AN ETHNOVETERINARY STUDY ON MEDICINAL PLANTS USED FOR ANIMAL DISEASES IN RIZE (TURKEY)

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Abstract. Medicinal plants used in the treatment of animals in Rize province in northeast of Türkiye were recorded through semi-structured interviews with farmers and shepherds. The collected data were analyzed using the quantitative indices informant consensus factor (FIC) and fidelity level (FL). It was identified that a total of 38 plants belonging to 30 families were found used in ethnoveterinary. The most cited families were Fabaceae and Asteraceae. The highest FIC was recorded for digestive system diseases (0.93), followed by skin diseases (0.88) and milk production (0.85). The high FL values were Datisca cannabina L. for varroa, Malva sylvestris L. for wound healing, and Sambucus ebulus L. for external parasite (respectively 100%). Ethnoveterinary uses of Datisca cannabina L., Caltha palustris L., Bryum schleicheri Schwägr., Adiantum capillus-veneris L., Solidago virgaurea L. were recorded for the first time.

Keywords: ethnoveterinary knowledge, folk remedies, informant consensus factor, livestock ailments, traditional practices

Introduction

Plants have been a natural resource for humans and their pets to stay healthy. The best way to detect plants used in animal diseases is ethnoveterinary and ethnobotanical studies (Erarslan and Kültür, 2019). About 70000 of the plants on earth are used for therapeutic purposes. A large part of the world’s population continues to trust folk medicine in the treatment of animals as well as their private health (WHO, 2021).

Ethnoveterinary medicine is a traditional treatment method applied by local people to protect the health of livestock and pets according to their traditions and cultures (McCorkle, 1986). Ethnoveterinary apps, which are unlike medical veterinary apps, are practiced and developed by farmers and shepherds and are handed down from generation to generation (Pande et al., 2007). This information, which usually does not have a written record, is in danger of being lost over time.

Traditional treatment methods for animals in Türkiye are limited to ethnobotanical studies. There are few resources available for ethnoveterinary knowledge (Sinmez and Aslım, 2017; Sinmez and Yaşar, 2017; Yipel et al., 2017; Sinmez et al., 2018; Güler et al., 2021; Akbulut, 2022; Babacan et al., 2022). For this reason, recording traditional information in Türkiye will contribute to the development of animal husbandry. It was a decrease in the presence of cattle and a significant increase in bees and small cattle in the last 20 years in Rize. The cattle population, which was over one hundred thousand before, has decreased to 29,522 today. There are 6,908 sheep, 10,855 goats, 173 odd-toed ungulates, 2,425 cats and dogs, and 7,259 poultry. In Rize, the culture breed is Jersey, and there are few Brown Swiss and Holstein breeds. Beekeeping activities have gained momentum in recent years. The number of old type hives (black hives) is 4.159,
and new type hives are 62,952, totaling 67,111. The number of villages dealing with beekeeping is 303. Annual honey production; is 638,250 kg, and wax production; is 22,400 kg. The number of registered farmers is over 10,000. (TR Ministry of Agriculture and Forestry, 2021). The study aims to record the plant taxa used in the ethnoveterinary, their preparation, and application methods used by local farmers and shepherds in treating different animal diseases in Rize and to contribute to animal medicine in this context.

Materials and methods

Study area

Rize is located in the Eastern Black Sea Region of Türkiye (Fig. 1). It is adjacent to the Black Sea in the north, Trabzon in the west, Artvin in the east, Bayburt in the southwest, and Erzurum in the south, and located between 40°-21’ and 41°-25’ east longitudes and 40°-33’ and 41°-20’ north latitudes. Rize is located in the Euro-Siberian flora region and the A8 squares according to the grid system by Davis (Davis, 1965). It has a significant plant diversity with approximately 1430 plant taxa, 110 of which are endemic (Güner et al., 2000). The region was mentioned for the first time in written records in the 8th century BC. Since then, it has hosted many civilizations covering Urartu, Pontus, Roman, Byzantine, and Ottoman (TR Ministry of Culture and Tourism, 2021). The most significant source of income of the region is tea agriculture. Due to the mountainous terrain, animal husbandry is usually ranched in the plateaus of Rize.
Data collection

The study was performed in the villages and highlands of Rize province between March and November 2021. Semi-structured interviews were carried out by 83 locals. Locals were chosen among the farmers and shepherds in the region. A survey was managed to the locals through face-to-face interviews. The demographic characteristics of the informants were noted. In the second part of the survey, the traditional methods related to the treatment of animals, plant species used, and the plant parts were recorded. Prior Informed Consent was taken orally before beginning each survey. Ethical directives considered the Code of Ethics of the International Society for Ethnobiology (ISE, 2008). Plant taxa were identified and named according to the Flora of Turkey (Davis, 1965-1985; Güner et al., 1987; Davis et al., 1988) and World Flora Online (WFO, 2021).

Data analysis

Ethnoveterinary information obtained from the surveys with farmers and shepherds was evaluated using quantitative methods (informant consensus factor and fidelity level).

The informant consensus factor (FIC) was calculated for each disease group to determine the informants’ agreement on the noted treatment (Andrade-Cetto, 2009). The FIC formula was (Eq. 1):

$$FIC = \frac{Nur - Nt}{Nur - 1}$$  \hspace{2cm} (Eq. 1)

$Nur$: Total citation in each disease group. $Nt$: The number of use taxa.

Fidelity level (FL) refers to the specificity of the plants of choice for the diseases most frequently cited by locals (Friedman et al., 1986). The FL formula was (Eq. 2):

$$FL(\%) = \frac{Ip}{Iu} \times 100$$  \hspace{2cm} (Eq. 2)

$Ip$: The number of people recommending utilizes of a plant for a specific disease. $Iu$: The total people who cited that a taxon is used to treat any disease.

Results

The study results showed that farmers and shepherds in Rize province use various ethnoveterinary methods for the health of their animals.

Ethnoveterinary records were compiled from face-to-face interviews with 83 locals. The informant ages ranged from 33 to 82, and the average was 52 (Table 1). The results showed that besides using the plants medicinally were used for milk yield and egg production (Table 2).

Ethnoveterinary medicine was usually used in cattle and small cattle. This is followed by bees, poultry, and horses. In the current study, a total of 38 plant taxa from 30 families used by farmers and shepherds for animal health were identified (Table 2). Plants were commonly used in the treatment of diseases such as wounds, cough, varroa, external parasites, and diarrhea. The most dominant family in terms of the number of species in the region was Fabaceae (4 taxa) and Asteraceae (3 taxa), and the remaining families had one or two taxa (Fig. 2). Leaves (15 taxa) and aerial parts (12 taxa) were used more for therapeutic effects, followed by flowers (6), fruits (3), and roots (2), respectively (Fig. 3).
**Table 1.** Demographic features of informants

| Indicator         | Number of informants | Percentage (%) |
|-------------------|----------------------|----------------|
| Gender            |                      |                |
| Male              | 31                   | 37.35          |
| Female            | 52                   | 62.65          |
| Educational level |                      |                |
| Elementary school | 6                    | 7.23           |
| Secondary school  | 24                   | 28.92          |
| High school       | 43                   | 51.81          |
| University        | 10                   | 12.05          |
| Age groups        |                      |                |
| 30-40             | 19                   | 22.89          |
| 41-50             | 33                   | 39.76          |
| > 50              | 31                   | 37.35          |

**Figure 2.** The most frequently used plant families

**Figure 3.** Plant parts used
### Table 2. Ethnoveterinary uses of plant taxa in Rize (Türkiye)

| Scientific name                  | Family               | Vernacular name | Parts used | Preparation | Route | Ethnoveterinary uses/therapeutic effect                          |
|----------------------------------|----------------------|-----------------|------------|-------------|-------|------------------------------------------------------------------|
| Sambucus ebulus L.               | Adoxaceae            | Livor           | Aerial parts | Decoction   | Dermal | External parasites                                                |
| Chenopodium polyspermum L.       | Amaranthaceae        | Sirius, Düdülü otu | Aerial parts | Fresh (fodder) | Oral | Increasing milk secretion                                         |
| Allium sativum L.                | Amaryllidaceae       | Sarımsak        | Bulb        | Fresh       | Dermal | Wound healing                                                     |
| Rhus coriaria L.                 | Anacardiaceae        | Sumak           | Fruits      | Decoction   | Dermal | Wound healing                                                     |
| Ferula szowitziana DC.           | Apiaceae             | Cağışır         | Roots (dried) | Powder      | Oral | Muscle pain (The powder is added to the water the animal will drink.) |
| Sanicula europaea L.             | Apiaceae             | Kada            | Aerial parts | Dried (fodder) | Oral | Boosting the immune system (for chicks)                           |
| Hedera helix L.                  | Araliaceae           | Sarımsak        | Leaves      | Decoction   | Oral  | Wound healing                                                     |
| Achilles millofolium L.          | Asteraceae           | Mayasıl otu     | Leaves, flowers | Crushing | Dermal | Wound healing (for cat and dog)                                  |
| Helichrysum plicatum DC.         | Asteraceae           | Altınnot, İspir ćeşği | Flowers     | Decoction   | Dermal | Wound healing                                                     |
| Solidago virgaurea L.            | Asteraceae           | Altınbaşak      | Leaves (dried) | Powder      | Oral  | Burn wounds                                                       |
| Anchusa azurea Mill.             | Boraginaceae         | Şişrotu, Goriz  | Leaves      | Fresh       | Oral  | Poisoning                                                        |
| Bryonia schleicheri Schwägr.     | Bryaceae             | Yosun           | Leaves      | Decoction   | Oral  | Sore mouth                                                       |
| Cannabis sativa L.               | Cannabaceae          | Kenevir         | Leaves      | Set on fire (dried) | Dermal | Varroa                                                           |
| Colchicum speciosum Steven       | Colchicaceae         | Gökövan         | Flowers     | Decoction   | Dermal | Cleaning cow udders                                               |
| Juniperus communis L.            | Cupressaceae         | Arduq           | Bark        | Set on fire | Dermal | Varroa                                                           |
| Datisca cannabina L.             | Datisaceae           | Renkotu         | Aerial parts | Set on fire (dried) | Dermal | Varroa                                                           |
| Equisetum arvense L.             | Equisetaceae         | Atkıuyunu       | Aerial parts | Crushing   | Dermal | Wound healing                                                     |
| Equisetum fluviatile L.          | Equisetaceae         | Atkıuyunu       | Aerial parts | Crushing   | Dermal | Wound healing                                                     |
| Euphoria dijimileensis Boiss.     | Euphorbiaceae        | Sütleğen        | Aerial parts | Fresh       | Oral  | Snake poisoning (for goat)                                        |
| Astracantha microcephala (Willd.) Podleck | Fabaceae            | Geven           | Leaves, roots | Decoction | Oral  | Increasing milk secretion                                        |
| Medicago sativa L.               | Fabaceae             | Yonca           | Aerial parts | Fresh (fodder) | Oral | Increasing milk secretion                                         |
| Onobrychis vicifolia Scop.       | Fabaceae             | Körunga, Alapar | Aerial parts | Decoction   | Oral  | Increasing milk secretion                                         |
| Trifolium pratense L.            | Fabaceae             | Yonca           | Leaves      | Fresh (fodder) | Oral  | Increasing milk secretion                                         |
| Populus tremula L.               | Fabaceae             | Kavak, Çeniçi   | Wood        | Poultice    | Dermal | Swollen leg and foot                                              |
| Hypericum perforatum L.          | Hypericaceae         | Kantarom       | Flowers     | Decoction   | Dermal | Wound healing, burn wound                                         |
| Rosmarinus officinalis L.        | Lamiaceae            | Biberiye        | Aerial parts | Crushing    | Dermal | Cleaning up fleas                                                 |
| Malva sylvestris L.              | Malvaceae            | Ebegünmecci     | Leaves      | Crushing    | Dermal | Wound healing                                                     |
| Ficus carica L.                  | Moraceae             | Incir           | Latex       | Fresh       | Dermal | Warts (on cow udder)                                              |
| Epilobium angustifolium L.       | Onagraceae           | Yaknotu         | Leaves      | Decoction   | Dermal | Wound healing                                                     |
| Picea orientalis (L.) Peterm.    | Pinaceae             | Karaçam         | Resine      | Cooking     | Dermal | Wound healing (with olive oil)                                    |
| Plantago major L.                | Plantaginaceae       | Çibanotu, Damarotu | Leaves      | Fresh       | Oral  | Antitussive, diarrhea                                             |
| Triticum aestivum L.             | Poaceae              | Buğday          | Leaves      | Crushing    | Oral  | Antitussive                                                       |

**Scientific name:** Scientific name of the plant taxa.  
**Family:** Family name of the plant taxa.  
**Vernacular name:** Vernacular name of the plant taxa.  
**Parts used:** Parts of the plant used.  
**Preparation:** Method of preparation.  
**Route:** Route of application.  
**Ethnoveterinary uses/therapeutic effect:** Ethnoveterinary uses/therapeutic effect of the plant taxa.
Adiantum capillus-veneris L.  Pteridaceae  Baldırıkara  Leaves  Poultice  Oral  Increasing milk secretion  Dermal  Sprains and swelling

Caltha palustris L.  Ranunculaceae  Gongoros  Aerial parts  Decoction  Dermal  Foot pain

Alchemilla sericea Willd.  Rosaceae  Kapara otu, Tifilica  Leaves, flowers  Dried (fodder)  Oral  Antitussive (for horses)

Alchemilla speciosa Buser  Rosaceae  Kapara otu, Tifilica  Leaves, flowers  Dried (fodder)  Oral  Antitussive (for horses)

Viscum album subsp. austriacum (Wiesb.) Vollm.  Santalaceae  Çabu  Fruits  Crushing  Dermal  Wound healing

Urtica dioica L.  Urticaceae  Sığran, Erengiç  Aerial parts  Dried  Oral  Enterozoon

Cooking  Oral  Eclampsia

The decoction was the most preparation method in traditional remedies (10 taxa), followed by fresh (8 taxa), crushing (7 taxa), and dried (7 taxa) (Fig. 4). Two routes of administration, dermal and oral, were used in the treatments. Both were equally cited.

Ethnoveterinary data were collected in 8 main categories in the FIC evaluation. In the current study, the FIC value ranged from 0.67 to 0.93 (Table 3). The medicinal plants are mostly used for skin diseases and wound healing, followed by digestive system diseases, milk production, and respiratory system diseases. Digestive system diseases have the highest FIC value (0.93). Skin diseases have the second-highest FIC value (0.88), milk production has the 3rd highest FIC value (0.85). The lowest FIC value with 0.67 corresponds to internal system diseases.

Table 3. Informant consensus factor (FIC) for each disease category

| Disease categories       | Diseases                                      | nt  | nur  | FIC  |
|--------------------------|-----------------------------------------------|-----|------|------|
| Digestive system diseases| Enterozoon, diarrhea, stomach ailments, dyspepsia | 3   | 30   | 0.93 |
| Skin diseases            | External parasites, skin inflammation, flea, varroa | 9   | 66   | 0.88 |
| Milk production          | Milk production                               | 5   | 27   | 0.85 |
| Respiratory system diseases| Cough                                        | 4   | 18   | 0.82 |
| Wound healing            | Wound, burn, fungus, tomites                   | 14  | 65   | 0.80 |
| Poisonings               | Poisonings                                    | 2   | 5    | 0.75 |
| Orthopedics and traumatology| Sprains and strains, mouse, foot pain, muscle pain | 4   | 12   | 0.73 |
| Internal system diseases  | Eclampsia, tonic                              | 2   | 4    | 0.67 |

Figure 4. Usage preferences in traditional remedies
An evaluation had made of the FL values of the cited plants. These values were found for the six most frequently cited plants, and their ranks ranged from 47.8 to 100 (Table 4). High FL was *Datisca cannabina* for varroa, *Malva sylvestris* for wound healing, and *Sambucus ebulus* for external parasite (respectively 100%).

**Table 4. Fidelity level (FL) index for the most cited medicinal plants**

| Scientific name           | Disease             | Ip | Iu | FL value (%) |
|---------------------------|---------------------|----|----|--------------|
| *Datisca cannabina* L.    | Varroa              | 15 | 15 | 100          |
| *Malva sylvestris* L.     | Wound healing       | 11 | 11 | 100          |
| *Sambucus ebulus* L.      | External parasite   | 16 | 16 | 100          |
| *Hypericum perforatum* L.| Wound healing       | 18 | 26 | 69.2         |
| *Allium sativum* L.       | Wound healing       | 8  | 13 | 61.5         |
| *Plantago major* L.       | Cough               | 12 | 23 | 52.2         |
| *Plantago major* L.       | Diarrhea            | 11 | 23 | 47.8         |

**Discussion**

In the current study, locals used mostly the leaves for treatment. Similarly, it was reported that leaves were the most preferred plant part in ethnomedicine studies, especially in ethnoveterinary medicine in Türkiye (Erarslan and Kültür, 2019). Difference from those, aerial parts took place in the first place in the study conducted in Trabzon, which is adjacent to the research area (Akbulut, 2022).

The decoction was the most frequently used method for treatment in the study area that was like the various research from Northeast and Eastern Anatolia (Güler et al., 2021; Akbulut, 2022; Babacan et al., 2022). In the studies carried out in Central Anatolia and the Mediterranean, different preparation methods took the first place (Yaşar et al., 2015; Sinmez and Aslım, 2017; Yıpel et al., 2017; Sinmez et al., 2018).

Ethnoveterinary uses of *Datisca cannabina*, *Caltha palustris*, *Bryum schleicheri*, *Adiantum capillus-veneris*, *Solidago virgaurea* were recorded for the first time in Türkiye. Different usage areas of *Populus tremula*, *Astracantha microcephala*, *Cannabis sativa*, *Juniperus communis* were reported.

Beekeeping is so common and is a significant source of income in the region. Various measures are taken for varroa disease, which is effective in honey yield. The “set on fire” method, which is applied using various plants to protect bees from varroa disease, has not been included in the records before. In this method, especially *Datisca cannabina*, *Cannabis sativa*, and *Juniperus communis* are fired and the bees are exposed to smoke.

The majority of recorded plants are in general use for the treatment of all animals. Some plant species are used specifically to treat animals in different categories, as in beekeeping. The main groups and the plants used in the treatment resume in Table 5.

Some studies have shown that *Adiantum capillus-veneris* extract has been used on animals in clinical studies (Yadegari et al., 2019). It was reported that *Adiantum capillus-veneris* was used for increasing milk secretion, sprains, and swelling. The use of the plant in our study area was different from the world and it was reported that it was used for diarrhea and birth (Benítez et al., 2012; Shoab et al., 2021). It was recorded that different species of *Adiantum* were used for different purposes such as skin diseases (Prakash et al., 2021) and abdominal pain (Abbasi et al., 2013).
Table 5. Main animal groups and plants used in their treatment

| Main groups               | Plants used especially and diseases                                |
|---------------------------|-------------------------------------------------------------------|
| Cattle-raising            | *Colchicum speciosum* - Cleaning cow udders                        |
|                           | *Populus tremula* - Fungal infection                               |
|                           | *Ficus carica* - Warts                                            |
| Sheep and goat breeding   | *Euphorbia djimilensis* - Snake poisoning                          |
| Poultry farming           | *Sanicula europaea* - Boosting the immune system                   |
|                           | *Triticum aestivum* - Increasing egg production                    |
| Odd-toed ungulates        | *Alchemilla sericea* - Antitussive                                 |
|                           | *Alchemilla speciose* - Antitussive                                |
| Domestic animals          | *Achillea millefolium* - Wound healing                            |
| Beekepping                | *Datisca cannabina* - Varroa                                       |
|                           | *Cannabis sativa* - Varroa                                         |
|                           | *Juniperus communis* - Varroa                                      |

In the research area, it was recorded that the aerial parts of *Caltha palustris* were used in the treatment of foot pain. Extracts from this plant are known to have immunomodulatory properties (Suszko et al., 2012). The plant was reported to be used in skin diseases in China (Shen et al., 2010) and the treatment of worm-infested wounds and broken horns in India (Pande et al., 2007). With this study, the use of the plant for foot pain has also been added to the world literature.

*Bryum schleicheri* is a species from the bryophyte flora of the region. The plant, a type of moss, was recorded for the first time in ethnoveterinary folk medicine in Türkiye and the world. The decoction prepared from the leaves is given to animals for treatment of mouth sores.

*Solidago virgaurea* was included in the list of folk medicine for the first time in Türkiye and the world as a species used in the treatment of burns. The use of the plant for different purposes has been reported in the literature, such as antitoxic and abscess (Pande et al., 2007; Carrió et al., 2012). It has already been reported that the active ingredients of *Solidago virgaurea* are used in veterinary homeopathy in clinical signs (EMEA, 2000). Ajaib et al. (2021) stated in their study in Pakistan that *Solidago lacustralis* was used for ethnombotanical purposes in the treatment of burns in human medicine.

High FIC values document the use of herbs by many informants to treat a particular disease (Heinrich et al., 1998). In the current study, the highest FIC value of 0.93 belongs to digestive system diseases. In similar studies from Türkiye, the FIC value of dermatological ailments is generally higher (Erarslan and Kültür, 2019; Güler et al., 2021; Akbulut, 2022). In other countries, different disease groups come to the fore in high FIC values. It has the highest FIC values for respiratory disorders in China (Xiong and Long, 2020), gastrointestinal diseases in Lebanon (Arnold-Apostolides et al., 2020), dermatological and gastrointestinal diseases in Pakistan (Ahmad et al., 2015; Sharma and Manhas, 2015), and digestion in Indonesia (Pratama et al., 2021).

Plants with high FL are more preferred by local people compared to plants in the same category. High FL values have *Sambucus ebulus* for parasites and *Malva sylvestris* for wounds in the current study. It was also similar using methods and diseases in the various research from Türkiye and the world (Akerreta et al., 2010; Yüpel et al., 2017; Güler et al., 2021; Pascual and Herrero, 2021; Akbulut, 2022). *Datisca cannabina* has been accepted as the species used in traditional treatment methods for varroa disease in beekeeping.
Conclusion

Traditional treatment methods are significant for livestock activities in mountainous terrains and rural areas. It has been determined that the local people dealing with animal diseases in Rize province use 38 plants in ethnoveterinary practices. Each study adds new plants used in treatment to the literature. In this study, it was determined that Datisca cannabina, Caltha palustris, Bryum schleicheri, Adiantum capillus-veneris, Solidago virgaurea species were used in the treatment of diseases. It is thought that such determinations can be a source for medical and veterinary research.

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