

# Herbal medicinal uses and their practices in human health care and livestock from district Haripur, Khyber Pakhtunkhwa, Pakistan

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## Abstract

**Background:** In light of the increasing need, for global health care, traditional medical knowledge is receiving considerable attention in order to fulfil the public health needs not only for human health but also animal health.

**Objectives:** Thus, the aim of the study is to explore ethnomedicinal uses of plants in human and livestock health care of the study area.

**Methods:** Data were gathered through arranged surveys and meeting techniques by focusing on 80 sources in the investigation region during 2018–2020. Quantitative ethnobotanical indices were calculated.

**Results:** Eighty plant species (33 herbs, 21 shrubs, 24 trees and 2 climbers) belonging to 50 families, distributed in 74 genera, were being used in the study area. Forty-nine medicinal plants in the treatment of 42 human diseases under 52 natural recipes and 40 plants in 34 livestock diseases under 40 recipes were used, in which 9 plants are used commonly in ethnopharmacy and veterinary medicine. Jaccard index was used to predict the similarity and dissimilarity among cities of Pakistan and reflected the novel use of medicinal plants. Results showed that *Boerhavia diffusa*, *Centella asiatica*, *Morus nigra*, *Nasturtium officinale*, *Rumex hastatus* and *Sageretia thea* have the higher use value (UV). Comparative analysis with other studies strongly reflected the novel use of these plants because of the deep-rooted and unique sociocultural setup of study area.

**Conclusions:** Our research shows that the wild plants used in the study area are extremely varied, both in terms of species and function, and folk medicine is one of the main health care systems in the area.

## KEYWORDS

ethnomedicinal, human health care, livestock, medicinal plants, veterinary

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## 1 | INTRODUCTION

Medicinal, aromatic and spice herbs have been prescribed to supply human needs from diet, shelter, house, forage, and more importantly for health care of human beings and veterinary applications in traditional medicines, and other cultural purposes for millennia (Ahmad et al., 2009; Ahmed, 2016). Ethnobotanical study of indigenous people plays a significant role not only for conservation and document the knowledge and medicinal plant species but also for developing natural medicine based on herbal preparations too, in virtually all cultures (Yaseen et al., 2015). This is probably due to the indigenous community culture, readily available and cheap source, natural and less adverse effects of herbal drugs (Ahmed et al., 2021). Different parts of the medicinal plant possess secondary metabolites that synthesis a certain physiological response in the treatment of different ailments (Ahmed, 2016). In Indo-Pak, the first record system of herbal medicine was issued in Rigveda between (4500–1600 B.C.) and Ayurveda (2500–600 B.C.) which traces to Greek medicine and was adopted by Arabs and then spread to India and Europe (Hussain et al., 2008). The use of medicinal plants in Pakistan based mainly on the Unani medicine system, particularly in villages and territories of the country where it is considered as a basic therapy (Shaikh et al., 2009).

Pakistan is known for four phytogeographical regions composed of Irano-Turanian (46%), Sino-Himalayan (10%), Saharo-Sindian (9.5%) and Indian element (4.5%) (Hamayun, 2005). The studied area is located in the north of Pakistan and is characterised by unique biodiversity due to the existence of Himalayas, Karakorums and Hindu-kush mountain. In addition, nearly 6000 species of wild floras are available in which around 600 medicinal plants have been reported to be used in the traditional medicinal system and about 50,000 physicians of folk medicine registered in Pakistan (Hamayun, 2005). The area is under enormous pressure from locals because of the overuse of valuable plants, overgrazing, poor collection and storage, non-sustainable policy by government and non-government organisations (Siddique et al., 2019). It is a farming nation (ul Hassan et al., 2014) and depends on conventional medicines (Tariq et al., 2014). Thus, the main aim of this study is to document and record traditional folk knowledge and recipes being used in human and veterinary health care, with the highest use value (UV), credibility level values (CL values) values and informant consensus factor (ICF) values for further in vitro investigations.

## 2 | MATERIALS AND METHODS

### 2.1 | Study area

Haripur district is located in Hazara division of Khyber Pakhtunkhwa territory of Pakistan (Figures 1 and 2) at latitude 33°44 to 34°22 and longitude 72°35 to 73°15, and around 610 m over the ocean level. The complete territory of the region is 1725 km<sup>2</sup>. Haripur was established in 1822 by Hari Singh Nalva, a Sikh General of Ranjit Singh's military and pronounced region in 1991. He was the legislative head of Kashmir in 1822–1823 A.D. after whom is named. The district is divided

into three Tehsils (Khanpur, Ghazi and Haripur). The whole district is sub-divided into 44 Union Councils (UCs). According to the population census of 2017 conducted by Pakistan Bureau of Statistics (PBS), the population of the district is 1,003,031, having a population density of 581 persons per square kilometre. A region is a place where just 12% of the populace live in metropolitan regions. Horticulture is the fundamental wellspring of business of the provincial populace of the region. District Haripur has distinct geographical significance as its boundary touches seven districts, namely, Abbottabad, Attock and Rawalpindi, Buner, Mansehra, Swabi, Torghar and also Federal Capital Islamabad in the south (Siddique et al., 2019).

### 2.2 | Field survey

The entire investigation region was often visited between January 2018 and October 2020. The main target sites in the study area were Tofkian, Khanpur, Bareela, Hattar, Syria, Najafpur, Muslimabad, Barkot, Jabri, Bagra, Rehana, Jatti Pind, Teer, Beer, Kalinjar, Dingi, Sirikot, Qazipur, Ghazi and Nara Amazai. A field survey was planned to gather field information and activities such as ethnoveterinary and medicinal uses of plants along with recipes, informant's description, plant collection and identification, indigenous data about plants, identification of potential threats and photography. Verbal informed consent was taken from every informant prior to starting the interview process. This study was finished through very much arranged questionnaires, meetings and sharp perceptions. The questionnaire strategy was additionally useful in the documentation of society native information. The meetings were useful in examinations of neighbourhood individuals and learned people (hakims, ranchers and herders) who are predominantly associated with plants and associated with conventional medical services. Urdu and Hindko languages were used as a means of communication.

### 2.3 | Description of informants

A total of 80 informants participated in questionnaires and interviews during the field visits. 'Hindko' and 'Pahari' were the primary languages of informants. But, they could also speak 'Urdu' language at a glance and some informants had a grip over 'Pashto' language as well. Other description of informants with respect to age, education and profession is given in Table 1.

### 2.4 | Plant collection and identification

The plant specimens collected were authenticated using the international plant name index (<https://www.ipni.org/>), the Plant List (<http://www.theplantlist.org/>) and Germplasm Resources Information Network (GRIN) (<https://www.ars-grin.gov/>), while the name of families follows an angiosperm phylogeny group (APG), (<http://www.mobot.org/MOBOT/research/APweb/welcome.html>) (Stevens, 2019).

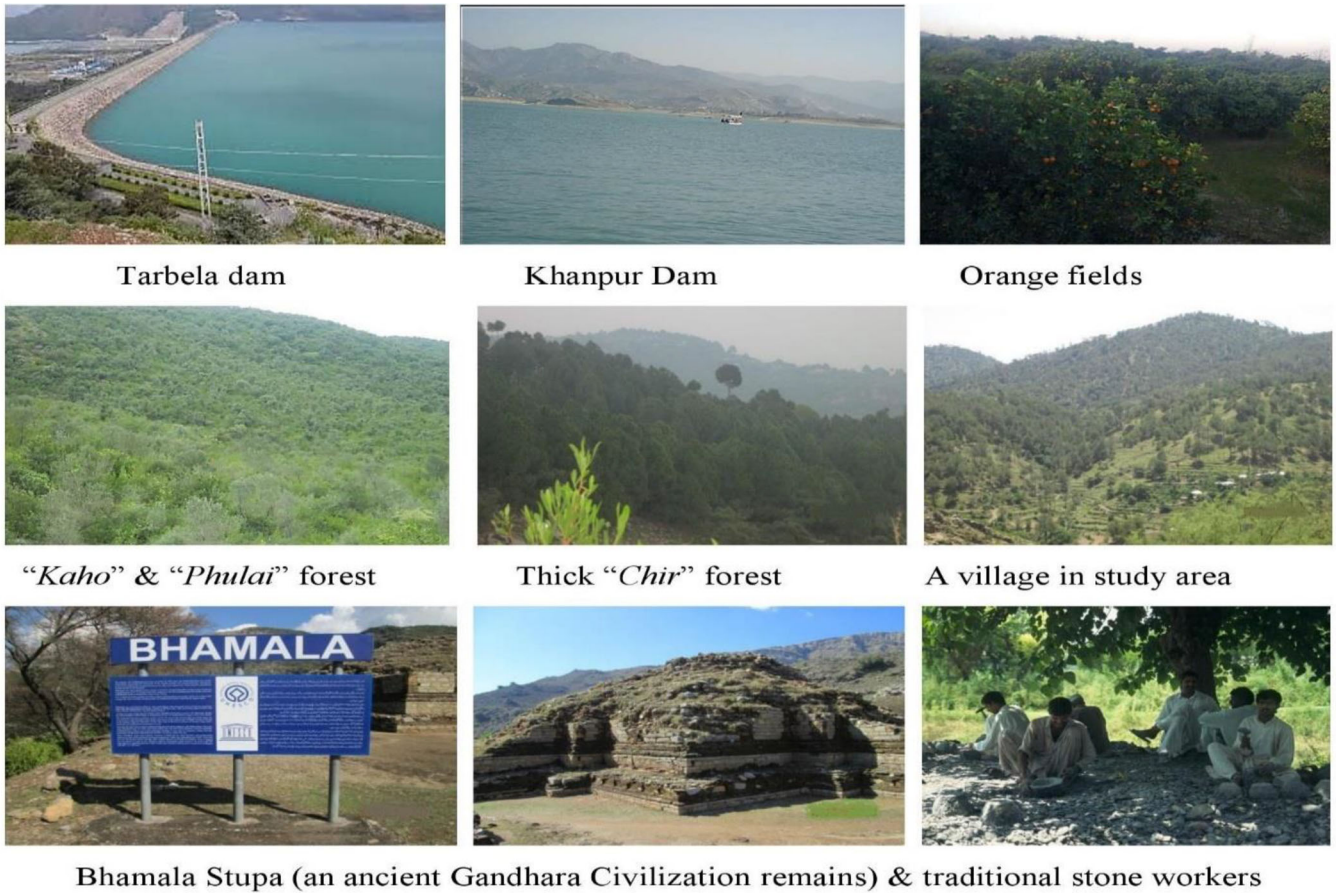


FIGURE 1 Recent pictures and descriptions of the study area

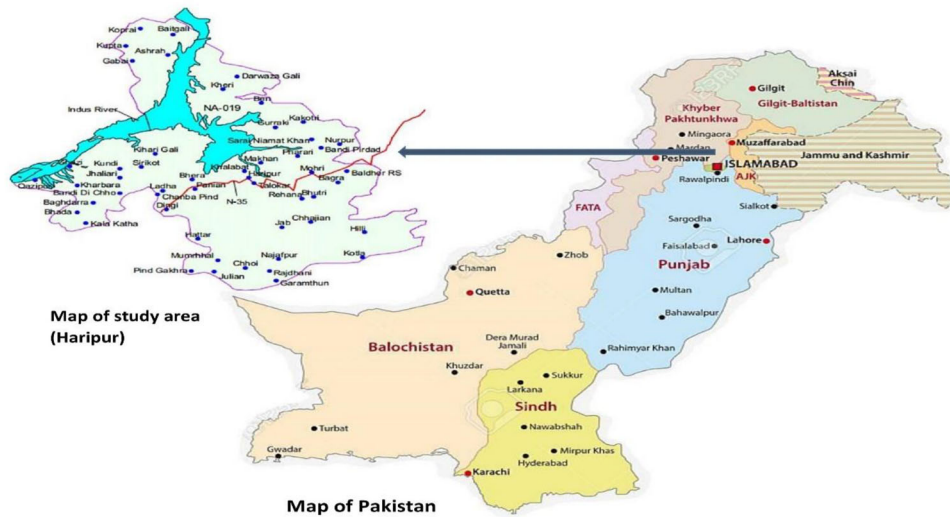


FIGURE 2 Map of the study area (Pakistan < Khyber Pakhtunkhwa < District Haripur)

The living organisms were ordered into spices, bushes, grasses and trees (yearly, biennial or enduring), as indicated by the framework proposed by Raunkiaer (1934), and altered by Brown (1977). The voucher examples were submitted in the herbarium of the Department.

2.5 | Statistical analysis

Use value (UV) of plant species: Use value (UV) determines the relative importance of the uses of medicinal plant species. It was calculated

**TABLE 1** Demographic profile of informants

By age	10–20 years	20–30 years	30–40 years	40–50 years	50–60 years	Above 60 years	Total	%
Male	0	05	10	15	18	22	70	87.5%
Female	–	–	–	03	04	03	10	12.5%
Total	–	05 (6.2%)	10 (12.5%)	18 (22.5%)	22 (27.5%)	25 (31.2%)	80	–
By qualification	Illiterate	Primary	Middle	Secondary	Higher secondary	Higher education	Total	%
Male	16	18	14	14	06	02	70	87.5%
Female	05	03	02	–	–	–	10	12.5%
Total	21 (26.2%)	21 (26.2%)	16 (20%)	14 (17.5%)	06 (7.5%)	02 (2.5%)	80	–
By profession	Farmers	Herdsmen (nomadic)	Hakim (healers)	Teachers	Shopkeeper	Labourers	Total	%
Male	45	15	03	02	02	03	70	87.5%
Female	08	02	–	–	–	–	10	12.5%
Total	53 (66.2%)	17 (21.2%)	03 (3.7%)	02 (2.5%)	02 (2.5%)	03 (3.7%)	80	–

using the following formula as explained before (Ahmed, 2016).

$$\frac{UV_i = \sum U_i}{N}, \quad (1)$$

where  $UV$  shows the use estimation of individual species,  $U$  is the quantity of employments recorded for that species and  $N$  addresses the number of sources who revealed that species.

**Jaccard index (JI):** To contrast the results of the present study with previously published work and to get to the comparability of information among various communities, the Jaccard list (Gonzalez et al., 2008) was determined utilising the accompanying formula.

$$\frac{JI = c \times 100}{(a + b) - c}, \quad (2)$$

where  $a$  is the number of species of region A (our investigation zone),  $b$  is the number of species of the adjoining territory B and  $c$  is the number of species mutual to both A and B.

### 3 | RESULTS AND DISCUSSION

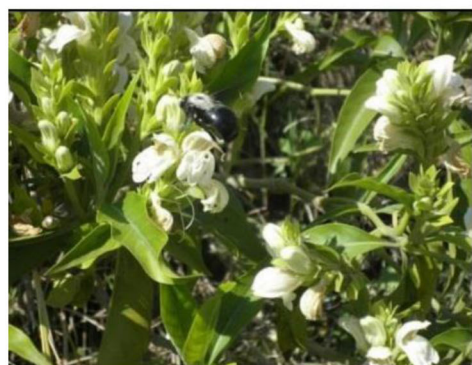
#### 3.1 | Sociodemographic profile of local informants

Man has been using plants for a long time to satisfy diverse day needs and to keep up life forms including medical purposes by indigenous occupants, as well as for ethnoveterinary medicine which displays a less expensive and sustainable alternative to synthetic medicines. This information changes from area to district and from community to society. The study area has unique plant diversity as its upper parts contain Himalayan moist temperate forests generally called Blue pine forests. The middle has sub-tropical pine forests generally called 'Chir' forests, still lower parts fall in dry sub-tropical broad-leaved forests generally called Scrub forests and locally as 'Kao & Phulai' forests, while areas

adjacent to Punjab has tropical vegetation. According to the demographic profile (Table 1), 87.5% of informants are male and only 12.5% of women have traditional knowledge about ethnomedicine. This was also mentioned by other studies (Farooq et al., 2019; Ahmed et al., 2014; Kayani et al., 2015; Umair et al., 2017) and probably because of cultural and religious restrictions as females would not be happy to participate and sharing knowledge with the male interviewees. More than 80% of older people (aged over 40) have more information regarding traditional medicine than middle-aged people (aged under 40). The significant indigenous information on plants is being bound to the old individuals for the most part, as the youthful ages have little enthusiasm for such customary practices and primarily on account of changing the way of life and culture among the young. This can be derived from the source's depiction by age, indicating that there were just 6.2% witnesses beneath 30 years old. This trend was versa in terms of education where adolescents are more literate than elderly informants. 56.2% of the informants are farmers, followed by 22.2% herdsmen and only 3.7% Hakim (Healers). This may be the outcome of modernisation and feeble convictions of youngsters concerning alternative medicines and because of evolving ways of life, improvement in present-day medicine and urbanisation (Ahmed, 2016). Hindko is the predominant language in the study area, while other languages spoken are Pahaari, Punjabi, Mirpuri, Pashto, Potohari, Gojri and Urdu.

#### 3.2 | Diversity of ethnomedicinal flora

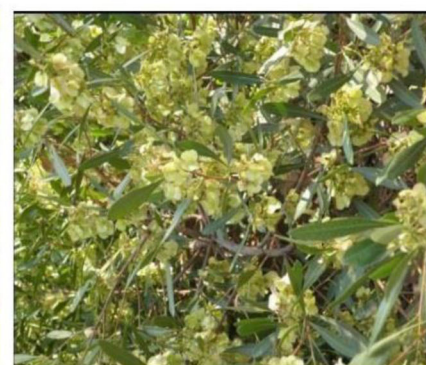
In the present study, data on 80 medicinal plant species belonging to 49 families, distributed in 74 genera have been collected and recorded from the study area for treatment of human health and animal health. Pictures of some important plants are given in Figure 3. The medicinal plant studied has diverse growth forms and life span this was including 33 herbs (41.2%), 21 shrubs (26.2%), 24 trees (30%) and 2



*Adhatoda vasica* Nees



*Berberis lycium* Royle



*Dodonaea viscosa* (L.) Jacq.



*Ficus benghalensis* L.



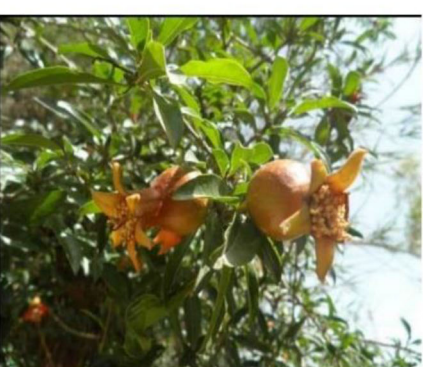
*Mallotus philippinensis* Muell.



*Morus nigra* L.



*Nerium indicum* L.



*Punica granatum* L.



*Vitex negundo* L.

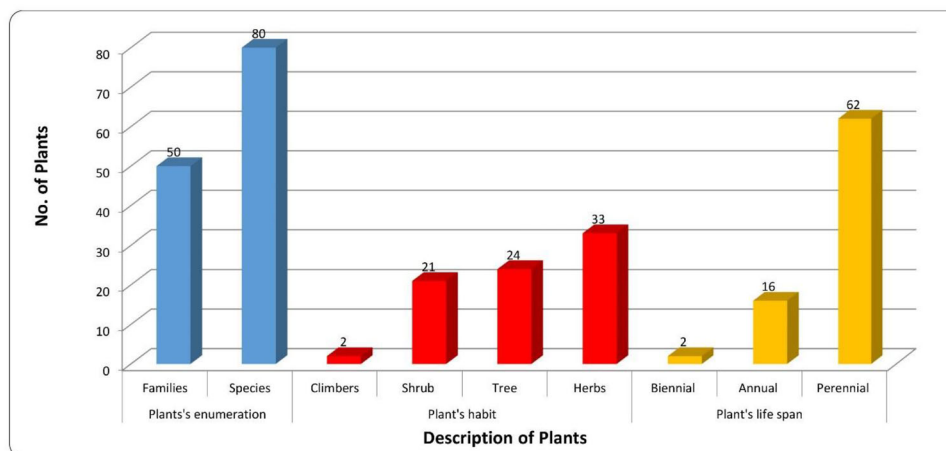
**FIGURE 3** Pictures of some ethnobotany medicinal plants of District Haripur used by indigenous people

climbers (2.5%). Furthermore, there were 16 annual (20%), 2 biennial (2.5%) and 62 perennial (77.5%) plant species as shown in Figure 4. This represents the unique phytogeography and phytosociology of the study area.

There are 40 plants used in livestock health care, 49 plants are used in the treatment of human diseases. Thus, 9 plants are used commonly in both livestock and human health care in the area. Detailed information about each plant pertaining to botanical name, voucher number, local name, family, habit, life span, locality, parts used, animals treated, animal diseases treated, ethnoveterinary recipes, human dis-

eases treated, human ethnomedicinal recipes, number of informants and use values are listed in Table S1. In similar researches, many other researchers (Abbasi et al., 2010; Shah et al., 2012; Abbasi et al., 2013) have significantly explored ethnomedicinal plants used in human health care and livestock from many other areas of Pakistan.

It has been found a diversity of plant families in the study area, as represented by 49 different families. Among these 49 families, Lamiaceae was the largest family represented by 6 species (7.5%), followed by Moraceae with 5 species (6.2%), Apocynaceae with 4 species (5%), Fabaceae/Leguminosae, Asteraceae/Compositae,



**FIGURE 4** Description of plants used in the study area by people to treat diseases

**TABLE 2** Description of medicinal plant families used in the study area

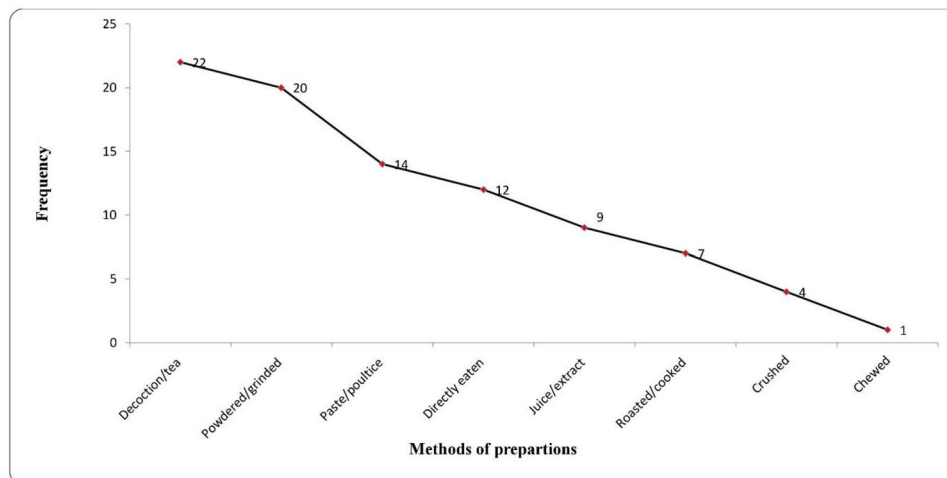
No	Family	No. of medicinal plant species	Percentage
1	Lamiaceae/Labiatae	6	7.5
2	Moraceae	5	6.2
3	Apocynaceae	4	5
4	Fabaceae/Leguminosae	3	3.7
5	Asteraceae/Compositae	3	3.7
6	Euphorbiaceae	3	3.7
7	Rhamnaceae	3	3.7
8	Solanaceae	3	3.7
9	Amaranthaceae	2	2.5
10	Apiaceae	2	2.5
11	Caesalpinaceae	2	2.5
12	Cruciferae	2	2.5
13	Liliaceae	2	2.5
14	Malvaceae	2	2.5
15	Meliaceae	2	2.5
16	Menispermaceae	2	2.5
17	Verbenaceae	2	2.5
18	Others	32	40.3
Total		80	100

Euphorbiaceae, Rhamnaceae and Solanaceae with 3 species each (3.7%), Amaranthaceae, Apiaceae, Caesalpinaceae, Cruciferae, Liliaceae, Malvaceae, Meliaceae, Menispermaceae and Verbenaceae with 2 species (2.5%) and so on as given in Table 2. The number of species against respective families is much lower as 80 medicinal plant species reported against 49 families. The number of families reflects that there is considerable diversity of flora because of the unique phytogeography of the study area; however, the number of plant

species showed that there is a rapid elimination of medicinal plants due to various potential threats. While, in another study conducted in Cholistan desert, Punjab Province, Pakistan among, 70 medicinal plants reported, Poaceae was the predominant family (Ahmed et al., 2014), and study in communities of Dhirkot, Azad Jammu and Kashmir, Pakistan showed Asteraceae was the dominant family with (14.29%), followed by Poaceae (10%), Lamiaceae (7.86%) (Farooq et al., 2019). The dominance of Lamiaceae, Moraceae, Apocynaceae, Asteraceae might be due to the nature of the study area District Haripur which owns unique geography, culture, history, and phytodiversity and area is the part of lesser Himalaya and gateway to Hazara division and northern areas of Pakistan. In addition, its boundaries touch to the seven districts, namely, Mansehra, Abbottabad, Torgar, Buner, Swabi, Attock and Rawalpindi. The Federal Capital Islamabad and Marghalla Hills National Park are also adjacent to the District in the south. It has two important water reservoirs, that is, Tarbela dam on Indus River and Khanpur dam on Haro River. The ancient Buddhist site of Bhamala located at the origin of Khanpur Dam reflects the diverse history of the study area. Recently unearthed 48-foot long 'sleeping Buddha' statue dates back to the 3rd century, which is the world's oldest 'sleeping Buddha' statue. The study area is home to one million people belonging to different castes and tribes, namely, the Hindko Speaking Pashtun Tribes, Tanolis, Panni, Jadoon, Mashwani, Tareen, Utmanzai, MusaKhail, Dilazak and some other castes include Mughal, Douli Mughal, Abbasi, Gujjar, Awan, Qureshi and Gakhar. Only 12% of the population live in urban areas, while the rest of 88% live in rural areas. Agriculture is the main livelihood of the rural population.

### 3.3 | Preparation of herbal remedies and plant parts used

The methods of preparation for 80 different remedies/recipes fall into eight categories such as plant parts used as a decoction/tea (22), powdered/ ground (20), paste/poultice (14), directly eaten (12),



**FIGURE 5** Methods of drug preparations used in the study area to treat different ailments

juice/extract (09), roasted/cooked (07), crushed (04) and chewed (01) as shown in Figure 5. These methods of preparations have been adopted from generation to generation through folk knowledge. Elder people in the study area were enriched in medicinal plant knowledge, their preparations and usage. People make use of mortar and pestle to prepare medicinal recipes by crushing and grinding medicinal plants into different forms like paste, powder, crushed, etc. depending upon whether the medicinal plant used was dried or fresh. Usually, mortar is made of hardwood or hard stone, however, the pestle is always made of wood, as wood is easily available. For this purpose, they use wood of *Olea ferruginea* locally called 'Kaho'. People made such implements for domestic use or for sale purposes to earn money. Machines are also used to obtain other forms of medicinal preparations. These medicinal preparations are used both internally and externally. Medicinal preparations are often preserved in different ways for later use. Most preparations are preserved in powdered forms with due care. They are a cheaper and instant source of relief for local people. The use of medicinal plants is going on from generation to generation. But unfortunately, authentic/folk knowledge of these plants is depleting due to transforming culture and new trends emerging in society. The frequent use of decoction had also been reported previously in the studies conducted by Bibi et al. (2014) and Umair et al. (2019).

Data presented in Figure 6 revealed that local inhabitants of the study area use 11 various parts of medicinal herbs in making recipes to treat different ailments. Among these, leaves were the most abundantly utilised plant parts with percentage contributions of nearly half of the plant parts (46%), followed by fruit (15%), whole plants and roots (8%) for each one, bark and stem (6%) for each one, seeds (5%), bulb, twigs, pod and spines (2%, 2%, 1%, and 1%), respectively. This is due to the fact that leaves are the easiest and abundant part to collect and accumulate secondary metabolites that are responsible to release health benefits for human disorders (Zahoor et al., 2017). Moreover, leaves are easy to prune, processing and using. In contrast, for the extraction of roots, the technical aspects are to be followed. The study revealed that people of District Haripur use recipes/preparations both

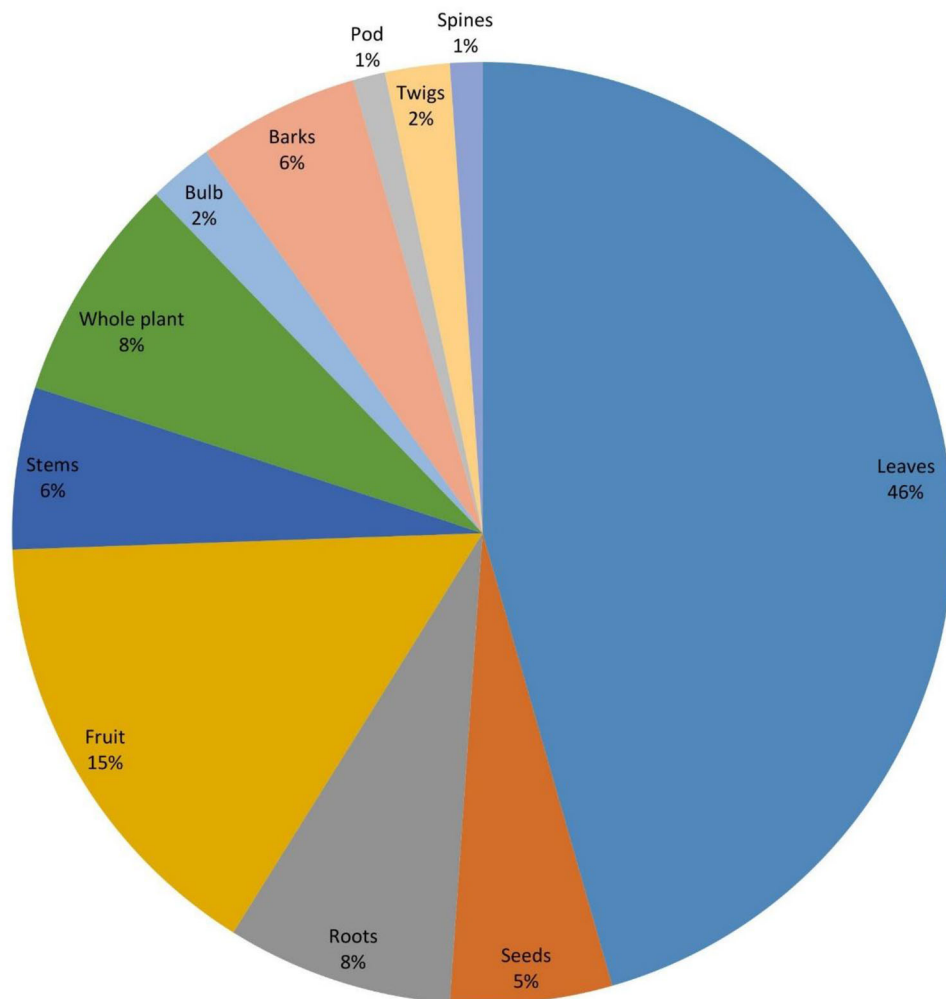
internally and externally. These treatments involve 75% internal and 25% external use.

### 3.4 | Statistical analysis of medicinal plant species

#### 3.4.1 | Human ailments treated with medicinal herbs

In the study area, 42 human ailments were identified to be treated by 49 medicinal plants under 52 natural remedies. These 42 ailments were further categorised into 12 major disease categories. Local people use 12 remedies for digestive system related disorders followed by 10 remedies for dermal and wound problems, 06 remedies for liver tonic and jaundice, 05 remedies each for diabetes and respiratory system related, 04 remedies for circulatory system and blood-related disorders, 03 remedies for mouth and throat infections, 02 remedies each for excretory system-related disorders and fever and 01 each for animal and insect bites, bones and joints related and reproductive system related as shown in Table S2. It was found that single medicinal plant species can treat several human ailments, and single ailments can be treated by many medicinal plant species. For example, dermal and wounds can be treated by 10 different medicinal plants.

Almost all plant parts were subjected to medicinal use both for human and livestock diseases. Use value (UV) of plant species was also calculated in order to determine the relative importance of plants in the study area with respect to usage. Results showed that *Boerhavia diffusa*, *Centella asiatica*, *Morus nigra*, *Nasturtium officinale*, *Rumex hastatus* and *Sageretia thea* have a higher use value (UV), i.e. 1, while *Caralluma edulis* species has a lower use value (UV), i.e., 0.1 as shown in Table S1. Indigenous communities differ greatly in their ethnobotanical knowledge due to differences in their origins and cultures. Documenting and comparing this knowledge can reveal the considerable depth of knowledge among communities which can result in novel sources of drug development (Leonti, 2011). Such studies also point out the importance



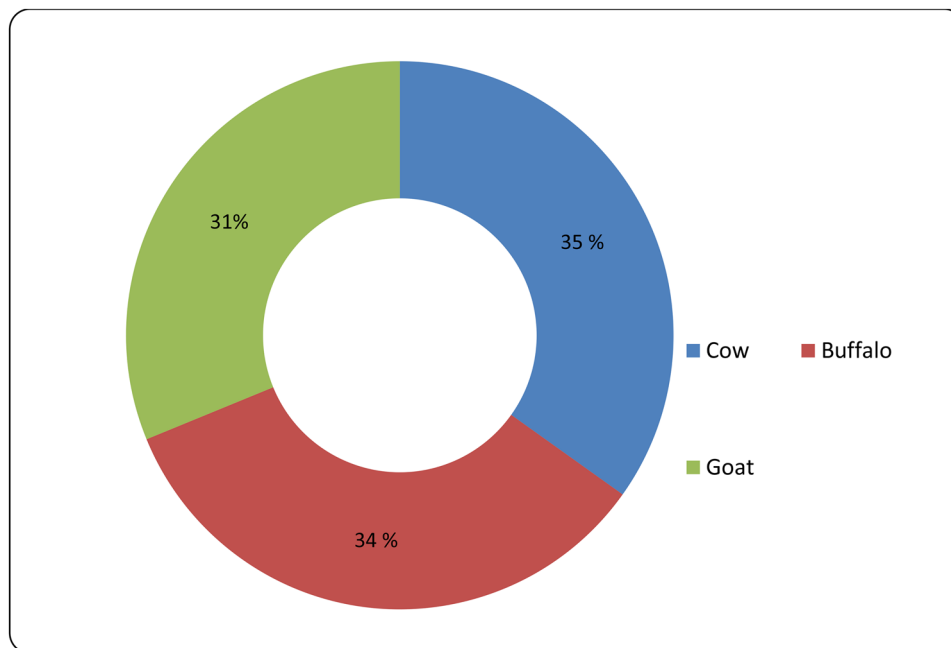
**FIGURE 6** Frequency of plant parts employed in ethnomedicinal uses by peoples of the study area

of indigenous knowledge of medicinal plants, with differences between regions arising as a result of historical, ecological, phytochemical and even organoleptic differences (Ladio et al., 2007). The ethnomedicinal results were also compared with 45 studies conducted in different areas of Pakistan similar in terms of sociocultural values by using Jaccard index. Jaccard index was calculated separately for ethnomedicinal plants used for human and livestock health care.

Likewise, Jaccard index (JI) for 49 human medicinal plants of our study area was also compared with the 20 national studies conducted in different areas of Pakistan similar in terms of cultural values in the study area. The data show that across 49 plant species used in human health care, the similarity percentage ranges from 0% to 57.1%, while the dissimilarity percentage ranges from 42.8% to 100% (Table S3). The high degree of similarity index was with studies by Abbasi et al. (2010) and Shah and Khan (2006) with JI values 17.04 and 12.1, respectively. These studies might have a cross-cultural exchange of knowledge between the communities through any means. The lowest JI values were for the studies conducted by Qureshi (2012) and Ahmad et al. (2012) with JI values of 2.3 for each one. This might be

due to the greater difference in ethnobotanical knowledge, differences in population size, species diversity and habitat structure or due to less chance of the exchange of cultural knowledge between the areas. This comparative analysis strengthens the value of the folk medicinal knowledge from our study area by emphasizing the novelty of our findings, whilst also providing a basis for future studies. In the study area, 09 medicinal plants are used for the treatment of both livestock and human ailments as shown in Table S4. It was observed that different parts of plants are used against different diseases of both livestock and humans. Medicinal plant species still give well-being security to individuals living in the rural territories of immature and poor countries of Africa, Asia and South America. In Pakistan, an enormous bit of the rustic populace utilizes indigenous therapeutic plants for relieving their illness. Pakistan has around 50,000 registered practitioners of customary drugs known as Tibb-e-Unani and most of the populace, particularly the countryside, is getting social insurance by Tabbibs (specialists of the eastern medication). It is believed that 60% of the populace utilized natural medications endorsed by conventional specialists (Hamayun et al., 2006).





**FIGURE 7** Types of livestock treated by using herbal drugs in the study area

### 3.4.2 | Livestock ailments treated by herbal plants

In the study area, 34 livestock ailments were identified to be treated by 40 plants under 40 remedies. These 34 ailments were further categorized into 07 major disease categories. Local people use 16 remedies for digestive system related disorders followed by 6 remedies for bones and joints related disorders, 5 remedies each for the reproductive system and dermal and wound problems, 2 remedies each for fever, mouth and throat infections, excretory system and respiratory system related disorders as shown in Table S1. Thirty-seven remedies were those that use a single plant while 3 use more than one plant. The study explored that people of District Haripur mainly rely on cow, buffalo and goats for their dairy and meat requirements. Thus, mostly these animals are treated with ethnoveterinary medicines as recorded during the study. Cow constitutes 35%, buffaloes 34% and goats 31% of the total treatments as shown in Figure 7.

The ethnoveterinary results of the present study were compared with those from 25 national studies conducted in different areas of Pakistan, showed similar trends in terms of their cultural values and climatic conditions in the study area (Table S5). The data show that across 40 plant species used in veterinary health care, the similarity percentage ranges from 0% to 60%, while the dissimilarity percentage ranges from 40% to 100%. The high degree of similarity index was with studies by Tariq et al. (2014), Islam et al. (2012) and Khan et al. (2012) with JI values of 32.7, 25 and 13.4, respectively. These studies either have common ethnic values, historical and ecological factors and similar vegetation types or cross-cultural exchange of knowledge between the communities. The lowest JI values were recorded for the studies conducted by Dilshad et al. (2008), Raziq et al. (2010) and Mirani et al. (2014) with JI values of 1.5, 2.1 and 2.5, respectively. This might be

due to the greater difference in ethnobotanical knowledge due to the differences in population size, species diversity and habitat structure or due to less chance of the exchange of cultural knowledge between the areas. These findings are in agreement with studies carried out by Kayani et al. (2015). This comparative analysis strengthens the value of the ethnoveterinary knowledge from our study location by emphasizing the novelty of our findings, whilst also providing a basis for future studies.

## 3.5 | Ethnomedicinal comparisons and novelty

### 3.5.1 | Ethnomedicinal uses for humans

As, mentioned earlier, in the current study there were 49 medicinal plants used for the treatment of human diseases and 9 medicinal plants were common to both livestock and human health care. Medicinal plants or their parts are collected in different seasons depending upon their availability or frequency of active constituent deposition. The plants after collection are dried in shade and sunlight. Mostly leaves and flowers are dried in shade, while seeds, roots, fruits and bark are dried in sunlight for 6–9 days. Most plants are dried by women and old men on a cloth on the ground. Some plants are also used in fresh form. Medicinal plants are also preserved for later use. Thus a comparison was made between the 12 most cited ethnomedicinal plants of district Haripur, used in human health care, with other studies in order to reveal novelty and to strengthen our findings on a similar and dissimilar basis. It was revealed that 10 ethnomedicinal plants of District Haripur have dissimilar uses, while 2 have similar uses. Plants with dissimilar uses are in District Haripur, for example, *Achyranthes aspera* is used for

tonsillitis, while in Chenab riverine area, Punjab province (Pakistan) it is used for kidney stone, pneumonia, chest pain, puncture wounds, ulcer, dysmenorrhea, aerodontalgia and asthma (Umair et al., 2019).

Similarly, in Haripur district, *Morus nigra* is used to treat cough and throat infection, while in Terich valley, Chitral it is used in jaundice and dyspepsia (Zaman and Badshah, 2019). *Azadirachta indica* is used to treat diabetes; however, in Hafizabad district along with diabetes, it is also used for purification of blood, malaria, intestinal worm, headache, toothache, liver tonic, rheumatism and smallpox (Umair et al., 2017). *Melia azedarach* is used during high blood pressure, while in Swat district it is used as antidandruff agent (Ahmad et al., 2011). *Cichorium intybus* is used for a stomach problem, while in Laspur Valley Chitral, it is used for cardiac problems, malaria, vomiting and typhoid (Bibi, 2019). *Otostegia limbata* is used for wound healing, while in the Lesser Himalayan region of Pakistan, it is used for toothache, jaundice and eye inflammation (Majid et al., 2019). *Ficus carica* is used to overcome blood deficiency, while in Laalqilla, District Lower Dir it is used as a general body tonic (Irfan et al., 2018). *Datura stromonium* is used to treat bleeding piles, while in karamar valley Swabi, it is used to treat asthma (Khalid et al., 2017). *Nasturtium officinale* is used for constipation, obesity and as a diuretic, while in Thana village district Malakand, it is used for stomach ache (Gulzar et al., 2019). *Zanthoxylum armatum* is used for jaundice, while in southern Himalayan regions of Pakistan, it is used for toothache and cardiac disorders (Qureshi et al., 2009).

The 2 most cited ethnomedicinal plants of our study area, used in human health care, reported with similar uses include; *Allium sativum* which is used for high blood pressure with similar use by the people living around Indus River (Mussarat et al., 2014). *Caralluma tuberculata* used for diabetes with a similar use in Namal valley (Shah et al., 2019). Leaves of *Althaea officinalis* L have been used to cure burns, cough, and chest inflammation externally and internally in the form of poultice, decoction in Slemani, Kurdistan (Iraq), and while in our study is used for cough and tonsillitis and this could be a new use. Leaves and flowers of *Artemisia vulgaris* L in the same area are used for anaemia, obesity, abdominal pain (Ahmed, 2016), but in the present study is used for hepatitis. *Nasturtium officinale* R. Br. is used for constipation, diuretic and obesity in our study while in Hawraman, Slemani, Kurdistan Region is used as a diuretic (Pieroni & Ahmed, 2017). Therefore, in comparison with other literature, it was revealed that 10 ethnomedicinal plants used in human health care have new uses in the folk herbal medicinal literature, while 2 have the same uses.

### 3.5.2 | Ethnoveterinary medicinal plant uses

The study showed that 40 plants were used for the treatment of livestock diseases. Thus, comparative analysis shows that the use of medicinal plants of District Haripur in veterinary health care may or may not be similar to the other reviewed literature reported from various other areas. The most widely used ethnoveterinary medicinal plants in our study area are *Grewia optiva*, *Cassia fistula*, *Dodonaea viscosa*, *Mallotus philippensis*, *Solanum surattense*, *Carissa opaca*, *Melia azedarach*, *Berberis lyceum*, *Punica granatum*, *Adhatoda vasica*, *Cynodon*

*dactylon*, *Mentha arvensis*, *Curcuma longa*, *Acacia modesta*, *Amaranthus viridis*, *Ricinus communis* and *Acacia nilotica*. Furthermore, comparison of 17 most cited ethnoveterinary medicinal plants with other studies (Tariq et al., 2014; Jabbar et al., 2006; Dilshad et al., 2010; Raziq et al., 2010; Mussarat et al., 2014; Khan, 2009; Patil and Deshmukh, 2015; Raut and Shrestha, 2012; Balan and Baskaralingam, 2015; Tariq et al., 2016; Khattak et al., 2015; Sindhu et al., 2012; Zia-ud-Din et al., 2010; Deeba et al., 2009; Akhtar et al., 2000; Muhammad et al., 2005; Raza et al., 2014; Ahmad et al., 2015) revealed that 13 has dissimilar uses, while 4 have similar uses. It was found that the plants with new ethnomedicinal uses have not been subjected to any phytochemical or biological studies with respect to ethnoveterinary uses. Plants with dissimilar uses were, for example in District Haripur, *Grewia optiva* is used for easy delivery, while in South Waziristan and Bajaur Agency it is used for wound healing (Aziz et al., 2018). *Dodonaea viscosa* is used in our study to recover bone fractures, while in Chail valley, Pakistan, it is used as anthelmintic (Ali, 2017). *Solanum surattense* is used to treat fever, while in Cholistan desert (Pakistan), it is used for curing myiasis (Farooq et al., 2008). *Carissa opaca* is used in the treatment of foot and mouth disease, while in Kathua, Jammu and Kashmir (India) it is used to increase milk in cattle (Sharma et al., 2012). *Berberis lyceum* is utilised for the healing of wounds and internal injury, while it is used against gastrointestinal worms by the Pashtun Koochi nomads (Afghanistan) (Davis et al., 1995). *Adhatoda vasica* is used for wound healing and inflammations, while in Tamil Nadu (India) it is used to treat cough, diarrhoea and dysentery (Parthiban et al., 2016). *Cynodon dactylon* is used during haematuria, while in Hamirpur, India, it is used during burns and injuries (Sehgal and Sood, 2013). *Mentha arvensis* is effective for curing dysentery, while in Kathua, Jammu and Kashmir, it is utilised as bloating (Sharma et al., 2012). *Curcuma longa* is used for wound healing and *Acacia modesta* is utilised for easy delivery while in Thakht-e-Sulaiman hills, Pakistan, both are used for the treatment of skeletomuscular disorders (Ahmad et al., 2015). *Amaranthus viridis* is used to enhance milk production, while in Northern Pakistan, it is used to treat constipation (Shah et al., 2012). *Acacia nilotica* is effective during colic pain, while in Karnataka, India, it is used to cure jaundice (Kumar and Nagayya, 2017).

The 4 most cited plants of study area reported with similar ethnoveterinary uses include *Cassia fistula*, *Mallotus philippensis*, *Melia azedarach* and *Ricinus communis*. In the study area, *Cassia fistula* is used against asthma and pneumonia with a similar use in north coastal Districts of Andhra Pradesh, India (Lakshminarayana and Rao, 2013). Likewise, *Mallotus philippensis* is used against intestinal worms, with similar use in Poonch Valley Azad Kashmir (Khan et al., 2012). *Melia azedarach* is effective in combating intestinal worm and stomach flatulence with a similar use in Bheri, district Muzaffarabad (Ahmed and Murtaza, 2015). *Ricinus communis* is used to treat constipation with a similar use in Patagonia, Argentina (Ladio et al., 2007). The comparison of 17 most cited ethnoveterinary medicinal plants revealed that only 4 plants have similar uses, while 13 have dissimilar ethnoveterinary uses. This reflects the novel and new use of ethnoveterinary plants in District Haripur. Hence, there are certain uses of the studied ethnoveterinary medicinal plants that were not reported or scarcely reported earlier

in ethnoveterinary documentations across or outside the country. The comparison of present findings with previous studies shows that the same medicinal plants are used in different parts of the country with different uses. Moreover, people also use different parts of the same plant for similar or different diseases.

The Jaccard index and comparative analysis with other studies showed the novel use of medicinal plants from our study area. This might be due to the following aspects of our study area which makes it different from others:

- (i) Distinguish and unique history, indigenous culture, phytogeography and phytodiversity of the study area.
- (ii) Existence of different tribes, castes, languages and folk knowledge. 'Hindko' language is predominantly restricted to our study area.
- (iii) Less chance of exchange of cultural knowledge due to restricted movement of people being residing in remote and hilly areas. And also the absence of a proper system of documentation, sharing and conservation of folk knowledge.
- (iv) Least interest of the younger generation (comprising about 70% of the total population) in folk knowledge and practices.
- (v) Differences in methods and techniques of medicinal plant collection, their processing, preparations, usage and storage.

Jaccard index analysis shows that about 21.3% of medicinal uses of reported species are similar, whereas 78.6% are dissimilar. Comparison of ethnomedicinal uses of 29 most cited medicinal plants with other studies revealed that 23 plants have dissimilar uses. This shows the novel use of medicinal plants from our study area. The major threats to the plant resources in the district were recognised such as overexploitation by humans and animals, consequent backwoods fires throughout the mid-year. Local collectors, vendors are among those who threaten the flora of Pakistan. The plant species with new medicinal uses could be studied further to screen bioactive compounds and their pharmacological activities to introduce novel drugs.

## 4 | CONCLUSION

The current study reports the value of ethnomedicinal plants used in veterinary and human health care in District Haripur. Local people have sufficient knowledge about ethnomedicinal folk practices; however, this knowledge is mainly confined to elder people and nomadic grazers. Mostly the younger generation does not take an interest in the utilisation of traditional remedies. The lifestyle of people is rapidly transforming due to modernisation. Because of which folk traditional knowledge is getting depleted. It is necessary to create awareness among local people about the importance of traditional herbal knowledge through documentation and other sources. Scientific and experimental validation of traditional knowledge is necessary to ensure safety and efficacy.

## AUTHOR CONTRIBUTIONS

Zeeshan Siddique: methodology, project administration, resources, writing-original draft. Hiwa M. Ahmed: writing-original draft, investigation, supervision, resources, software, visualisation, writing-review and editing, validation. Khabat Hussein: formal analysis, software. Khulod Hassan: resources, software, validation. Bashdar Meena: investigation, software.

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## CONFLICT OF INTEREST

All the authors declare no conflict of interest.

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## DATA AVAILABILITY STATEMENT

The data sets used for this study are available and can be accessed at a reasonable request.

## ETHICAL STATEMENT

The authors confirm that the ethical policies of the journal, as noted on the journal's author guidelines page, have been adhered to. The study included sampling of plants for diagnostic purposes and therefore did not require approval from the ethic committee.

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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