Assessment of medicinal folklores and chemical composition of *Aerva javanica* (Burm. f.) Juss. ex Schult.) in Cholistan Desert of Pakistan

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Research

Abstract

Background: The desert ecosystem of Cholistan is rich in xerophytic flora of medicinal importance. *Aerva javanica* is most common shrub and equally neglected as potential medicinal plant in the study area. Chemical composition as well as medicinal folklores of *Aerva javanica* in the Cholistan desert of Pakistan was explored in this study.

Methods: Data was collected through questionnaires by interviewing local inhabitants and herbal practitioners and direct observations during field surveys. A total of 320 respondents of various age groups were selected randomly for household survey and medicinal plants experts (n=14) were interviewed by using snowball method for validating medicinal uses. Whole plant including leaves, flowers and tender shoots was sampled. Nutritive and phytochemical attributes were analyzed.

Results: The plant use inventory of this plant showed that local inhabitants used this shrub as firewood, fodder, making huts and as human and veterinary medicine like treating diarrhea (14.3%in cattle and 50% in human) and intestinal pain (35.7%),Diuretic (64.3%), kidney disease and face acne (21.4%). Plant use knowledge varies according to community status and increases with increasing age of respondents. Nitrogen (N), Protein and Ash contents (5.22%, 32.51% and 33.50% respectively) were recorded. Secondary metabolites like phenolics (188.67mg g^{-1}), Alkaloids (8.00mg g^{-1})and flavonoids (0.35mg g^{-1})were recorded in the plant on of dry weight basis.

Conclusion: Results on nutritive parameters and secondary metabolite prove it to be good as forage for livestock and can be used for medicinal purposes. So, further studies should be conducted to explore its medicinal properties.

Key words: Bui, traditional uses, Chemical composition, ethnobotany, Cholistan desert

Background

Life is always very fragile in desert ecosystems due to limited resources. It makes all kinds of life very opportunistic and constitutes a specific type of flora and fauna. Cholistan desert rangeland has no exception of it. It is rich in xerophytes and provides food, fuel wood, construction material and even remedy for curing ailments of local people (Azhar *et al.* 2017). (reference). Further, this flora is a fodder source for livestock, which is the main livelihood

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source in that area. Some of these plants have additional medicinal properties and are rapidly gaining economic importance. Plant resources all over the world provide various services to man since ages by so many ways and ultimately gaining economic importance. The inhabitants of Cholistan desert are relying on indigenous vegetation for numerous ethnobotanical uses including human and veterinary medic treatments in specific traditional recipes (Azhar *et al.* 2015). However, indigenous plants and their use knowledge are threatened by habitat loss due to urbanization, industrialization, urban migration for livelihood by cultural changes with time.

Aerva javanica (Burm. f.) Juss. ex Schult. is a dioecious plant species, a shrub and belongs to Amaranthaceae. Range of its distribution varies from North Africa to southwestern Asian regions. In Pakistan, it thrives well on calcareous and sandy soils of arid and semiarid rangelands. In English, it has different names like Aerva, Java Aerva, Kapok bush, Snow bush and Pillow bush (Ruffo *et al.*2002; Shahin *et al.* 2021). This perennial shrub grows to a medium height. It can occasionally grow as high as 1.6 meters tall and can reach heights of up to 30 to 100 cm. Throughout the year, terminal branches continuously produce clusters of white woolly flowers. It produces capsule-shaped fruit with shiny, dark-brownish seeds that are 0.90 to 1.5 mm long (Karela & Dedar 2022). They remain viable for a long time and spread via the wind, animals, etc. (Swarnkar et al. 2021).All plant parts including white leaves and woolly hairs are ethnobotanically important (Haq et al. 2011). .

*Aerva javanica*is well reported for various chemical compounds like triterpenes, steroids, lipids (Thasneem *et al.* 2022; Karela & Dedar 2022), and widely used in treating diseases all over the globe with local recipes and folklores. This research was designed by keeping in mind its worldwide medicinal importance. Different cultures possess different traditions and recipes of plant utilization (Hussain *et al.* 2022). Being familiar with local religious beliefs, cultural norms and part of various previous research activities, three assumptions were made for this study: 1) knowledge increases with age 2) knowledge varies with community status and 3) folk medicines have scientific grounds as plants contains various phytochemicals. Therefore, ethnobotanical uses of *Aerva javanica* in the area were documented and assessment of the nutritive value/Secondary metabolite concentrations of indigenous *Aerva javanica* spp. was carried out.

Materials and Methods

Study area

This study was conducted in Cholistani union councils of Bahawalpur district. The Bahawalpur district was chosen because it has the largest area of Cholistan desert with a projected population of 1.55 million sharing 67.54 % of the whole area (Haider *et al.* 2021). Within Bahawalpur district, four union councils of tehsil Yazman were selected purposively because these are officially declared as Cholistani union councils. These targeted union councils are geographically situated between latitudes 27°42ánd 29°45´North and longitudes 69°52and 75°24Éast (Fig. 1).

Data collection/Research tools

Focal group discussions, opportunistic discussion, household and market surveys with well-equipped questionnaire were used as research tool. Collected data from semi-structured key informant interviews were summarized and assessed during focus group discussions.

Focus group discussions

The focus group discussions were carried out for better understanding of indigenous plant use knowledge, local culture and to document plant use perceptions of the area. Each focus group consisted of 7-14 participants selected purposively for comprehensive discussion which held in presence of the village head (chairman/numberdar).

Household interviews

Structured and semi structured household interviews were conducted for randomly from 320 households, including 20 samples from each village (total 16 villages from 4 union councils. All households living in Cholistani villages notified by district Government were sampled. The ethnobotanical data from each household and medicinal use of selected plant as well was gathered through semi structured interviews. Information on plant use perceptions was also gathered during interviews and field visits. All interviews were conducted from a representative of a household (mostly household head). Interviews were also formulated with key informants i.e. the local medicinal plant experts, to validate the local dwellers medicinal uses. These (total 14) were selected by using snowball method(Leighton *et al.* 2021). Separate structured questionnaires were used for interviewing. Different plant parts used by local people were also sampled and labeled with the help of available standard literature (Shafi*et al.*2001). The most responded used plant part for medicine and food were putted under shade for drying. Further, ground and stored for chemical analysis.

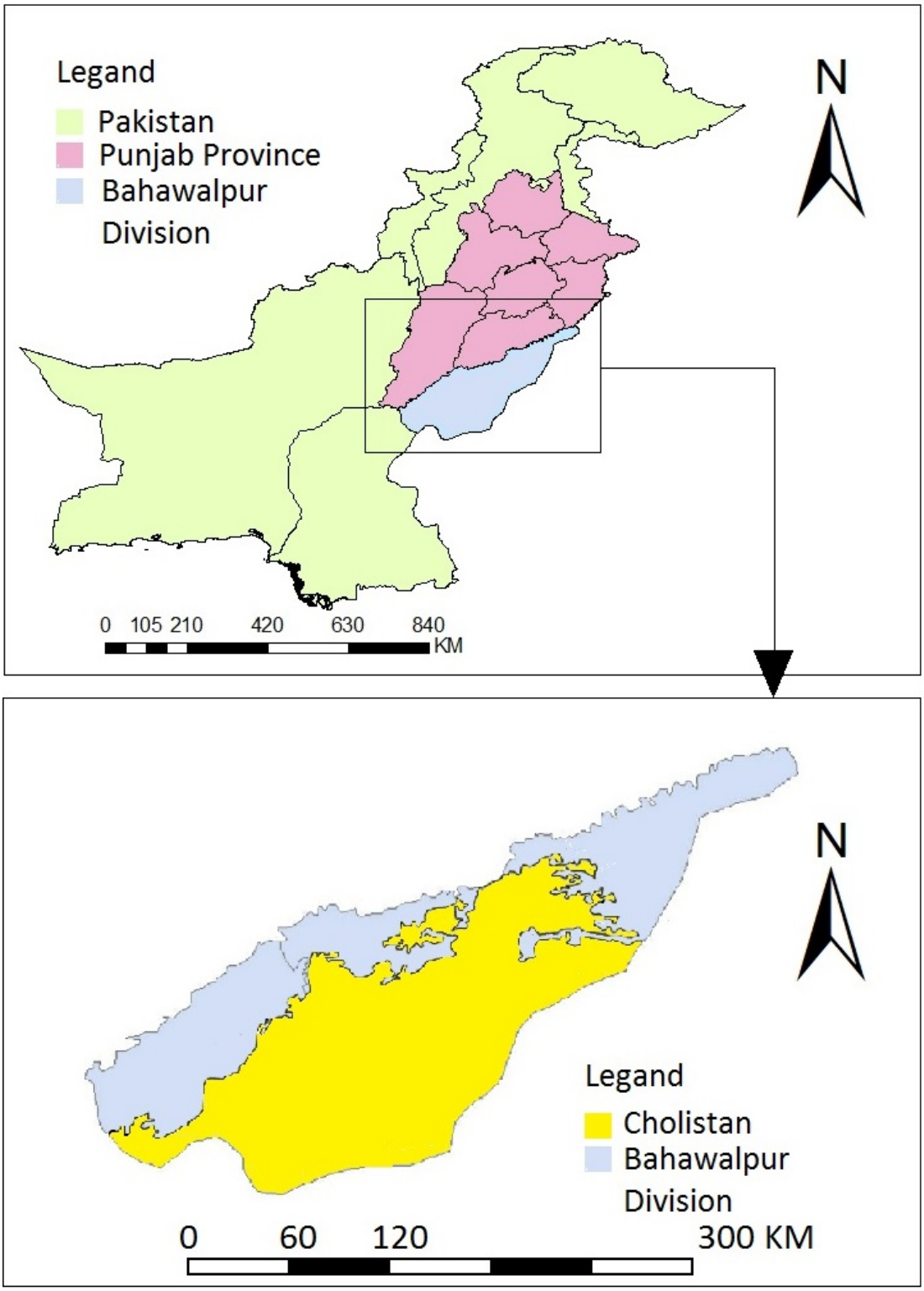

Figure 1. Map of the study area

Table1. Selected villages from four union councils of Yazman Tehsil

Community Status	**Frequency (n=334)**	%	**Age Class**	**Frequency (n=334)**	%
Local Pastoralist	132	39.52	Up to 40	98	29.34
Nomadic Pastoralist	96	28.74	41-50	108	32.34
Agro Pastoralist	92	27.54	51-60	110	32.93
Herbal practitioner	14	4.19	Above 60	18	5.39

Chemical analysis

Standard techniques were applied for laboratory analyses for various proximate and photochemical analyses. Different laboratories at University of Agriculture, Faisalabad were used, and analysis was repeated three times for each parameter. Procedures of AOAC (A.O.A.C. 1995) were adopted for proximate analysis as followed by Keerthana et al. (2022). Total phenolics, alkaloids and flavonoids contents were measured by following the procedures of Khoddami et al. (2013); Raj et al. (2017) and colorimetric assay method (Zhishen *et al.* 1999; Senguttuvan *et al.* 2014). A detail of all these procedures is available with our previous publications (Azhar *et al.* 2014a, Azhar *et al.* 2015; Azhar *et al.* 2020).

Statistical analysis

Collected data was entered in MS Excel sheets for analyzing. Descriptive statistics was employed by applying SPSS (Caplova, & Svabova 2020). The proximate and photochemical results were presented statistically by applying Tukey's 1 degree test in complete randomized design.

Results

Demographic characteristics

The respondents of this study were divided according to their different community status and age classes (four groups of each). Respondents were from all prominent stakeholders of the area from local pastoralist, nomadic pastoralist, agro-pastoralist to local herbal practitioners with similarities that they were well aware of the study plant.

The major number of respondents was from local pastoralist group with a share of 39.52 % (n=132) of the total respondents (Table 2). Similarly, respondents were also divided according to age into four classes and majority respondents (n=236) were above 41 years (Table 2).

Table 2. Community status and age class of respondents

Ailments	Responses (%)	Preparation, part and mode of usage
Joint pain	14.3	Leaves paste is applied externally on inflamed parts of body (especially joints).
Intestinal pain	35.7	Fresh leaves, oral intake.
Diarrhea cattle	14.3	Fresh leaves orally administrated and some time in combination with minerals.
Kidney diseases	21.4	Fresh leaves singly and sometimes in combination with other plants as oral intake.
Piles	7.1	Fresh leaves orally administrated
Diarrhea	50	Fresh leaves orally administrated
Paralysis	14.3	Steam bath is taken by boiling smashed leaves and stem of this plant in water for curing paralysis.
Worms	7.1	Fresh plant both leaves and branches are crushed and administrated orally. As decoction also
Diuretic	64.3	Fresh plant both leaves and branches are crushed and administrated orally.
Toothache	14.3	A decoction of leaves used as gargle in toothache.
Face acne	21.4	Leaves paste is applied externally on face for acne.

Ethnobotanical Uses

Common Uses

In different research approaches, common uses of this plant were documented from different age groups and community status of respondents. *Aerva javanica* was commonly used in medicines, fodder, firewood and making huts. Respondents from the first age class group was more aware from the firewood use and with age other uses were also increased. The last group was more aware from the medicinal use of this plant. Younger respondents in

participant observations preferred it as fodder and firewood species. Older participants reported extensive medicinal use knowledge of this plant (Fig. 2).
Similarly, common uses of this plant were also documented from different community status of the respondents. Nomadic pastoralists were more aware to the common uses as they are more associated with vegetation due to their livestock and remain moving in the area for green vegetation. Herbal practitioners were more aware from the medicinal use of this plant but less aware from the other uses as they use vegetation for their medicinal properties (Fig. 3).

The pastoralist and habitants of remote rangelands possess more knowledge and concerned about plants and their common and medicinal utilization. It was due non-availability of modern resources and less accessibility of modern medicines.

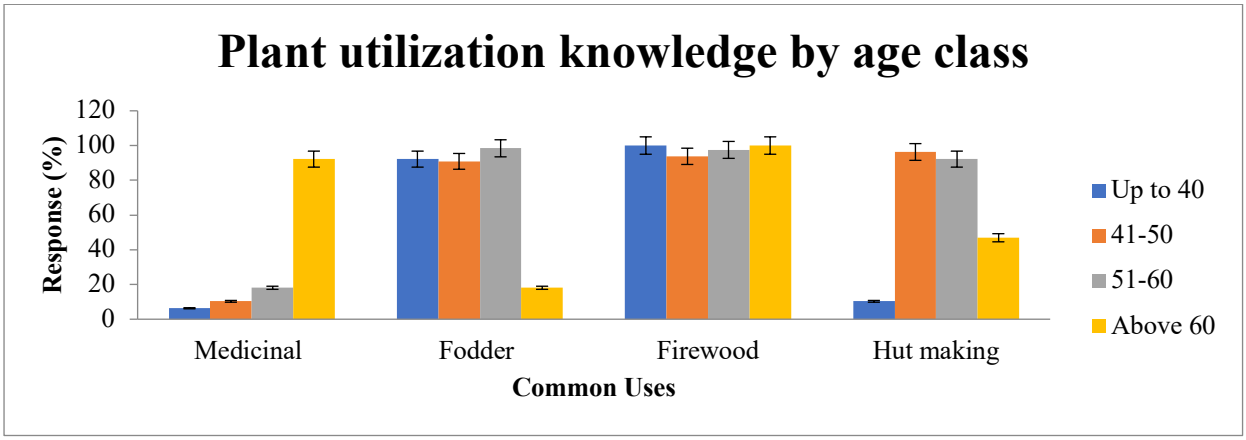

Figure 2. Plant use response of respondents by age

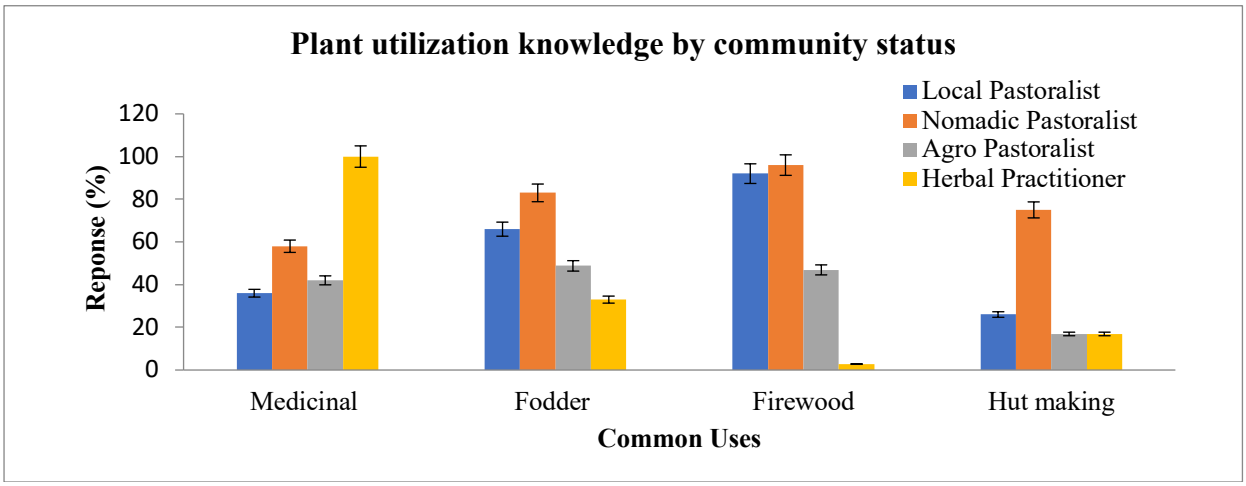

Figure 3. Plant use response of respondents by community status

Age and community status (livelihood source) also affect the familiarity and use knowledge with natural resources. Results of this study were in favor of the assumption that ethnobotanical knowledge/ plant use knowledge varies between age groups and community status(Cohort 2009; Guimbo *et al.* 2011). It increases with persons who are more associated with plants and with age.

Medicinal Uses

The respondents reported 11 ailments which were cured by this plant (Table 3). Respondents of all age classes and community groups were aware of the medicinal use of this plant. Herbal practitioners and the respondent over the 60 year of age demonstrated more no. of ailments which can be cured by this plant.Table 3 also reveals the name of ailments cured by this plant with the mode of usage and specific part of plant utilization in folk recipes.

Table 3. Number of diseases cured by according to various community status and age classes

Community Status			Age		
Respondents	**No. of disease (n=11)**	**%**	**Respondents**	**No. of disease (n=11)**	**%**
Local Pastoralist	1	9.09	Up to 40	4	36.36
Nomadic Pastoralist	3	27.27	41-50	8	72.72
Agro Pastoralist	2	18.18	51-60	8	72.72
Medicinal Plant Experts	9	81.81	Above 60	11	100

*Analyses are the means of triplicate measurements. . Here, DW is dry weight, (N) nitrogen, (CF) crude fiber, (CP) crud protein, (EEF) ether extractable fat, (P) phosphorus, (K) potassium, (NFE) nitrogen-free extract] All analyses are mean of triplicate measurements. **All analyses are mean of triplicate measurements. DW (dry weight)

Nutritive value and secondary metabolite compounds

Laboratory assessment of plant validate the presence of all major nutritive and secondary metabolite contents (Table 4) i.e., carbohydrates as NFE (28.9%), crude protein (32.51 %), crude fiber (32.17 %), nitrogen (5.22 %) and ether extractable fat (5.21 %). Similarly, Secondary metabolite compounds analyses were also presented in table 5

Table 4. Nutritive composition& secondary metabolites [Mean ± SE] in percentage

*Nutritive composition	N	CF	CP	Ash	EEF	P	K	NFE
Whole Plant	5.22±0.088	32.17±0.266	32.51±0.442	33.50±0.337	5.21±0.030	0.02±0.120	0.69±0.049	28.91±0.049
**Secondary metabolite compounds(mg g-1 DW)			Phenolic		Flavanoids		Alkaloids	
Whole Plant			188.67±0.073		8.00±0.002		0.35±0.003	

Highest value of phenolics (188.67 mg g^{-1} of dry weight) was recorded from branches, leaves and flowers (whole plant) of *Aerva javanica*. Flavanoids and alkaloids were also measured which validated its medicinal use.

Availability of *Aerva javanica*

Aerva javanica was exploited mainly by the local people for fodder, firewood and for making thatched houses). Its availability was reported to be decreased by majority of respondents (68%) during last five years and similarly during last one year (43%) as presented in Fig. 4.The reason of declining as revealed from the group discussions was the agriculture expansion and its extraction as firewood but in some areas where goat herds dominated, overgrazing was also a reason. It is a similar trend as studied previously for other medicinal plants in the area (Azhar *et al.* 2017; Azhar *et al.* 2015; Malik *et al.* 2015; Hameed *et al.* 2011).

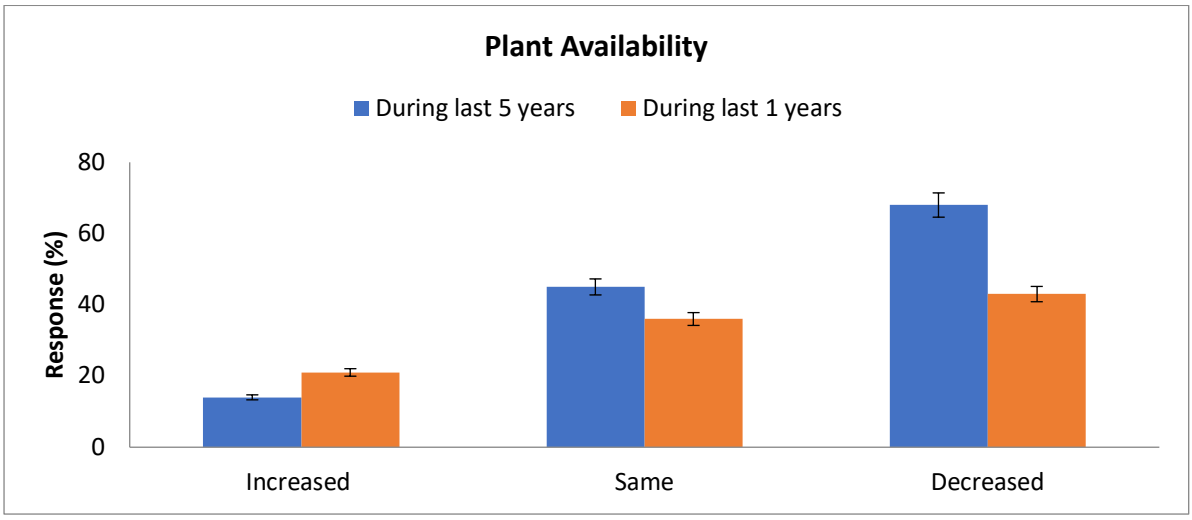

Figure 4. Plant availability during last 5 and 1 year

Discussion

This study examines the variation of ethnobotanical knowledge across age and community status (based on their livelihood source) in four classes namely 1) local pastoralist, 2) Nomadic pastoralist, 3) Agro-pastoralists and 4) Medicinal plant experts in 16 villages of Cholistan desert rangeland by using interviews during household and market surveys, key informant interviews, opportunistic discussion and focus group discussion. All aged persons during survey were interviewed with the assumption that aged persons were more aware of ethnobotanical uses of the plant sources. Herbal practitioners were interviewed as they are knowledgeable in folk medicines. We linked lists of plant utilization during interviews as firewood, fodder, construction (Hut making) and medicine, among different age groups and community classes. Compared to Age, the age group above 60 years age cited more medicinal and firewood uses of this plant. Age groups from 1 to 3 (i.e., up to 40, 41 to 50 and 51 to 60) reported its uses as firewood, Hut making (except up to 40-year age) and fodder more than its medicinal uses. It was observed that the younger respondents were more active and spent a lot of time outside their homes for their livelihood. This may be the reason of more plant uses citations as they explored more desert area and have accounts with different peoples. These findings confirmed our assumption as "ethnobotanical knowledge increase with age". Interview data further indicated the impact of community status on ethnobotanical knowledge as the people associated with animal grazing were more aware with multiple plants uses as fodder, firewood and hut making while the medicinal plant experts although aware from different other uses but less than the others. They are more concerned about the medicinal uses of this plant. These results confirmed our second assumption as "knowledge varies with community status" as the people who are more associated with vegetation and not influenced by the modernization has more knowledge about the use of vegetation traditionally. Other similar studies were also confirmed that older than 40 years aged persons were more aware of traditional plant use and reported more use citations (Kebede *et al.* 2016; Zenebe *et al.* 2012; Sop *et al.* 2012; Guimbo *et al.* 2011; Tolassa 2007).

Medicinal uses as diuretic (64.3%) and in treating diarrhea (50%) were reported by more respondents from all age classes in medicinal plants expert community class. Aerva species are commonly used in traditional medicine to treat a variety of illnesses globally. *A. javanica* root mash is applied directly on face to treat acne (Raza *et al.* 2014) and flowers, fruits and seeds are used for inflamed body parts and face acne, applied externally as paste (Tounekti *et al.* 2019). *Aerva javanica* is also reported by various other studies to be used as diuretic, demulcent, anthelmintic, for headache and as decoction to remove swellings (Arbab *et al.* 2016; Suleiman 2019). Recently, its different parts i.e., root and flowers were reported to be used for their anticancer properties, for treating rheumatism, renal disease, and toothache (Movaliya and Maitreyi 2012). Remedy for abdomen disorder internal organ inflammation was reported by Tounekti et al. (2019). It has been found good remedy in gastric ulcers at various degrees (Kushima *et al.* 2005; Samejho *et al.* 2012). In African countries, *A. javanica*, is being used traditionally for treating wounds, ulcers, as anti-plasmodial for abdominal pains, rheumatism, breast cancer and snake bites (Elaseed *et al.* 2015; Eltayeb *et al.* 2017).

In Cholistan rangeland, use of various local flora including *Aerva javanica*, is very common and frequent among Cholistani locals for curing chronic to acute diseases it has been reported by other scientists to be used in chronic and acute diseases (Shafi *et al.* 2001; Hameed *et al.* 2011; Raza *et al.* 2014; Azhar 2014b; Ahmad *et al.* 2014; Mustafa *et al.* 2016).

Presence of different minerals and nutritive compounds in plants make them good food and fodder plants for animals especially the presence of crude fiber and crude protein. Higher crude fiber (32.17%) and crude protein content (32.51%) in this plant make it good fodder for animals.

Plants produce a wide range of secondary metabolites, the majority of which serve to protect plants from predators, as well as to disgust pathogens and herbivores (El-Tayeh *et al.* 2020). The defensive role of plant secondary metabolites has been confirmed by in vitro examination of plants whose secondary metabolite expression has been modified using modern techniques (Tharachand *et al.* 2012). It is thought that more than 100,000 metabolites are involved in plant defense system and are formed as a result of plant pathogen interaction over the years, but true picture is not cleared yet (Ganie *et al.* 2015). These secondary compounds are successfully isolated in pharmaceuticals for making medicines to treat various human ailments. Alkaloids, phenolics, and flavonoids are examples of secondary plant metabolic compounds that have antiviral properties (El-Tayeh *et al.* 2020). Alkaloids have a wide range of biologically active compounds that have an impact on living things (Moloudizargari *et al.* 2013; Erharuyi *et al.* 2014). Ancient potent Chinese herbs used for their antiviral qualities are reported to have 18000 alkaloids (Zaynab *et al.* 2018.).

Highest value of phenolics (188.67 mg g^{-1} of dry weight) was recorded from branches, leaves and flowers (whole plant) of *Aerva javanica*. Flavonoids and alkaloids were also measured which validated its medicinal use. Our results confirm our third assumption "folk medicines have scientific grounds as plants contain various phytochemicals".

Similar to our results various chemical and nutritive compounds like lipids, flavonoids, steroids, triterpenes, alkaloids, tannins, saponins, carbohydrates, sulphates and glycosides were also reported by other researchers (Reddy and Reddy 2009; Munir *et al.* 2014). Inhibitory studies encourage its phytochemicals be potential remedy for diseases like skin hyperpigmentation, Alzheimer and stress complications (Saleem *et al.* 2021). It was concluded from analysis that the plant parts contained significant amounts of total phenolics and flavonoids, which may be the cause of their successful medicinal use.

Due to overuse and land conversion, wild plants, particularly those with medicinal properties, are in decline everywhere in the world. Land transformation exceeds high levels in developing nations with rapid population growth in order to meet societal needs. Similar to our findings, agricultural development, the production of charcoal, and the harvesting of firewood were regarded as major threats to the survival of medicinal plants in these regions (Abebe *et al.* 2021).

Conclusion

The inhabitants of Cholistan Desert are very much familiar with this shrub. Although they are aware with various common uses of this plant but hardly have any knowledge about its medicinal uses and properties. Plant use knowledge is more in aged respondents and also varied with change of community status of the respondents. Livestock alone and or sometimes along with agriculture is the most common livelihood source of the area. Therefore, it is mainly exploited by the local people for construction of huts (thatched houses) and fuelwood. Herbal practitioners/elderly known people use it in curing a few ailments and use whole plant for making the remedy. There is a gradual decrease of this plant day by day. Results on nutritive parameters and secondary metabolite prove it to be good as forage for livestock and can be used for medicinal purposes. So, further studies should be conducted to explore its medicinal properties.

Declarations

Ethics approval: All participants provided oral prior informed consent.
Consent to publish: The paper does not show any personal data or photographs. Availability of data and materials: The authors will provide the raw data on request without the names of informants.
Competing interests and conflict of interest: The authors declare that they have no competing interests and conflict of interest.
Funding: No funding received.
Authors' contribution: MFA deliberated this work, conducted field survey, performed the main statistical analysis and wrote the manuscript. AA and EA read and corrected the manuscript.

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