

## Traditional knowledge about animal-derived remedies in human and veterinary ethnomedicine on Rujan Mt, Serbia

Milica N Simić<sup>a</sup>, Marija S Marković<sup>b</sup>, Bojan K Zlatković<sup>a</sup>, Jelena S Matejić<sup>c</sup>, Saša S Stanković<sup>a</sup>, Mrdjan M Djokić<sup>a</sup> & Nataša M Joković<sup>a,\*</sup>

<sup>a</sup>University of Niš, Faculty of Sciences and Mathematics, Višegradska 33, 18000 Niš, Republic of Serbia

<sup>b</sup>Institute of Forestry, Kneza Višeslava 3, 11030 Belgrade, Republic of Serbia

<sup>c</sup>University of Niš, Faculty of Medicine, Department of Pharmacy, Bulevar Dr. Zorana Đinđića 81, 18000 Niš, Republic of Serbia

\*E-mail: natasa.jokovic@pmf.edu.rs

Received 12 September 2024; revised 23 September 2025; accepted 13 November 2025

Small rural areas represent significant sources of ethnopharmacological knowledge preserved in these areas since ancient times. This study aimed to systematize traditional knowledge about the use of animal remedies in human and veterinary ethnomedicine according to the data collected from the inhabitants of Rujan Mt. This rural area is unique both in terms of the flora and fauna present in the area and in the fact that two different ethnic groups, Serbs and Albanians, have inhabited this area for centuries. The study recorded 36 animal-based remedies, including 29 for 13 categories of human ailments, 3 for ritual-medicinal purposes, and 4 for veterinary ethnomedicine. The antidote prepared from venomous snakes in "komovica" brandy is the only folk medicine used to treat humans and animals. Mammals, birds, reptiles, snails, and insects are used for the preparation of folk remedies, and the domestic goat was the most frequently mentioned animal species in the survey. Skin and respiratory groups of human ailments are mostly treated with traditional animal-derived remedies, and goat pulmonary pleura was reported as the most used animal ingredient in the researched area. Five new species unknown in previous ethnozoological research (*Dendrocopos* sp., *Garrulus glandarius*, *Streptopelia turtur*, *Vipera berus*, and *V. ammodytes*), 14 new animal remedies, and 67 new applications were reported in the study. The collected data contribute to preserving and expanding traditional knowledge about animal remedies in ethnopharmacology, but can also form a scientific basis for further pharmacological research.

**Keywords:** Balkan Peninsula, Ethnozoology, Multivariate correspondence analysis, Survey

**IPC Code:** Int Cl.<sup>25</sup>: A61K 36/00

In ancient times, when medicine was not yet so advanced and there were no drugs for treating humans and animals, people found cures for ailments in nature. Various remedies were made from plants and animals available in areas where people lived. This traditional knowledge has been passed down from generation to generation and today represents valuable knowledge anchored in the identity of different nations around the world. The application of this long-established knowledge in the modern world is limited mainly to certain rural areas, but in recent years, there has been an increasing tendency to research and use traditional medicinal ingredients<sup>1</sup>. In the last decade, plants have been extensively investigated for their possible use in ethnopharmacology, while research on using animal-

derived therapeutics has been insufficient and neglected<sup>2</sup>. However, the systematization of this information would make it possible to build a database that would serve as the foundation for additional studies into novel medications and the enhancement of current ones<sup>3</sup>.

Folk remedies of animal origin can be products derived from domestic and wild animals, such as honey or milk, but whole animals or their parts are also used for the healing of humans and animals<sup>4</sup>. Reptiles, amphibians, fish, birds, mammals, and various invertebrates have been utilized for medicinal purposes in South America (Brazil), Africa (Nigeria, Zimbabwe, Benin, Johannesburg) and Europe<sup>3</sup>, while mammals are the most common sources of traditional remedies in Tanzania<sup>5</sup>, India<sup>6</sup>, and Pakistan<sup>7</sup>. In Europe, the application of animal-derived therapeutics has been documented mainly in the southern regions<sup>3</sup>. In some parts of Spain, mammals and reptiles are most used to

\*Corresponding author

**Abbreviation:** URs – use reports

produce traditional medicines<sup>8</sup>, while in Italy, Croatia and Albania, the remedies are most frequently prepared from pigs, cattle, poultry, goats, and dogs<sup>9-15</sup>.

Animals have also been used for ritual purposes since ancient times, for various social and religious customs that mostly involved animal sacrifice. Some of these rituals were believed to contribute to the healing of people and animals or to have a beneficial effect on their health. In Italy, donkey tail hair rope was used as a ritual object to treat skin inflammation or red wind disease<sup>15</sup>.

The use of animal folk remedies for the treatment of humans and animals has been poorly studied in Serbia. Based on our knowledge, there is only one paper that describes the application of animal-based traditional remedies in human ethnomedicine in the Pešter Plateau in southwestern Serbia<sup>16</sup>. Rujan Mt is in the southeastern part of Serbia and has not been studied from the aspect of ethnozootherapy, although it represents an area of exceptional features, both in terms of flora and fauna. The research area is also specific because Serbs and Albanians have inhabited it for centuries. Due to constant population migration in the researched area, preserving the traditional knowledge of both ethnic groups is very important.

The goal of this study is to systematize traditional knowledge about the use of animal ingredients in human and veterinary ethnomedicine according to the data collected from the inhabitants of Rujan Mt. The study was designed and conducted to provide answers to the following questions:

What are the most commonly used folk remedies of animal origin in treating humans and animals?

How are remedies prepared, in what form are they applied, and for which ailments?

Is there a difference between the Serbian and Albanian populations in the use of animal-based therapeutics?

## Materials and Methods

### Research area

Rujan Mt is in southeastern Serbia (42.262406° N–42.450750° N and 21.710398° E–21.888848° E). The study area included two municipalities on this mountain, Bujanovac and Preševo, covering 166.34 km<sup>2</sup> at elevations 398 to 968 m a.s.l. The area is rural and includes 10 villages in the municipality of Preševo and 15 villages in the municipality of Bujanovac (Fig. 1).

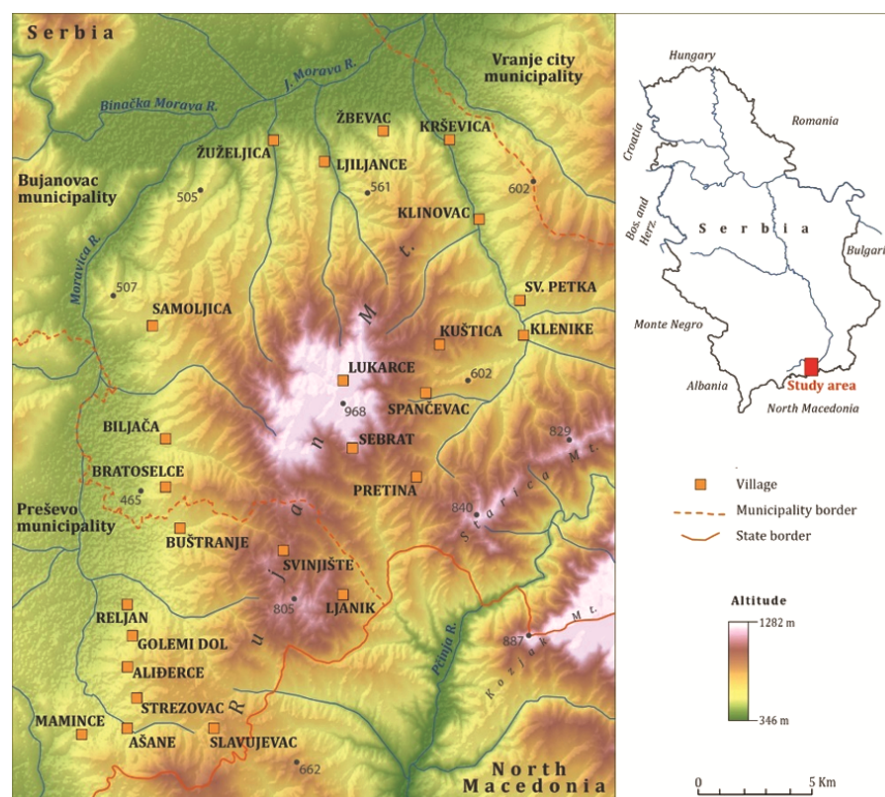


Fig. 1 — A map of Rujan Mt from the researched area as part of interviews in two municipalities (Source: Djokić)

**Population**

The study area is interesting for scientific research because two culturally and religiously different nations, the Serbs and the Albanians, have lived in this area for centuries. The Albanian population makes up about 25% of the total population in the surveyed area, and they represent 90% of the population on the western side of Rujan Mt.

**Ethnozoological survey**

The local population on Rujan Mt was interviewed during June and July 2022, and 130 respondents from 25 villages participated in the survey. Interviews were conducted with 68 men aged 41-86 and 62 women aged 42-91. The respondents presented the material in fresh or prepared form, and in some cases, the animal species were determined based on the photos, especially the bird species. The identification of animals was carried out based on the literature for the identification of snails<sup>17</sup>, insects<sup>18</sup>, snakes<sup>19</sup>, birds<sup>20</sup>, and mammals<sup>21</sup>.

**Ethical consideration**

The data presented in the study were obtained exclusively through surveys in which the respondents voluntarily gave their answers. Participants were included in the study after obtaining informed consent. The animals and their ingredients mentioned in the study were not collected in the field, so the study was conducted following the Ethical Code of ISE<sup>22</sup>. Human and animal experimental models were not used in the study.

**Data analysis**

Use reports (URs) are defined as the number of respondents' statements per category. The variance was

calculated for the recorded animal-derived ingredients concerning the total number of respondents and the number of statements<sup>23</sup>.

**Statistical analysis**

Multivariate correspondence analysis<sup>24</sup> was performed to indicate a potential relationship between variables, looking at the state of grouping of characters in the graph. The output of this multivariate analysis shows the coordinates of the row (respondents) and column (character states) on correspondence axes displayed on the scatter plot. Statistical analyses were done using Minitab 17 at the significance level of  $p < 0.05$ . The multivariate correspondence analysis enables visualization of the relationship between animal remedies, their use, and the health conditions they treat. In the resulting diagram, categories that are close to each other are more closely related, allowing recognition of patterns and understanding of relationships between the different elements.

**Results**

**Ethnozoological analysis**

In the study conducted on Rujan Mt, the respondents provided information on the use of animal ingredients or products in human and veterinary ethnomedicine and for ritual-medicinal purposes from domestic (7 species) and wild (13 species) animals, belonging to invertebrates (3 species, 3 families, and 2 classes) and vertebrates (17 species, 12 families and 3 classes) (Table 1 & Fig. 2).

Invertebrates, the Roman snail *Helix pomatia* (19 URs), and two types of insects, the honeybee *Apis*

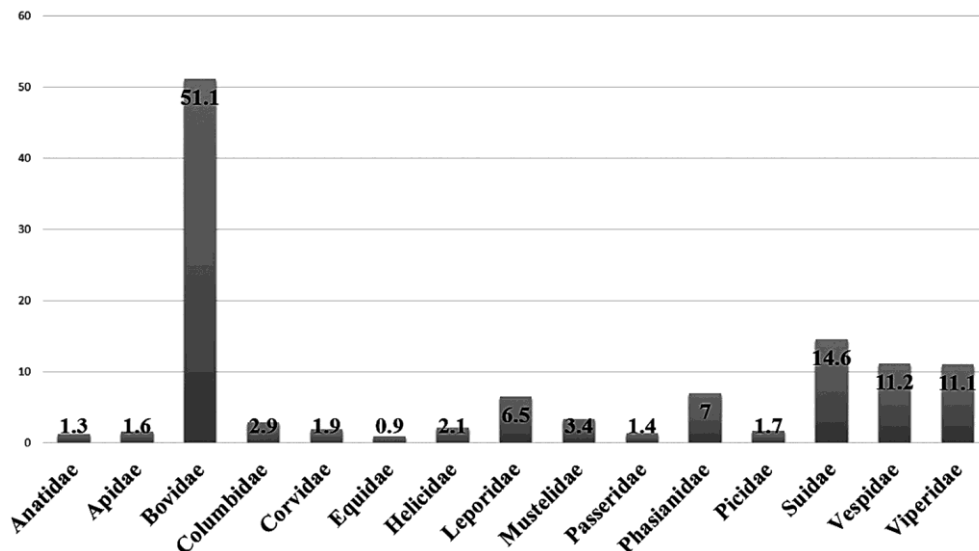


Fig. 2 — The most frequently reported animal families in human ethnomedicine on Rujan Mt

*mellifera* and the European hornet *Vespa crabro* (18 URs) were reported in surveys. Mammals (682 URs), birds (150 URs), and reptiles (50 URs) were also the sources of animal-based remedies. Two venomous snakes, European adder *Vipera berus*, and horned viper *Vipera ammodytes* are the only reptiles used by respondents on Rujan Mt. Birds were identified as representatives from the families Anatidae (ducks and geese), Columbidae (pigeons), Corvidae (crows), Passeridae (sparrows), Phasianidae (chickens), and Picidae (woodpeckers). Domestic chicken *Gallus gallus domesticus* was the most frequently mentioned type of bird in surveys. Other birds in the study were identified as goose *Anser anser*, European turtle dove *Streptopelia turtur*, the Eurasian jay *Garrulus glandarius*, house sparrow *Passer domesticus*, and common quail *Coturnix coturnix*. In contrast, the

woodpecker could not be identified to the species level but only as a member of the genus *Dendrocopos*. Mammals recorded in the surveys were identified as representatives of the families Bovidae, Equidae, Leporidae, Mustelidae, and Suidae. Domestic cattle (*Bos taurus*), domestic goat (*Capra hircus*), water buffalo (*Bubalus bubalis*), domestic sheep (*Ovis aries*), donkey (*Equus asinus*), and domestic pig (*Sus scrofa domesticus*) were reported species of domestic animals, while European rabbit (*Lepus europaeus*) and the European badger (*Meles meles*) were wild animals reported by respondents on Rujan Mt. Animals identified as representatives of the families Bovidae (50%), Suidae (14%), Phasianidae (7%), Leporidae (6.5%) and Viperidae (5.4%) are the most frequently used as sources of animal-derived folk remedies on Rujan Mt (Fig. 2).

Table 1 — Animal-derived remedies on Rujan Mt.

Taxonomic rank Class Ordo, Family	Scientific name	English name	Preparation	Ailments /Application	No of URs	S <sup>2</sup> samplevar	Usage in other areas
Artiodactyla, Bovidae	<i>Bos taurus</i>	boiled whey	PP	Di: ☞Improvement of appetite of pigs / I, EV	15	0.103	✱✱
Artiodactyla, Bovidae	<i>Bos taurus</i>	Beef bones	PP	Ms: ☞Arthritis / I, EM	13	0.091	✱✱
Artiodactyla, Bovidae	<i>Bos taurus</i>	Cow milk	FP	Di: Constipation / I, Gu: ☞Prevention / I, In: ☞Herpes / E, Rs: Productive cough / I, Sk: ☞Eczema / E, ☞Lichen / E, ☞Psoriasis / E, EM Sk: ☞Ingrown nails / E, EM	40	0.215	▲ <sup>13</sup> , ▲ <sup>10</sup> , ▲ <sup>15</sup> , ●▲ <sup>16</sup> , ▲ <sup>25</sup> , ●▲ <sup>29</sup> ,
Artiodactyla, Bovidae	<i>Bos taurus</i>	Cow cheese	PP	Sk: ☞Ingrown nails / E, EM	1	0.008	▲ <sup>4</sup> ; ▲ <sup>15</sup>
Artiodactyla, Bovidae	<i>Bos taurus</i>	Butter	PP	Ms: ☞Rheumatism / E, Ne: ☞Headache / E, EM	8	0.058	▲ <sup>16</sup>
Artiodactyla, Bovidae	<i>Bos taurus</i> <i>Capra hircus</i>	Goat, cow sour milk	PP	Ci: ☞Lowering body temperature / E, Sk: ☞Sunburn / E, EM	7	0.051	▲ <sup>16</sup>
Artiodactyla, Bovidae	<i>Bubalus bubalis</i>	Buffalo milk	FP	Rs: ☞Asthma / I, EM	3	0.023	▲ <sup>4</sup> , ▲ <sup>16</sup> , ▲ <sup>7</sup>
Artiodactyla, Bovidae	<i>Capra hircus</i>	Goat milk	FP	Rs: Productive cough / I, EM	61	0.251	▲ <sup>4</sup> , ▲ <sup>13</sup> , ●▲ <sup>15</sup> , ●▲ <sup>16</sup> , ▲ <sup>26</sup> , ▲ <sup>7</sup>
Artiodactyla, Bovidae	<i>Capra hircus</i>	Goat pulmonary pleura	PP	Gu: ☞Chills / E, Rs: ☞Bronchitis / E, ☞Pharyngitis / E, ☞Pneumonia / E, ☞Productive cough / E, ☞Tonsils / I, Sk: ☞Eczema / E, EM	126	0.037	▲ <sup>4</sup> ; ▲ <sup>10</sup> ; ▲ <sup>15</sup>
Artiodactyla, Bovidae	<i>Capra hircus</i>	Young goat cheese	PP	Ca: ☞Carcinomas / I, Sk: ☞Fungal nail disease / E, EM	39	0.212	▲ <sup>16</sup>

... Contd.

Table 1 — Animal-derived remedies on Rujan Mt. (Contd.)

Taxonomic rank Class Ordo, Family	Scientific name	English name	Preparation	Ailments /Application	No of URs	S <sup>2</sup> samplevar	Usage in other areas
Artiodactyla, Bovidae	<i>Capra hircus</i>	Goat milk whey	PP	Di: ☞Appetite / I, ☞Liver diseases / I, EM	68	0.251	▲ <sup>16</sup> ; ▲ <sup>26</sup>
Artiodactyla, Bovidae	<i>Ovis aries</i>	The skin of young sheep	FP	Sk: ☞Bruises / E, ☞Swelling / E, EM	39	0.212	▲ <sup>4</sup> ; ▲ <sup>16</sup> ; ▲ <sup>25</sup>
Artiodactyla, Bovidae	<i>Ovis aries</i>	Lamb tallow	PP	Rs: ☞Bronchitis / E, EM	3	0.023	▲ <sup>4</sup> ; ▲ <sup>16</sup> ; ▲ <sup>29</sup> ; ▲ <sup>5</sup> ; ▲ <sup>6</sup>
Artiodactyla, Bovidae	<i>Ovis aries</i>	Sheep milk	FP	Bl: ☞Improvement of blood count / I, EM	26	0.161	▲ <sup>13</sup> ; ▲ <sup>15</sup> ; ▲ <sup>16</sup> ; ▲ <sup>6</sup> ; ▲ <sup>7</sup>
Artiodactyla, Suidae	<i>Sus scrofa domesticus</i>	Homemade pork soap	PP	Ci: ☞Lowering body temperature / (E), Sk: ☞Eczema / E, ☞Hair loss / E, ☞Oil on the skin / E, EM	78	0.242	**
Artiodactyla, Suidae	<i>Sus scrofa domesticus</i>	Pork fat	PP	Ci: ☞Hemorrhoids / E, Rs: ☞Productive cough / I, EM	35		▲ <sup>4</sup> ; ▲ <sup>13</sup> ; ▲ <sup>10</sup> ; ▲ <sup>27</sup> ; ▲ <sup>15</sup> ; ▲ <sup>16</sup> ; ▲ <sup>29</sup> ; ▲ <sup>6</sup>
Artiodactyla, Suidae	<i>Sus scrofa domesticus</i>	Pork bones	PP	Ms: ☞Arthritis / I, EM	7		**
Artiodactyla, Suidae	<i>Sus scrofa domesticus Bos taurus</i>	Pork and beef bones	PP	Ms: ☞Arthritis / I, EM	14		**
Carnivora, Mustelidae	<i>Meles meles</i>	Badger tallow	PP	Ms: ☞Rheumatism / E, ☞Sprain or strain of ligaments / E, Rs: ☞Bronchitis / E, ☞Pneumonia / E, Sk: ☞Wounds / E, EM	31	0.183	**
Lagomorpha, Leporidae	<i>Lepus europaeus</i>	Wild rabbit tallow	PP	Ca: ☞Carcinomas / I, Rs: ☞Pneumonia / E, Sk: ☞Ingrown nails / E, ☞Ulcer / E, Wounds / E, EM	60	0.250	● <sup>26</sup>
Perissodactyla, Equidae	<i>Equus asinus</i>	Donkey milk	FP	Rs: Productive cough / I, EM	8	0.058	▲ <sup>13</sup> ; ● <sup>10</sup> ; ● <sup>15</sup> ; ● <sup>16</sup> ; ● <sup>29</sup> ; ▲ <sup>7</sup> ; ● <sup>4</sup> ; ▲ <sup>29</sup>
Anseriformes, Anatidae	<i>Anser anser</i>	Goose fat	PP	Rs: ☞Asthma / I, ☞Bronchitis / I, ☞Pneumonia / E, EM	12	0.084	▲ <sup>4</sup> ; ▲ <sup>29</sup>
Columbiformes, Columbidae	<i>Streptopelia turtur</i>	Turtle eggs	FP	In: ☞Prevention "swine pox" / I, EV	27	0.166	■
Galliformes, Phasianidae	<i>Coturnix coturnix</i>	Eggs common quail	FP	Ci: Anemia / I, Sk: ☞Freckles / E, ☞Ointment for burns / E, EM	20	0.131	▲ <sup>29</sup> ; ● <sup>6</sup>
Galliformes, Phasianidae	<i>Gallus gallus domesticus</i>	The gall bladder of a young rooster	FP	Ru: ☞Determining the sex of the baby / E, Ru-EM	44		**
Passeriformes, Corvidae	<i>Garrulus glandarius</i>	Jay bird	PP	Ru: ☞The health of family members / I, Ru-EM	18	0.120	■
Passeriformes, Passeridae	<i>Passer domesticus</i>	Sparrow bird	PP	Ru: ☞The health of family members / I, Ru-EM	13		▲ <sup>4</sup>
Piciformes, Picidae	<i>Dendrocopos sp.</i>	Woodpecker bird	PP	Sk: ☞Mejasil / I, EM	16		■
Squamata, Viperidae	<i>Vipera berus Vipera ammodytes</i>	Antidote	PP	Sk: ☞Snakebite / E, EM and EV	49	0.237	■

... Contd.

Table 1 — Animal-derived remedies on Rujan Mt. (Contd.)

Taxonomic rank Class Ordo, Family	Scientific name	English name	Preparation	Ailments /Application	No of URs	S <sup>2</sup> samplevar	Usage in other areas
Squamata, Viperidae	<i>Vipera berus Vipera ammodytes</i>	Snake and salt flat; PP "rasolnica" – liquid in which cabbage is pickled		Gu: ☞Different diseases / I, EM	1		■
Hymenoptera, Apidae	<i>Apis mellifera</i>	Royal jelly	PP	Em: ☞Improvement of immunity / I, EM	2	0.015	▲ <sup>28</sup>
Hymenoptera, Apidae	<i>Apis mellifera</i>	Perga	PP	Bl: ☞Lowering cholesterol / I, Ci: ☞Increase in heart pressure / I, EM	3	0.023	✱✱
Hymenoptera, Apidae	<i>Apis mellifera</i>	Propolis	PP	Em: ☞Improvement of immunity / I, Sk: ☞Wounds / E, EM	7	0.051	▲ <sup>26</sup>
Hymenoptera, Apidae	<i>Apis mellifera</i>	Beeswax	PP	Ea: For making fisheks for ear pain / E, Sk: ☞Navel healing / E, EM	3		▲ <sup>4, 10,</sup> ● <sup>15, 16</sup>
Hymenoptera, Vespidae	<i>Vespa crabro</i>	Hornet	FP	Rs: ☞Chills / E, EV	3	0.023	✱✱
Gastropoda, Helicidae	<i>Helix pomatia</i>	Snail mucus	FP	Sk: ☞A scar on the skin / E, ☞Eczema / E, ☞Wounds / E, EM	19	0.126	▲ <sup>1</sup>

PP- processed product, FP- fresh product, EM (use in human ethnomedicine), EV (use in veterinary ethnomedicine), Ru-EM (ritual use in human ethnomedicine), Administration codes: I - Internal, E – External., Groups of disorders: Bl – blood, Ca – carcinomas, Ci - circulatory, Dg – digestive, Ea – ear, Em - endocrine, metabolic, and nutritional, Gu - general and unspecified, In – infectious, Ms – musculoskeletal, Ne – neurological, Rs – respiratory, Ru - treatment of diseases through rituals, Sk - skin. The following symbols indicate comparisons: (●) identical use, (▲) different use, (●▲) same uses are identical or similar, while same uses are different, ■ animals and their products or ingredients were not mentioned in other ethnozoological studies; ✱ ingredients of animal origin were not mentioned in other ethnozoological studies<sup>4-7,10,13,15-16,25-29</sup>, (☞) the use in presented study was not mentioned in previously conducted ethnozoological studies in surrounding areas.

### Animal-derived remedies

In the conducted study, 130 respondents who live on Rujan Mt and belong to Serbian and Albanian nationality gave 919 URs about the use of 36 remedies of animal origin for the treatment of humans and animals, including 750 URs in human ethnomedicine, 75 URs for ritual-medicinal purposes, 45 URs in veterinary ethnomedicine, and 49 URs in human and veterinary ethnomedicine. All animal-derived remedies reported by the respondents are shown in Table 1.

Inhabitants of the Rujan Mt are best acquainted with traditional animal-based remedies for healing people. In the conducted survey, 750 URs (82%) statements were about the use of 29 remedies for the treatment of different groups of human ailments. The most frequently mentioned folk medicine in the survey was goat pulmonary pleura (126 URs, 17%), but respondents also reported the use of homemade pork soap (78 URs, 10.4%), goat milk whey (68 URs, 9.1%), goat milk (61 URs, 8.1%) and wild rabbit tallow (60 URs, 8%) (Fig. 3).

Skin (255 URs, 33.3%), respiratory (217 URs, 29%), digestive (73 URs, 9.7%), and circulatory (58 URs, 7.7%) human ailments are treated with reported remedies (Table 1). External application (494 URs, 84%) is the most common form of therapeutic administration. Most respondents mentioned the external use of goat pulmonary pleura for treating pneumonia (109 URs, 22.1%), homemade pork soap (63 URs, 13%) for combating hair loss, and antidote treatment for snakebite (49 URs, 3.2%). Goat milk whey for improving liver function (68 URs, 27%), goat milk as a therapy for productive cough (61 URs, 24%), and cow milk for health prevention (27 URs, 10.6%), especially in cold seasons, are animal products that are most often used internally (255 URs, 77.5%).

Animal-derived remedies are most often applied in processed form (533 URs, 85%). Goat pulmonary pleura (126 URs, 24%), homemade pork soap (78 URs, 15%), and wild rabbit tallow for the treatment of ingrown nails (60 URs, 11.2%) were reported as the most used processed preparations. Goat milk as

therapy for productive cough (61 URs, 28.1%), cow milk as preventive medicine (40 URs, 18.4%), and skin from a young sheep for the treatment of bruises on the skin (39 URs, 18%) are the most used folk remedies in fresh form (217 URs, 74.6%).

Respondents of Serbian nationality also indicated the use of 3 ingredients of animal origin for ritual-medicinal purposes (75 URs, 10%): the gall bladder of a young rooster (44 URs, 59%), the meat of a jay (18 URs, 24%), and the meat of a sparrow (13 URs, 17.3%).

The use of animal-derived remedies for the treatment of animals is much less common on Rujan Mt than in human ethnomedicine. A total of 45 URs (5%) reported knowledge of three remedies of animal origin in veterinary ethnomedicine, and only among members of Serbian nationality. The eggs of the turtle dove for preventing "pig pox" diseases in pigs (27 URs, 60%), "cvik" for accelerating weight gain in pigs (15 URs, 33.3%), and hornet nest against colds in horses (3 URs, 6.7%) are used in veterinary ethnomedicine on Rujan

Mt. "Cvik", as a product obtained by cooking whey, is the only folk therapeutic used in a processed form. The only folk therapeutic of animal origin used for the treatment of humans and domestic animals on Rujan Mt is an antidote (49URs, 5.3%), which is applied externally against snake bites. Antidote is prepared from a venomous snake caught on St. George's Day (the 6th of May), which is kept for a month in a strong homemade brandy called "komovica". Statements about the use of an antidote were recorded only among respondents of Serbian nationality.

**Animal-derived remedies in two ethnic groups**

Inhabitants of the Albanian population gave statements about their knowledge of animal-derived remedies only for human ethnomedicine. Members of both ethnic groups reported 17 same remedies of animal origin (58.7%) in human ethnomedicine, while Albanians mentioned 2 additional remedies and Serbs 10 (Fig. 4).

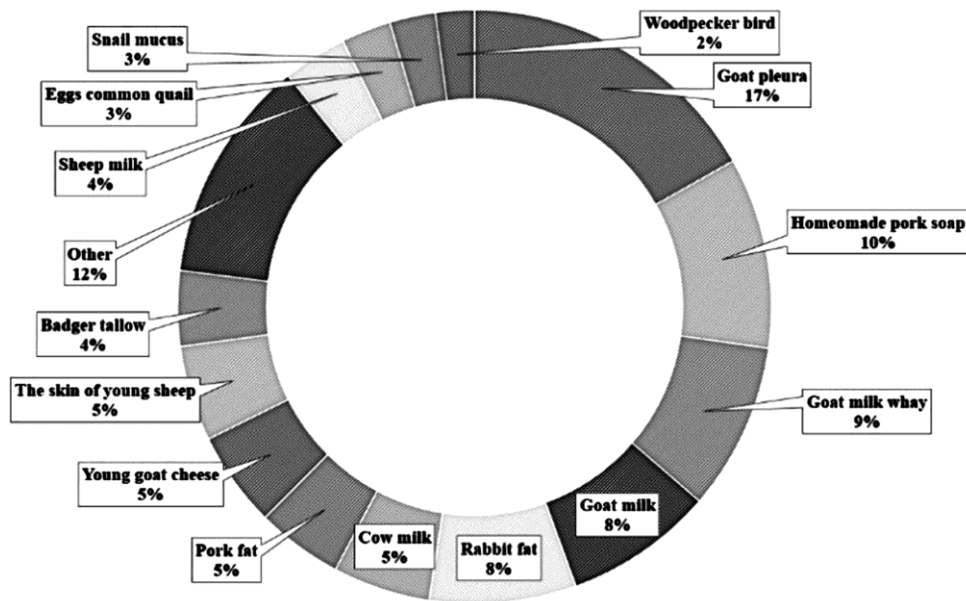


Fig. 3 Reported animal-derived remedies in human ethnomedicine on Rujan Mt

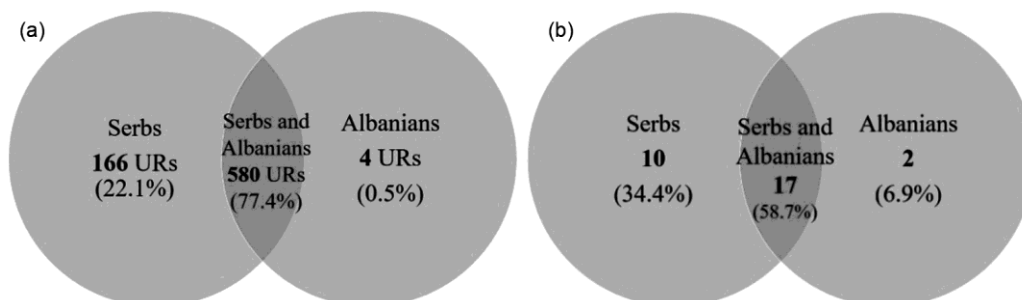


Fig. 4 — The overlap of URs (A) and animal taxa (B) recorded by two ethnic groups in human ethnomedicine on Rujan Mt

In the Albanian population, goat pulmonary pleura used for respiratory diseases (29 URs, 13.4%), goat milk for the treatment of productive cough (27 URs, 12.5%), and skins of young sheep for the treatment of bruises and swelling (24 URs, 11.1%) were the most frequently reported remedies. In the Serbian population on Rujan Mt, the most recorded folk therapeutics were goat pulmonary pleura for respiratory ailments (80 URs, 11.4%), homemade pork soap for circulatory and skin disorders (78 URs, 11.1%), and an antidote used in the treatment of snakebites in humans and animals (49 URs, 7%). Respiratory and skin human disorders were mainly treated with animal-based remedies in both nationalities.

#### Correspondence analysis

Based on the results of the correspondence analysis shown in Figure 5, three groups of associated elements can be distinguished. There is a clear connection between the use of species from the Columbidae family in the treatment of infectious ailments in veterinary ethnomedicine (1) and the use of birds from the families Passeridae, Phasianidae,

and Corvidae for ritual-medical purposes (2). There is no overlap between the ritual and medicinal use of species from the two mentioned families. The third group of variables (3) consists of four families with elements that build three segregates with far more complex internal relations. The first or main set of associated elements implies the use of animal products obtained from species from the Bovidae and Anatidae families in the treatment of human ailments of the digestive and respiratory tract and cancer, as well as for general treatment purposes. A certain degree of dissociation from the described pattern is observed due to two more sets of associated elements. The use of animal medicinal preparations against productive cough obtained from species that belong to the Equidae family is distinguished, and species from the Vespidae family used in the treatment of respiratory diseases. The pattern of association emphasizes the internal application of medicinal materials from animals from the Vespidae family in fresh form, which to some extent connects this group of elements with the main part of the segregate.

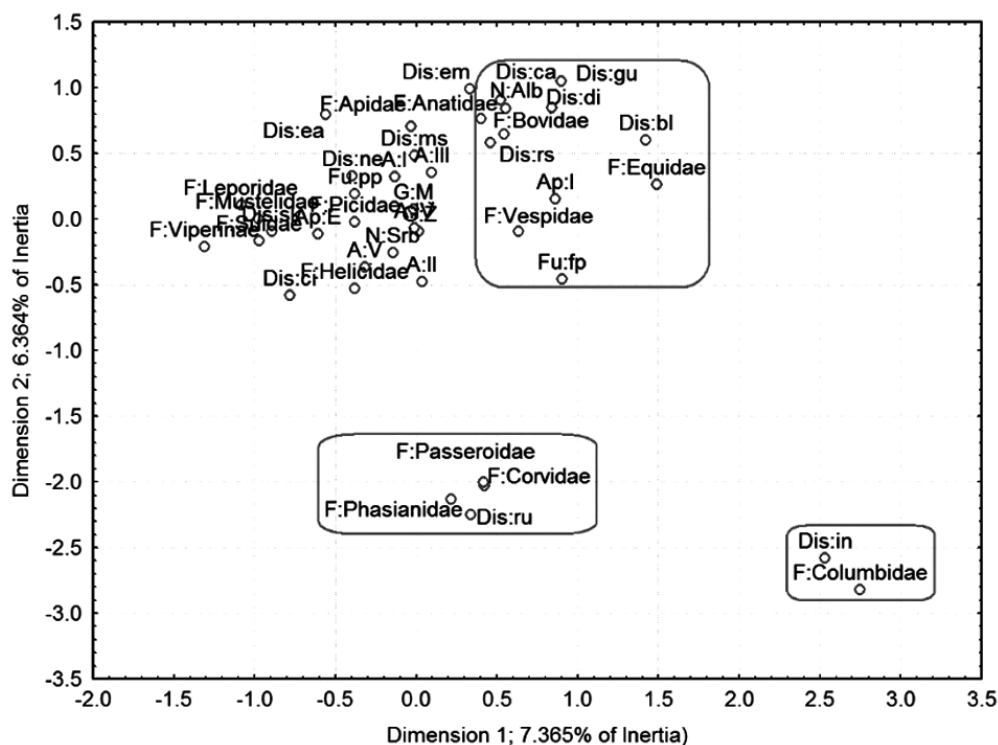


Fig. 5 — Results of the correspondence analysis showing associations between animal-derived remedies and their uses in human and veterinary ethnomedicine and ritual practices. F-family; Respondent age groups: A:I (41-50), A:II (51-60), A:III (61-70), A:IV (71-80), A:V (81-90); Gender groups: G:M – male, G:F – female; Nationality groups: N:A (Albanians), N:S (Serbs); Disorders (Dis) : bl – blood, ca – carcinomas, ci – circulatory, di – digestive, ea – ear, em – endocrine, metabolic and nutritional, gu – general and unspecified, in – infectious, ms – musculoskeletal, ne – neurological, rs – respiratory, ru – ritual use, sk – skin; Form of use (FU): pp – processed product, fp – fresh product

## Discussion

Animals, their body parts, and products represent a significant pool of folk remedies used by various cultures around the world since ancient times. Today, these animal-based therapeutics are mainly used in small rural areas that become increasingly depopulated, which could lead to a complete loss of this valuable knowledge. Therefore, we conducted a study on the use of animal-derived remedies for medicinal and veterinary purposes on Rujan Mt, which is still unexplored in this aspect.

Three animal species, *Dendrocopos* sp., *Vipera berus*, and *V. ammodytes*, used on Rujan Mt as sources for folk remedies in human ethnomedicine, have not been mentioned in similar studies so far (Table 1). Cooked woodpecker meat is consumed to treat skin problems, commonly referred to as "mejasil". Venomous snakes are used to prepare an antidote for snake bites in humans and animals, as well as a folk remedy for various human ailments. In Croatia, snake skin with four stripes, though the exact species isn't specified, is traditionally used as a remedy for high fever<sup>11</sup>.

The study also mentions new remedies obtained from animals already known in human ethnomedicine (Table 1). Beef or pork bones, individually or in a mixture, are used after cooking to treat arthritis, while badger tallow and pork soap have multiple uses in human ethnomedicine on Rujan Mt. The badger internal organs were previously reported as remedies in the treatment of hemorrhoids in the region of the Pešter Plateau<sup>16</sup> and among Albanians from Raicë and Mokra<sup>25</sup>. Bee-derived product "perga" was not found in the analyzed ethnopharmacological studies. "Perga" is a preparation made from a thin membrane placed over honey collected from the hive, and it is used for lowering cholesterol and increasing blood pressure.

Other animal-based remedies mentioned by respondents on the Rujan Mt are well-known in human ethnomedicine<sup>26-28</sup>. However, many of them have a different application on Rujan Mt compared to those published in previous studies. The most used animal-derived folk medicine in human ethnomedicine on the Rujan Mt is goat pulmonary pleura for the treatment of chills, eczema, and various respiratory conditions (bronchitis, pharyngitis, pneumonia, productive cough, and tonsillitis). Goat pulmonary pleura has been used in the northern Albanian Alps and southern Italy as a folk medicine to cure asthma<sup>10</sup>, while in Italy, Spain, and Nepal, it is also used to treat burns<sup>15</sup>.

Specific folk remedies are used on Rujan Mt in the same way as in other parts of the world. Beeswax is used for earache in Albania<sup>15</sup>, Italy<sup>14</sup> and on Rujan Mt. Remedies used in human ethnomedicine on Rujan Mt, such as beeswax, propolis, cow and sheep milk, buffalo milk, and quail eggs, have been mentioned in ethnopharmacological studies conducted in areas very far from Serbia, such as Levant<sup>4</sup>, Tanzania<sup>5</sup>, India<sup>6</sup>, Pakistan<sup>7</sup>, Latin America<sup>29</sup>, Brazil<sup>1</sup>, Europe (Portugal), Africa (Nigeria, Zimbabwe, Benin), West and South Africa<sup>2</sup>.

Products from various domestic animals, which are an integral part of the diet of the inhabitants of the Rujan Mt due to their high nutritional value, are also used to treat human ailments. The most commonly used foods for medicinal purposes include various types of milk and products derived from it, such as whey, cheese, and curdled milk (Table 1). The positive influence of these foods on human health is known in areas where dietary habits are similar to those in Serbia. However, the application of these raw materials varies from area to area. Goat milk is used in Italy, Spain, Nepal<sup>15</sup>, and the Pešter Plateau<sup>16</sup> for the same medicinal purposes against cough as in our study, but additional applications as a therapeutic agent for burns and as a laxative have been reported in Italy, Spain, and Nepal<sup>15</sup>.

Ingredients of animal origin have been used in rituals to treat human ailments since ancient times, and their usages are characteristic only for a specific area where this type of application occurs<sup>5,15</sup>. On Rujan Mt, only members of the Serbian nationality mentioned three bird species, the domestic hen, the jay, and the sparrow used for ritual-medicinal purposes (Table 1). Including the meat of the jay and the sparrow in the diet after the Christmas fast is considered to bring good health to the household throughout the year, while the gall bladder of the young rooster is used to determine the sex of the unborn child. The domestic hen has already been reported as a species used for ritual-medicinal purposes. In Italy, the meat of the rooster or chicken is given as a gift to a woman immediately after childbirth to help her recover quickly<sup>13</sup>. On the other hand, sparrow meat is used to treat whooping cough in the Levant<sup>4</sup>.

The inhabitants of Rujan Mt use animal-based remedies for treating animals much less often than in human ethnomedicine. Only the inhabitants of Serbian nationality reported using four remedies in

veterinary ethnomedicine, of which the antidote is also used in humans. Fresh turtle dove eggs administered to young piglets to prevent "swine pox" are the most common animal therapeutic agent in veterinary ethnomedicine. Respondents also reported the use of a hornet nest and a raw material called "cvik". None of the mentioned raw materials reported on Rujan Mt in veterinary ethnomedicine were found in previously published studies. Only the use of hornets for the treatment of digestive problems in animals has been recorded in Spain<sup>30</sup>.

A comparison of the information provided by the Serbs and Albanians who took part in the survey shows that the coexistence of the two ethnic groups has influenced the exchange of traditional knowledge. Namely, 47.2% of the ingredients or animal products listed are common to both populations (Table 1). The Serbs showed a more homogeneous knowledge of animal medicines compared to the Albanians, which contrasts with the data published for the Pešter plateau<sup>16</sup>. In our study, this difference may be attributed to the lower number of Albanians interviewed compared to Serbs, and the uneven distribution of interviewed members across different nationalities is a study limitation.

The correspondence analysis reveals a link between animal remedies and their use in traditional human and veterinary ethnomedicine, indicating the common ethnopharmacological practices in the research area. The application of several animal species and their products were distinctive in human ethnomedicine on Rujan Mt. Characteristic remedies in the study were cow milk and goat milk whey for treating digestive disorders, ingredients for curing respiratory ailments including cow, buffalo, donkey and goat milk, goat pulmonary pleura, lamb tallow and goose fat, then young goat cheese for treating carcinoma, and cow milk and goat pulmonary pleura for general healing purposes. All the above-mentioned animal-based remedies are known in human ethnomedicine. Nevertheless, they are used by the inhabitants of this area to treat other human conditions than those reported in previous studies (Table 1). The use of goat and donkey milk for cough treatment is the same on Rujan Mt and in Italy<sup>10</sup>, Pešter Plateau<sup>16</sup>, and Brazil<sup>29</sup>.

The gall bladder of a young rooster and the meat of a jay and a sparrow used for ritual-medicinal purposes on Rujan Mt were clearly distinguished from other ingredients in the study area. "Cvik", hornet comb, and turtle dove eggs reported in veterinary ethnomedicine

are also characteristic in practice on Rujan Mt. Animal-derived ingredients characteristic for ritual and veterinary use on the Rujan Mt have not yet been published in ethnozoological studies.

Some wild animal species used for ethnopharmacological purposes on Rujan Mt are classified as endangered according to the Rulebook on the Protection of Wildlife Species in Serbia<sup>31</sup>. Five species are listed as protected (*Anser anser*, *Lepus europaeus*, *Meles meles*, *Streptopelia turtur*, and *Vipera berus*), and another five are designated as strictly protected (*Coturnix coturnix*, *Garrulus glandarius*, *Helix pomatia*, *Passer domesticus*, and *Vipera ammodytes*). To preserve natural populations of these species, their collection and use for ethnopharmacological purposes should be minimised and conducted only in strict accordance with legal regulations.

## Conclusions

This study presents natural remedies of animal origin used in human and veterinary ethnomedicine by two ethnic groups on Rujan Mt. The novelty of this study is reflected in 5 new animal species, 14 new animal-based remedies, and 67 new applications not previously published in ethnopharmacological studies.

The present study contributes to the preservation of worldwide knowledge on the use of animal-based remedies in ethnomedicine, which is in danger of being lost, although it has been present in human civilization since ancient times. These findings could also form the basis for future pharmacological research by testing the bioactivity of newly documented remedies and their potential therapeutic use.

## Acknowledgments

This research is part of the project: Ethnopharmacological study of the region of southeastern Serbia, O-02-17, supported by the Serbian Academy of Sciences and Arts. This research was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Contracts No 451-03-65/2024-03/200124, No 451-03-66/2024-03/200027, and No 451-03-65/2024-03-200113).

## Conflict of Interest

Authors declare that there is no conflict of interest.

## Author Contributions

MS – Data collection, writing, MM – Writing - original draft, analysis, BZ – Software, formal analysis, JM – Software, formal analysis, SS – Resources,

writing assistance, MDj – Data interpretation, graphic design, NJ – Conceptualization, writing - review & editing, supervision.

### Informed Consent

Informed consent was obtained from all participants before each interview. Respondents were fully informed about the aims and scope of the research and were assured that their participation was voluntary, with the right to withdraw at any stage of the interview.

### Ethics Statement

The research was conducted in accordance with the Ethical Code of ISE 22. No experimental procedures were performed on animals, and no animal species were harmed or endangered during the study.

### Data Availability

The datasets associated with this research can be obtained from the corresponding author upon reasonable request.

### References

- Alves R R N, de Sousa Neta R O, de Brito Melo Trovão D M, de Lucena Barbosa J E, Barros A T, *et al.*, Traditional uses of medicinal animals in the semi-arid region of northeastern Brazil, *J Ethnobiol Ethnomed*, 8 (1) (2012) 41. doi:10.1186/1746-4269-8-41
- Alves R R N & Rosa I L, Why study the use of animal products in traditional medicines?, *J Ethnobiol Ethnomed*, 1 (1) (2005) 5. doi:10.1186/1746-4269-1-5
- Alves R R N, Rosa I L, Albuquerque U P & Cunningham A B, Medicine from the wild: an overview of the use and trade of animal products in traditional medicines, In: *Animals in Traditional Folk Medicine*, R R Alves & I L Rosa (Eds), (Springer, Heidelberg New York Dordrecht London), (2013) 25-42. doi:10.1007/978-3-642-29026-8\_3
- Lev E, Traditional healing with animals (zootherapy): medieval to present-day Levantine practice, *J Ethnopharmacol*, 85 (1) (2003) 107-118. doi:10.1016/S0378-8741(02)00377-X
- Vats R & Thomas S, A study on use of animals as traditional medicine by Sukuma Tribe of Busega District in North-western Tanzania, *J Ethnobiol Ethnomed*, 11 (1) (2015) 38. doi:10.1186/s13002-015-0001-y
- Vijayakumar S, Prabhu S, Yabesh J E M & Pragashraj R, A quantitative ethnozoological study of traditionally used animals in Pachamalai hills of Tamil Nadu, India, *J Ethnopharmacol*, 171 (2015) 51-63. doi:10.1016/j.jep.2015.05.023
- Ahmad S, Akram M, Riaz M, Munir N, Tahir I M, *et al.*, Zootherapy as traditional therapeutic strategy in the Cholistan desert of Bahawalpur Pakistan, *Vet Med Sci*, 9 (4) (2021) 1861-1868. doi:10.1002/vms3.491
- González J A & Vallejo J R, The use of domestic animals and their derivative products in contemporary Spanish ethnoveterinary medicine, *J Ethnopharmacol*, 271 (2021) 113900. doi:10.1016/j.jep.2021.113900
- Pieroni A, Quave C, Nebel S & Heinrich M, Ethnopharmacy of the ethnic Albanians (Arbëreshë) of northern Basilicata Italy, *Fitoterapia*, 73 (3) (2002) 217-241. doi:10.1016/S0367-326X(02)00063-1
- Pieroni A & Quave C L, Traditional pharmacopoeias and medicines among Albanians and Italians in southern Italy: A comparison, *J Ethnopharmacol*, 101 (1-3) (2005) 258-270. doi:10.1016/j.jep.2005.04.028
- Pieroni A, Giusti M E, H Münz, C Lenzarini, G Turković, *et al.*, Ethnobotanical knowledge of the Istro-Romanians of Žejane in Croatia, *Fitoterapia*, 74 (7-8) (2003) 710-719. doi:10.1016/j.fitote.2003.06.002
- Pieroni A & Giusti M E, The remedies of the folk medicine of the Croats living in Čičarija, Northern Istria, *Coll Antropol*, 32 (2) (2008) 623-627.
- Pieroni A, Quave C L & Santoro R F, Folk pharmaceutical knowledge in the territory of the Dolomiti Lucane, inland Southern Italy, *J Ethnopharmacol*, 95 (2-5) (2004) 373-384. doi:10.1016/j.jep.2004.08.012
- Pieroni A, Quave C L, Villanelli M L, Mangino P, Sabbatini G, *et al.*, Ethnopharmacognostic survey on the natural ingredients used in folk cosmetics, cosmeceuticals and remedies for healing skin diseases in the inland Marches, Central-Eastern Italy, *J Ethnopharmacol*, 91 (2-3) (2004) 331-344. doi:10.1016/j.jep.2004.01.015
- Quave C L, Lohani U, Verde A, Fajardo J, Rivera D, *et al.*, A comparative assessment of Zootherapeutic remedies from selected areas in Albania, Italy, Spain and Nepal, *J Ethnobiol*, 30 (1) (2010) 92-125. doi:10.2993/0278-0771-30.1.92
- Pieroni A, Giusti M E & Quave C L, Cross-cultural ethnobiology in the Western Balkans: medical ethnobotany and ethnozoology among Albanians and Serbs in the Pešter Plateau, Sandžak, South-Western Serbia, *Hum Ecol*, 39 (3) (2011) 333-349. doi:10.1007/s10745-011-9401-3
- Evesham B, Identifying land snails, *Bedfordshire Cambridgeshire Northamptonshire*, 2 (3) (2018) 1-22. Available online: <https://www.wildlifebcn.org/sites/default/files/2018-06/Land%20Snails%20Key%20v%202.3%20iv2018%20illustrated.pdf> (Accessed on 28 March 2024).
- Dvořák L & Roberts S P M, Key to the paper and social wasps of Central Europe (Hymenoptera: Vespidae), *Acta Entomol Mus Natl Pragae*, 46 (2006) 221-244.
- Serbian Herpetological Society "Milutin Radovanović", Snakes of Serbia (2024). Available online: <https://www.shdmr.org/zmije-srbije> (Accessed on 28 March 2024).
- Hume R, Still R, Swash A & Harrop H, *Ptice Srbije i Evrope: vodič za raspoznavanje* (Društvo za zaštitu i proučavanje ptica Srbije: Jato; Princeton University Press, Belgrade), 2023.
- Hackländer K & Zachos F E, *Mammals of Europe-Past, Present and Future*, (Springer, London), 2020.
- International Society of Ethnobiology, International Society of Ethnobiology Code of Ethics (with 2008 additions), 2006, Available online: <http://ethnobiology.net/code-of-ethics/> (Accessed on 11 May 2024).

- 23 Weckerle C S, de Boer H J, Puri R K, van Andel T, Bussmann R W, *et al.*, Recommended standards for conducting and reporting ethnopharmacological field studies, *J Ethnopharmacol*, 210 (2018) 125-132. doi.org/10.1016/j.jep.2017.08.018
- 24 F J Rohlf, *NTSYS-pc: Numerical taxonomy and multivariate analysis system*, (Exeter Publishing, New York), 1998.
- 25 Pieroni A, Ibraliu A, Abbasi A M & Papajani-Toska V, An ethnobotanical study among Albanians and Aromanians living in the Rraicë and Mokra areas of Eastern Albania, *Genet Resour Crop Evol*, 62 (4) (2015) 477-500. doi:10.1007/s10722-014-0174-6
- 26 Pieroni A, Nedelcheva A, Hajdari A, Mustafa B, Scaltriti B, *et al.*, Local knowledge on plants and domestic remedies in the mountain villages of Peshkopia (Eastern Albania), *J Mt Sci*, 11 (2014) 180-193. doi:10.1007/s11629-013-2651-3
- 27 Quave C L, Pieroni A & Bennett B C, Dermatological remedies in the traditional pharmacopoeia of Vulture-Alto Bradano, inland Southern Italy, *J Ethnobiol Ethnomed*, 4 (2008) 5. doi:10.1186/1746-4269-4-5
- 28 Fratini F, Cilia G, Mancini S & Felicioli A, Royal Jelly: An ancient remedy with remarkable antibacterial properties, *Microbiol Res*, 192 (2016) 130-141. doi:10.1016/j.micres.2016.06.007
- 29 Alves R R N & Alves H N, The faunal drugstore: Animal-based remedies used in traditional medicines in Latin America, *J Ethnobiol Ethnomed*, 7 (2011) 9. doi:10.1186/1746-4269-7-9
- 30 González J A, Amich F, Postigo-Mota S & Vallejo J R, Therapeutic and prophylactic uses of invertebrates in contemporary Spanish ethnoveterinary medicine, *J Ethnobiol Ethnomed*, 12 (2016) 36. doi:10.1186/s13002-016-0111-1
- 31 Rulebook on the proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi: 5/2010-46, 47/2011-134, 32/2016-59, 98/2016-97. <https://pravno-informacioni-sistem.rs/eli/rep/sgrs/ministarstva/pravilnik/2010/5/3/reg>