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Comparative ethnobotanical analysis of the used medicinal plants in the region of the Northern Black Sea coast (Bulgaria)

Petya Boycheva, Dobri Ivanov

Medical University „Prof. D-r Paraskev Stoyanov“, Faculty of Pharmacy, Department of Biology,

84 Tsar Osvoboditel Blvd., 9000 Varna, Bulgaria

Abstract: *The current ethnobotanical study summarizes the use of medicinal plants by locals in the region of the Northern Black Sea Coast, Bulgaria. The survey was conducted in the period between 2014 and 2020. After prior informed consent, 709 local residents from 32 settlements were interviewed. The interviews with the local population were conducted using the "face to face" technique with the help of pre-prepared original questionnaires. The study presents quantitative ethnobotanical information on the use of medicinal plants in the study area. The results were analyzed using quantitative indices: Respondent Consensus Ratio (F_{IC}), Loyalty Level Index (FL) and Significance Value Index (IVs). A total of 332 species of medicinal plants belonging to 250 genera of 90 families have been identified for the region of the Northern Black Sea Coast. The largest number of citations are registered for the use of medicinal plants for culinary purposes and for use in human medicine. The use of medicinal plants in other household applications has been studied.*

Keywords: F_{IC} , FL, IVs, Northern Black Sea coast

Introduction

Globally, due to the trend of globalization, traditional knowledge, including that of medicinal plants, is declining and some of it is irretrievably lost. The use of synthetic and artificial products is increasing, as is the use of foreign plant species, which are replacing traditionally used plants [1]. This determines the relevance and importance of conducting ethnobotanical research in order to learn, store and update this

knowledge. The current state of traditional knowledge in Bulgaria is the subject of scientific interest of researchers from various scientific fields.

Bulgaria is rich in natural plant resources, with 4102 species of higher plants described on its territory [2]. The total number of medicinal plants in Bulgaria is 842 species, belonging to 444 genera and 118 families. Of these, 730 species of spontaneously distributed higher plants are included in the Medicinal Plants Act of the Republic of Bulgaria [3]. The other 114 species are also spontaneously distributed and are described in the literature on medicinal plants in Bulgaria [4].

The richness of plant resources at the regional level is also great. For comparison, only in the floristic region of Northeastern Bulgaria the number of medicinal plants is 600 species [4]. On the territory of the Frangensko Plateau, part of which enters the surveyed area, the number of medicinal plants is 362 species [5]. Despite the presence of such a large wealth of medicinal plants, the region of the North Black Sea coast is unexplored in ethnobotanical terms.

The study of the traditional use of medicinal plants by locals can provide valuable knowledge about: the application of herbal raw materials in the production of new pharmaceuticals for human and veterinary medicine, creation and enrichment of cosmetic products, development of food supplements based on used medicinal plants for culinary purposes, protection of natural habitats and conservationally important species in the region of the North Black Sea coast, as well as for preservation of traditional knowledge.

The aim of the present study is to make an ethnobotanical analysis of the medicinal plants used for prevention, treatment and in the life of the locals from the Northern Black Sea coast of Bulgaria.

Materials and methods

The sociological survey method was applied for registration of the primary information. The survey involved 709 locals from 8 cities: Varna, Aksakovo, Beloslav, Kavarna, Shabla, Byala, Balchik, and Obzor and 24 villages: Bozhurets, Bulgarevo, Vaklino, Gorun, Durankulak, Ezeretz, Kamen Bryag, Kichevo, Krapetz, Kumanovo, Poruchik Chunchevo, Sveti Nikola, Topola, Tyulenovo, Hadzhi Dimitar, Ezerovo, Kazashko, Osenovo, Bliznatzi, Kamenar, Kranevo, Shkorpilovtzi, Goritza, and Topoli, located on the Northern Black Sea coast.

Ethnobotanical data were collected through an extensive interview aimed at creating open, informal and semi-structured interviews. The face-to-face interview technique is also used in other ethnobotanical studies [1, 6, 7]. The survey was conducted only with local residents at random. The field ethnobotanical research was conducted through a specially created questionnaire on paper.

For conducting a survey with the participation of volunteers, permission was obtained No.96/24.09.2020 from the Commission for Ethics of Research at the Medical University - Varna. All interviews

were conducted after obtaining the prior informed consent of the participants, according to the Code of Ethics of the International Society of Ethnobiology (ISE) [8].

Quantitative indices for ethnopharmacological and ethnobotanical research

Several indices are used in the analysis of the large amount of information [9, 10]:

- Analysis of quantitative data that introduce the level of homogeneity of the information presented by different F_{IC} informants (IAR), using a **consensus coefficient of the respondents**. It is calculated by the formula:

$$F_{IC} = \frac{n.UR - n.taxa}{n.UR - 1},$$

where n is the number of respondents, UR are the answers for the use of a medicinal plant.

The high value (close to 1) indicates that relatively few taxa (more common species) are used by most informants, while the low value indicates that informants use different taxa within the specific application of medicinal plants. Therefore, if informants use few taxa, then a high degree of consensus is reached and thus the traditional use of medicinal plants is considered well defined [11].

This factor is applied in studies based on interviews with an open list of plant species and / or open interviews within certain areas of ethnobotany (eg medicinal plants, food plants) or categories of use [10]. The IAR or F_{IC} provides information on respondents' consensus on the use of a medicinal plant in a particular disease, symptom group, or category of use.

- **Fidelity Level Index** (FL – Fidelity Level) indicates respondents' choice of a potential plant that cures a disease or is used for a specific use [12]. It is calculated by the following formula:

$$FL (\%) = \frac{N_p}{N} \cdot 100,$$

where N_p is the number of responses for use for a particular plant species in a particular category of application, and N is the total number of respondents who indicated the plant for any use. FL quantifies the significance of a species for a given purpose.

- **Significance value index** (IVs – Importance Value)

$$IV_s = \frac{n_{is}}{n},$$

where n_{is} is the number of respondents who use medicinal plants, n is the total number of respondents. This index measures the share of respondents who consider a species to be the most important. Values range from 0 to 1 [9].

- **Processing of information in electronic form**

Microsoft Excel 2010 and specialized software for statistical processing SPSS v. 19.0 for Windows were used in data processing [13]. Following the latest recommendations for the publication of ethnobotanical field studies [14], the primary data are presented unchanged, which allows a direct comparison in other similar studies.

Results and discussion

From the study we found that in the floristic subregion of the North Black Sea coast, locals use 332 species of medicinal plants belonging to 250 genera and 90 families. Of these, 151 species from 126 genera and 57 families are included in the Medicinal Plants Act of the Republic of Bulgaria. The other 186 species are listed as medicinal in the available literature on medicinal plants, published in Bulgaria. The distribution of the identified 332 species by origin is as follows:

The present study describes 183 species from 37 genera and 58 families distributed in **the floral subregion of the North Black Sea coast**. The results show that the local population uses 30.86% of the species composition of medicinal plants in the area it inhabits. With regard to habitats, we found a low level of use of medicinal plants typical of coastal sands. Of this group of plants, only a few respondents indicated the following 3 species: *Eryngium maritimum* L., *Artemisia pedemontana* Balb. ex Loisel., and *Limonium vulgare* Mill.

Among **the species of medicinal plants foreign to Bulgaria**, the local population uses 34 species belonging to 33 genera and 24 families. Foreign species of medicinal plants are 10.24% of the total number of medicinal plants used in the region. This result is explained by the fact that the local population adapts quickly and is oriented towards new knowledge.

The used **medicinal plants from other floristic regions of Bulgaria** are only 13 species of 11 genera and 8 families (3.91% of all used medicinal plants in the North Black Sea coast). This extremely low level of use indicates a weak knowledge of the possibilities of medicinal plants, widespread in other parts of the country. One of the reasons for this is the poor supply in the commercial network of Bulgarian medicinal plants, distributed in other floristic regions, but absent in the floristic subregion of the North Black Sea coast.

Among **the cultivated medicinal plants**, 97 species from 81 genera and 31 families are used. The high share of the used cultivated medicinal plants (29.21%) is due to the fact that the supply with them is easy and accessible.

Among **the adventitious species among the medicinal plants**, the inhabitants of the Northern Black Sea coast use 5 species from 5 genera and 4 families.

Among the used medicinal plants with the most genera are the families: Asteraceae, Apiaceae, Rosaceae, and Lamiaceae. These include the most commonly used medicinal plants in folk medicine by the local population. It is an interesting fact that the same families include the most commonly used medicinal plants in human medicine in an area far from the North Black Sea coast (Bulgaria), as Bingöl (Turkey) [16].

Quantitative ethnobotanical analysis

The medicinal plants with the most frequent use in all applications by the locals of the study area are: *Urtica dioica* L. (FL 100), *Cornus mas* L. (FL 100), *Zea mays* L. (FL 100), *Capsicum annuum* L. (FL 100), *Juglans regia* L. (FL 99), *Citrus limon* (L.) Osbeck. (FL 99), *Prunus avium* (L.) L. (FL 96), *Matricaria chamomilla* L. (FL 95), *Thymus sp. diversa* (FL 95), and *Vitis vinifera* L. (FL 90). The species composition of the ten most commonly used medicinal plants in folk medicine differs from the most commonly used medicinal plants in all applications in the study area. This result is due to the fact that some species are used in more than one application. For example, *Urtica dioica* L. has applications in human and veterinary medicine, cosmetics, such as food, pet food, in the household, for sale, as well as in folk traditions and customs. The number of medicinal plants indicated only once in the questionnaires is 27 species. Among them are: *Polygonatum multiflorum* (L.) All., *Ruscus aculeatus* L., *Phyllitis scolopendrium* L., *Gypsophyla paniculata* L., *Saponaria officinalis* L., *Ricinus communis* L., *Ononis spinos* L., and others.

The knowledge about the use of medicinal plants by the locals on the North Black Sea coast is not equally preserved in all applications of medicinal plants (Table 1).

Table 1. Distribution of the significance of the used medicinal plants and their applications

No	Application	Family (num- ber)	Genus (num- ber)	Species (num- ber)	Answers received (UR)	IVs	Fic
1	Human Medicine	69	162	204	678	0,95	0,96
2	Veterinary Medicine	28	46	46	94	0,13	0,74
3	Cosmetics	36	51	54	302	0,42	0,63
4	Culinary purposes	62	132	152	707	0,99	0,98
5	Pet food and bee grazing	17	37	40	143	0,22	0,93
6	Household purposes	44	78	100	579	0,81	0,93
7	Decorative purposes	36	62	32	375	0,52	0,75
8	Sale	28	41	45	16	0,02	0,47

9	Weather forecast	6	7	7	71	0,10	0,56
10	Folk traditions and customs	29	39	43	581	0,81	0,84

The degree of knowledge stored, the choice of the species and number (FL) of medicinal plants used, as well as the number of local people who use them, is determined by the importance (IVs) of the specific use of medicinal plants according to the respondents. Some of the applications of medicinal plants are a thing of the past and are remembered only by the older inhabitants of the area. Other applications of medicinal plants have been passed on to future generations, but have evolved. New and hitherto unknown possibilities for the use of medicinal plants both for treatment and for culinary purposes are entering.

Most species of medicinal plants are used in human medicine (204 species), followed by medicinal plants used for culinary purposes (152 species). As the smallest number of used species of medicinal plants, the locals indicated their use for weather forecasting (7 species) and for pet food and bee grazing (40 species). This result correlates with the working hypothesis about the degree of importance in the applications of medicinal plants in the life of the local population, determined by the importance of good health and the importance of choosing and obtaining quality and easily accessible food. The small number of medicinal plants used in some of the applications (pet food and bee grazing) is explained by the declining functions in the area of small private farms for livestock. For the other applications, the number of medicinal plants used occupies an intermediate position, and in some of the applications ready-made products are often used (cosmetics, veterinary medicine, household purposes).

The largest number of interviewed locals (707 people) answered that they use medicinal plants for culinary purposes, followed by those who use medicinal plants in human medicine (678 people). This result confirms the hypothesis that knowledge about the use of medicinal plants for food is best preserved and developed, despite the fact that some of this knowledge is returning as new and modern. On the other hand, a large number of respondents use medicinal plants for culinary purposes without having knowledge of the medicinal properties of the plant. Of the applications of medicinal plants outside of human medicine, the smallest number of locals answered that they use medicinal plants for weather forecasting (71 people) and for sale (16 people). This result is explained by the fact that the respondents rely on the mass information for weather forecasting, as a result of which, according to this application of medicinal plants, we report a loss of ethnobotanical knowledge. With regard to the sale of medicinal plants, the locals believe that this activity is not considered sufficiently profitable and therefore almost not practiced.

In the case of medicinal plants used in human medicine, the coefficient of consensus of the respondent in the treatment and prevention of respiratory diseases is the highest ($F_{IC} = 0.98$) (Table 2). These are most often seasonal, flu-like illnesses with a characteristic seasonal application of medicinal plants. Among them

most often cited by respondents are medicinal plants: *Matricaria chamomilla* L., *Thymus sp. diversa*, *Tilia tomentosa* Moench., *Hipericum perforatum* L. Followed by cardiovascular disease ($F_{IC} = 0.97$) with the most frequently cited species – *Crataegus monogyna* Jacq., *Rosa canina* L., *Mentha sp. diversa* and skin disease ($F_{IC} = 0.96$) with the most frequently cited species by the respondents – *Calendula officinalis* L., *Matricaria chamomilla* L., *Hipericum perforatum* L.

Table 2. Respondent's consensus ratio for medicinal plants used in human medicine

Groups of diseases	Responses (UR)	Taxon	F_{IC}
Respiratory	2231	25	0,98
Dermatic	597	18	0,96
Cardiovascular	508	11	0,97
Gastrointestinal	340	21	0,93
Urogenital	183	19	0,89
Neural	112	20	0,82
Metabolic	119	17	0,85
Musculoskeletal	21	10	0,52
Total	4111	141	

One of the reasons for the high number of medicinal plants for the treatment of skin diseases is the fact that this group of diseases includes superficial wounds and inflammations, insect bites, burns, warts and other skin formations. A smaller number of plants, compared to the previous groups of diseases, we report in the treatment of urogenital, nervous and metabolic diseases. The smallest number of medicinal plants for the treatment of musculoskeletal diseases. For comparison, in an ethnobotanical study for the region of Central Macedonia, Greece [13] similar results were obtained. Others, close to our results, were published in an ethnobotanical study for the region of southern Kosovo [15], where the responses of locals from 6 settlements yielded high values of consensus coefficient for cutaneous ($F_{IC} = 0.88$), gastrointestinal, $F_{IC} = 0.74$), and cardiovascular ($F_{IC} = 0.71$) diseases.

According to the index of the coefficient of consensus of the respondent, according to the application of medicinal plants in veterinary medicine, most medicinal plants are used for skin diseases in animals ($F_{IC} = 0.94$) (Table 3). This result is reported due to the fact that skin diseases include ectoparasitosis, which is a common health problem in animals. The most frequently cited medicinal plants by the respondents are: *Artemisia sp. diversa* and *Sambucus ebulus* L.

Table 3. Respondent's consensus ratio for medicinal plants used in veterinary medicine

Groups of diseases	Responses (UR)	Taxon	F _{IC}
Respiratory	17	4	0,76
Dermatic	77	14	0,94
Gastrointestinal	18	10	0,44
Gynecological	3	2	0,33
Total	113	29	

The least are the types of medicinal plants used in gastrointestinal (including endoparasitosis) (Fic = 0.44) and gynecological diseases (including birth and postpartum conditions) (Fic = 0.33).

An ethnobotanical study in southern Kosovo, an area far from the northern Black Sea coast, reported results for the use of medicinal plants in veterinary medicine close to ours (Fic = 0.67) [15].

As almost 100% of the respondents use medicinal plants for culinary purposes and the indicated types of medicinal plants are significant, the index of the respondent's consensus coefficient (Fic) for all culinary applications is extremely high (Table 4).

Table 4. Respondent's consensus ratio for medicinal plants used for culinary purposes

Applications	Responses (UR)	Taxon	F _{IC}
Food	12245	73	0,99
Spice	7456	47	0,99
Drink	756	41	0,94
Beverage flavoring	597	41	0,93
Beverage colorant	610	42	0,93
Preservative	427	28	0,93
Total	22091	272	

For comparison, the respondent's consensus ratio for the use of medicinal plants for food in the area of southern Kosovo [15] is lower (Fic = 0.76) than the present study. This difference is explained by the fact that for the region of the North Black Sea coast all culinary applications of medicinal plants are described, as well as the significantly larger number of surveyed locals.

The highest value of the index of the coefficient of consensus of the respondent (F_{IC}) for the use of medicinal plants for household purposes, receive cleaning applications ($F_{IC} = 0.95$), followed by the use of heating ($F_{IC} = 0.94$) and application in construction ($F_{IC} = 0.94$) (Table 5).

Table 5. Respondent's consensus ratio for medicinal plants used for household purposes

Applications	Responses (UR)	Taxon	F_{IC}
Colorant	71	12	0,83
Pesticide	95	23	0,75
Cleaning	99	4	0,95
Making products	192	26	0,86
Construction	158	8	0,94
Heating	240	13	0,94
Total	799	51	

The result differs from the working hypothesis that the most used are heating plants (such as wood). The high F_{IC} score obtained for medicinal plants used for household cleaning is explained by the relatively high use by many respondents of the same plant species (lemon).

Conclusion

The results of the study show that part of the knowledge about the use of medicinal plants among the local population on the North Black Sea coast is preserved, and another part is developed and changed. The study reveals the use of a large number of plants foreign to the Bulgarian flora, which proves the effect of globalization on socio-cultural development, even in the use of medicinal plants. There is a tendency to unify the use of medicinal plants and the loss of some ethnobotanical knowledge. The lack of intergenerational continuity due to lack of interest among young people, as well as the use of the global network and means of communication, are some of the reasons for the loss of ethnobotanical knowledge.

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