pinkish tomato red color indicated the presence of flavanoid. Analysis was done.

## Results and Discussion

### Results

The presence of three chemical compounds (Alkaloids, Flavonoids and Saponins) was confirmed in the leaves of five desert dwelling tree species i.e. *Tamarix aphylla, Acacia nilotica*, *Zyziphus mauritiana*, *Salvadora oleiodes* and *Prosopis cineraria,* during this study.

Minimum alkaloid concentration was prevalent as 3.2% in *Tamarix aphylla* while 9.4% in *Salvadora oleiodes* and *Prosopis cineraria* each at its maximum for these five tree species. Whereas *Acacia nilotica* showed 5.6% and *Zyziphus mauritiana* had 3.5% alkaloids. Concentration of flavonoids ranged 4.6% to 28% among these species. Maximum concentration of flavonoids was sorted in *Acacia nilotica* (28%) followed by *Tamarix aphylla* (14.6%), *Zyziphus mauritiana* (12.5%), *Prosopis cineraria* (4.9%) and 4.6% in *Salvadora oleiodes*. Saponin's composition varied from 1.43% to 3.65%. *Prosopis cineraria* (3.65%) are a species that had highest percentage value of saponin. Concentration of saponin in *Acacia nilotica* was 2.6% followed by *Tamarix aphylla* (2.4%), *Zyziphus mauritiana* (1.8%) and lowest in *Salvadora oleiodes* (1.43%) (Table 1).

Taking into account the nitrogen free extract (NFE), the highest value for this content was present in *Zyziphus mauritiana* (72.22%) followed by *Acacia nilotica* (71.9%), *Prosopis cineraria* (70.2%), *Tamarix*

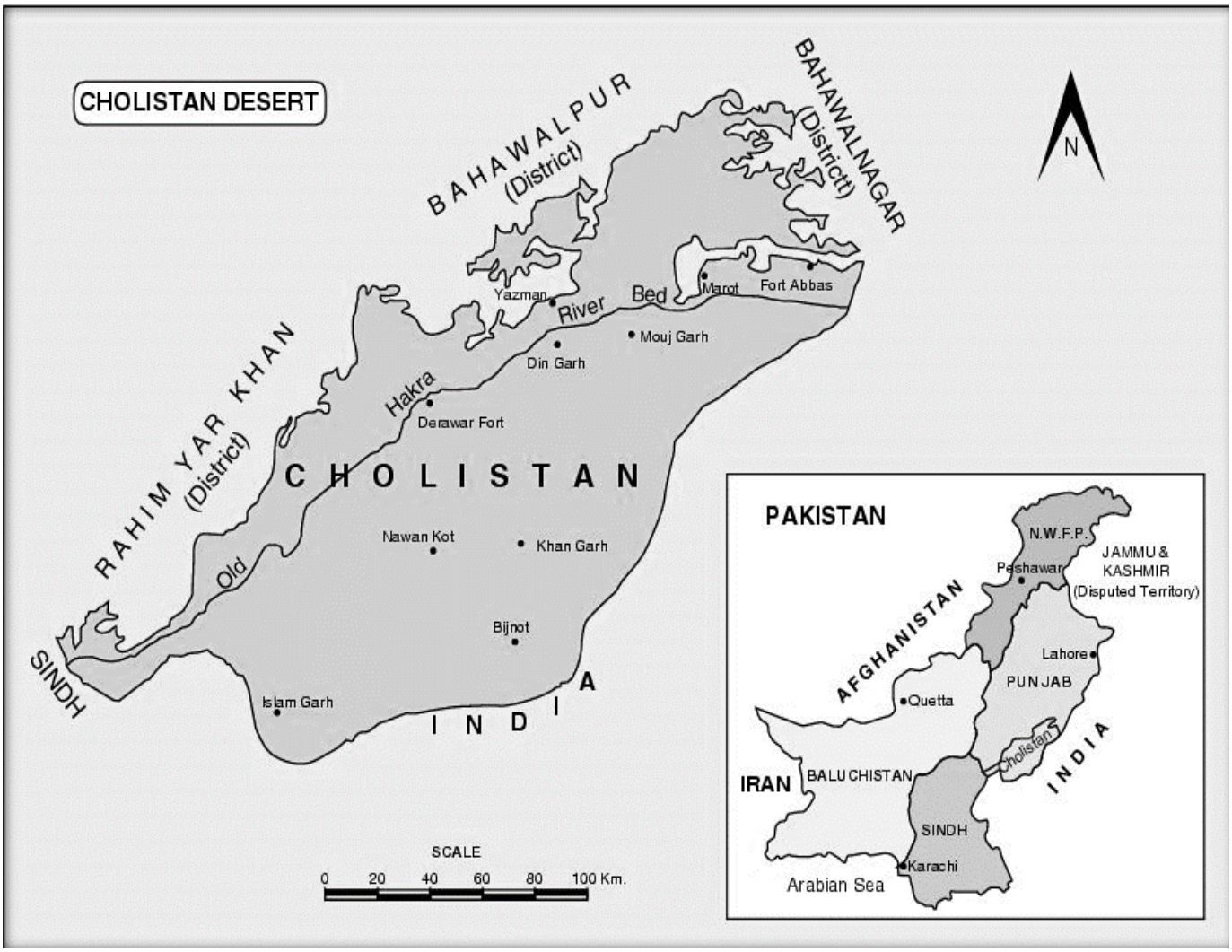


**Figure 1:** Map of Cholistan desert.

| Sr. No | Species Name | Alkaloids (%) | Flavonoids (%) | Saponins (%) |
|---|---|---|---|---|
| 1 | *Salvadora oleiodes* | 9.4 ± 0.7 | 4.6 ± 0.5 | 1.43 ± 0.2 |
| 2 | *Acacia nilotica* | 5.6 ± 0.8 | 28 ± 0.2 | 2.6 ± 0.4 |
| 3 | *Prosopis cineraria* | 9.4 ± 0.4 | 4.9 ± 0.5 | 3.65 ± 0.3 |
| 4 | *Tamarix aphylla* | 3.2 ± 0.2 | 14.6 ± 0.7 | 2.4 ± 0.3 |
| 5 | *Zyziphus mauritiana* | 3.5 ± 0.6 | 12.5 ± 0.3 | 1.8 ± 0.5 |

The values are the mean ± SD of triplicate experiments.

**Table 1:** Phytochemical profile of subject species.

| Species Name | EE | CF | CP | CA | NFE |
|---|---|---|---|---|---|
| *Salvadora oleides* | 2.33 | 8.33 | 2.36 | 41.67 | 45.31 |
| *Acacia nilotica* | 5.33 | 6.67 | 1.43 | 14.67 | 71.9 |
| *Prosopis cineraria* | 2.92 | 16.67 | 2.21 | 8 | 70.2 |
| *Tamarix aphylla* | 2.91 | 13.67 | 2.3 | 19 | 62.12 |
| *Zyziphus mauritiana* | 4.16 | 9 | 2.62 | 12 | 72.22 |
| Mean | 3.53 | 10.868 | 2.184 | 19.068 | 64.35 |
| SEM* | 0.31326 | 1.0595 | 0.11012 | 3.181 | |

Key: Mean tree species does not differ significantly at p>0.05.
*SEM: Standard Error of mean; Mean values based on three replicates

**Table 2:** Proximate nutritional composition

*aphylla* (62.12%) and *Salvadora oloeides* (45.31%). Average value was of NFA was calculated as 64.35% for these desert dwelling tree species (Table 2 and Figure 2).

Proximate analysis for EE (Ether Extract), CF (Crude Fiber), CA (Crude Ash), CP (Crude Protein) and NFE (Nitrogen Free Extract) of these five tree species from Cholistan desert explain that the EE ranged from 2.33% (*Salvadora oleides*) to 5.33% (*Acacia nilotica*) at its maximum with mean value as 3.53% while *Zyziphus mauritiana* (4.16%), *Prosopis cineraria* (2.92%) and *Tamarix aphylla* had 2.91%. The CF was highest in *Prosopis cineraria* (16.67%) followed by 13.67% (*Tamarix aphylla*), 9% (*Zyziphus mauritiana*), 8.33% (*Salvadora oleiodes*), and lowest was in *Acacia nilotica* (6.67%) having mean value of 10.868%. Contents of CP varied from 2.62% in *Zyziphus mauritiana* at its maximum and gradually decreased in *Salvadora oleiodes* (2.36%), *Tamarix aphylla*

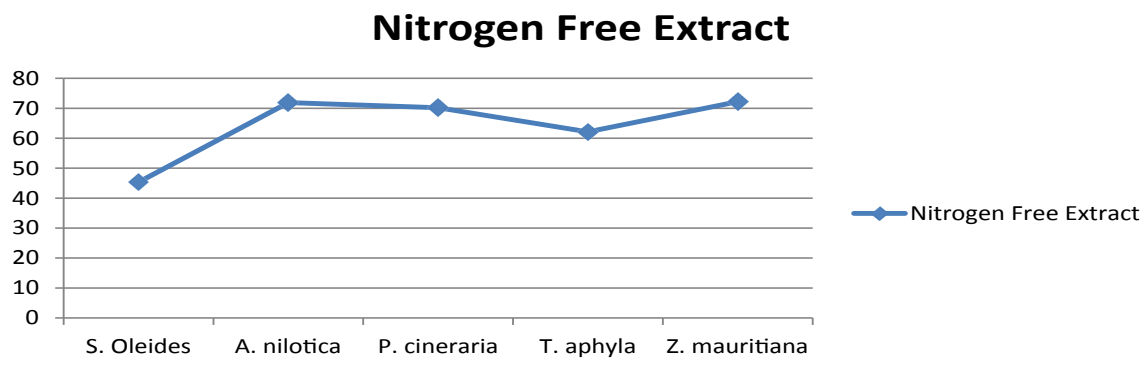


**Figure 2:** Nitrogen free extract of target species.

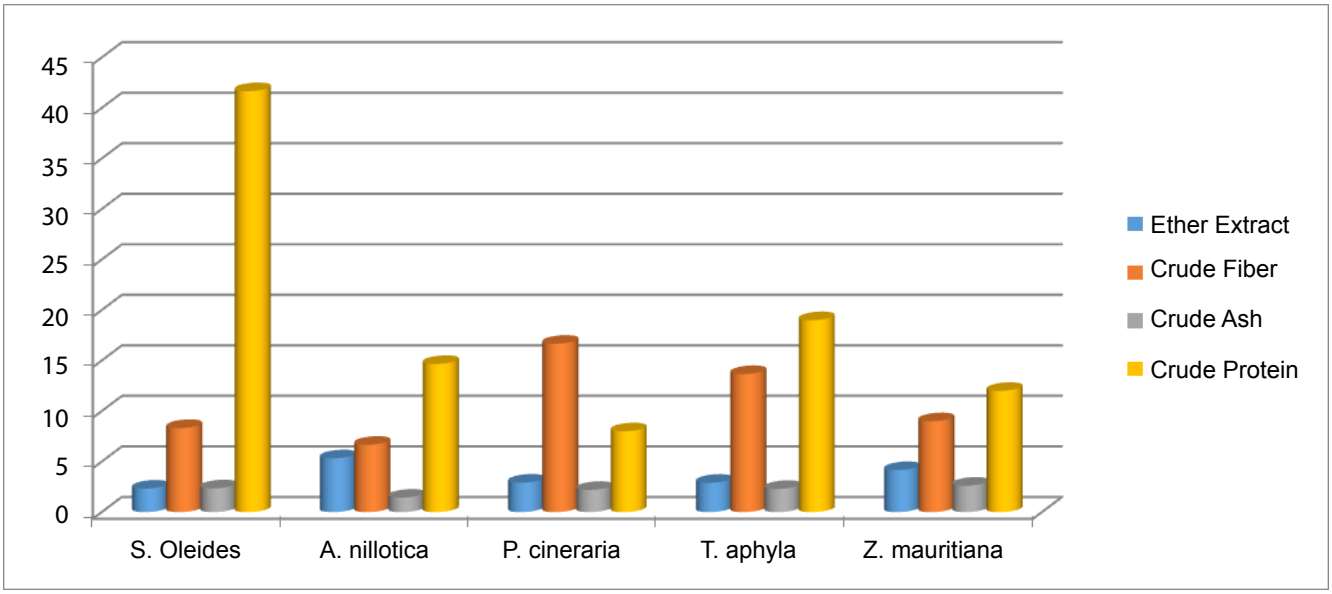


**Figure 3:** Proximate nutritional composition.

(2.3%), *Prosopis cineraria* (2.21%) and lowest as 1.43% in *Acacia nilotica*. Five tree species were having a mean value of 2.184% of CP. Highest amount of CA was measured 41.67% in *Salvadora oleiodes* followed by *Acacia nilotica* (14.67%), *Tamarix aphylla* (19%), *Zyziphus mauritiana* (12%) and least as eight percent in *Prosopis cineraria*. Mean value this CA was 19.068% (Table 2 and Figure 3).

## Discussion

The present research on five multipurpose desert dwelling tree species of Cholistan desert was considered to find phytochemical composition and nutritive profile of these. The study is of great interest for pharmaceutical companies to develop and formulate new drugs to cure various diseases as the phytochemicals of these tree species are useful for curing and healing in different kind of viral and other type of diseases, of which the phenolic acids and flavonoids have gained more attention [40-42]. The curative properties of medicinal plants are due to the presence of various complex chemical substances of different composition which occur as secondary metabolites [43], grouped as alkaloids, glycosides, flavonoids, saponins, tannins and essential oils and this study resulted in account of flavonoids, saponins and alkaloids.

The leaves of *Acacia nilotica* have shown the presence of alkaloids, saponins, flavonoids but no steroid and finding is consistent with the results of Banso [44]. The extracts of *Salvadora oleoides* leaves showed the presence of alkaloids, saponin and flavonoids which is in line with the stem extract results [45,46] but absence of steroids in our study showed dissimilarity.

The presence of phytochemicals in the leaves of *Tamarix* species justifies the local use of this plant for the treatment of various disorders. Current screening of the species resulted in the extraction of flavonoids, Saponins and alkaloids as the leaves are rich in flavonoids, saponins, polyphenols and proteins with considerable amount of carbohydrates and alkaloids [47] but my findings were in vain about the presence of steroids, detected earlier by Mohammedi et al. [48]. Our results about *Zyziphus maritiana* were same as that of Najafi's findings [49]. Thus the preliminary screening tests may be useful in the detection of the

bioactive principles and subsequently may lead to the drug discovery and development.

Various phyto constituents like tannins (gallic acid), steroids (stigmasterol, campesterol, sitosterol, etc.), Flavone derivatives (prosogerin A, B, C, D, and E), alkaloids (spicigerine, prosophylline), etc. isolated from the *Prosopis cineraria* pods by Rani et al. [50] correlates with this study on *Prosopis cineraria*. Different parts of the species are useful in treatment of skin diseases, piles, worms, vertigo and dyspnoea [51], protection from miscarriage, eye diseases, snake bite, asthma, bronchitis, dysentery, leucoderma, leprosy, muscle tremors and piles [19].

The nutritive profile of *Acacia nilotica* (EE: 5.33%, CF: 6.67%, CP: 1.43%, CA: 14.67% & NFE: 71.9%) in this study satisfies the feeding needs of livestock in the most arid climatic area. Among all the highest ether extract value was recorded for *A. nilotica* means it contains the highest amount of energy than other species, the similarity as evoked by Sawe et al. [52]. Supplementation of *A. nilotica* (proanthocyanidins) is reported to be a potentially powerful nutritional approach for management of cardiovascular disease risk in individuals with both metabolic syndrome and elevated low density lipoprotein cholesterol [30].

Our results about *Prosopis cineraria* (EE: 2.92%, CF: 16.67%, CP: 2.21%, CA: 8%, NFE: 70.2%) were compared with efforts of Rani et al. [50] that disclosed that green leaves of *P. cineraria* contain 14-18% crude protein, 13-22% crude fiber and about 6% ash, with a high calorific value of 5000 Kcal. Cheema et al. [53] explored the nutrational value of *Morus alba, Acacia nilotica, Syzygium cumuni* and *Ziziphus jujuba* leaves and stated that ash content (10%) were higher in *Z. jujuba* and *M. Alba*, respectively and we recorded 12% CA in *Zyziphus mauritiana*.

Lower crude protein content is found in *Salvodora oleoides* (2.36%) leaves which are comparable with the results of Kajero et al. [54]. But local people use its fruit as food in the Cholistan desert as earlier described by Duhan et al. [55] that the fruits of *Salvadora oleoides* are a delicacy in rural areas, eaten locally, and have been found to be rich sources of calcium. This very useful species in restoration of the fragile arid tract and provides fodder and shelter to the wildlife and livestock, and fruit, medication and recreation to the inhabitants of the surrounding areas Duhan et al. [55].

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