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Catching the Green—Diversity of Ruderal Spring Plants Traditionally Consumed in Bulgaria and Their Potential Benefit for Human Health

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Abstract: The global climate and societal challenges in the recent years urge us to strengthen food security; thus, the rediscovery of wild foods and foraging practices is also part of the sustainability agenda. Utilization of underappreciated sources such as ruderal plants could be a valuable option, especially for vulnerable parts of the society. We present data on traditional knowledge on spring edible ruderal plant taxa preserved in rural regions of Bulgaria, combining field studies in the period 2017–2022 that were compared to the available recent and historical ethnographic and (ethno)botanical literature. Semi-structured interviews were performed with representatives of 94 households in North and South Bulgaria, focusing on collection practices, used parts, and preparation methods. We list 65 edible ruderals, belonging to 22 plant families, of which 19 appeared only in the literature sources. Unlike in the Mediterranean tradition, edible ruderal plants in Bulgaria were regarded unfavorably, as poverty food. Amaranthaceae and Asteraceae were the most represented families, with 10 taxa each. About half of the taxa were collected for their leaves or whole young herbage that is used as pastry fillings, in stewed, and in cooked dishes. Taxa used in raw salads were mostly from the literature sources. The most diverse utilization was recorded in the southern-most regions of Bulgaria, where immediate tasting of the gathered plants was reported by the participants as the way to collect food plants. The bitter ones or those with an unappealing smell were considered non-edible and were avoided. References about biologically active compounds and potential benefits were collected, classified, and discussed in regard to their potential benefits for human health.

Keywords: wild edible plants; invasive plants; local knowledge; food security; foraging; traditional ecological knowledge

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1. Introduction

Diets based on the sustainable utilization of local biodiversity cater not only to the better overall well-being and health of the human population but also to the sustenance of ecological equilibrium and preservation of environment and natural resources [1–5]. Current assessments stress the importance of sustainable plant-based diets for the alleviation of negative impacts of industrial agriculture and for the mitigation of climate change [6–9]. Numerous studies have shown that plant-based foods provide a large spectrum of nutrients and bio-active non-nutrients [10,11], thus contributing to the overall fitness of the human body and reduction of risks of non-communicable diseases. It was shown that the increased number/diversity of consumed species elevates the nutritional adequacy of the diet [12]; however, traditions related to the consumption of both wild and cultivated plants are in decline, especially in modern urbanized societies (including those in Europe) [13–17]. Ethnobotanical reports have shown that the consumption of leafy vegetables, especially those gathered from the wild, is still popular in the Mediterranean region, the Balkans, and Eastern Europe. Local traditions include the preparation of everyday, as well as festive, dishes; preserves; and medicinal foods. The knowledge about these practices has been preserved and handed down over the generations and is still maintained even in diasporic communities abroad [18–28]. Wild greens are also an important part of the Mediterranean diet (MD), supplying, especially rural communities, consumers with various vitamins, essential fatty acids, minerals, fibers, phenolic and terpenoid compounds, etc. [29–31]. However, in the first decades of the 21st century, some authors have reported on the fading of the traditions for collecting wild vegetables in Central and Eastern Europa, as well as further north, with *Rumex* species being most favored [15,32]. Global climatic and socioeconomic changes in the recent years have brought (back) the importance of wild foods/foraging practices, placing them in the spotlight, as a part of the sustainability agenda that could contribute to a more balanced utilization of biological resources, while also bringing (possible) benefits to human health [33–38].

"To catch the green" (*Da se hvanem za zeleno*, in Bulgarian) is a traditional expression used by Bulgarians that describes the consumption of spring leafy vegetables, which are the first fresh plant food to be consumed after the long winter. This phrase also expresses the hopes of the people for the new season. Indeed, before the industrialization of the agriculture and introduction of modern food preservation (ca. 1950s) leafy greens, either collected from the wild or cultivated in the home gardens, were a source of important nutrients not only towards the end of winter food stocks but also during famines and war times when the procurement of fresh nutritive food rich in vitamins was scarce [39]. The consumption of spring wild greens was also practiced in relation to Easter fasting when they were the only plant food available. Some early ethnographic works even describe communities living in mountainous areas as vegetarians, consuming meat scarcely [40].

Until the beginning of the new millennium, the diet patterns of Bulgarians were close to the recommendations of the MD, which is known to sustain a high life expectancy and healthy body weight, thus reducing the risks related to cardio-metabolic disorders, certain cancers, etc. [41,42]. However, current data for the food preferences of Bulgarians have shown a deviation from the MD, i.e., a reduced intake of plant-based foods and an increase of foods of animal origin [43,44].

Early ethnobotanical reports do not exhibit a systemic interest in the consumption of spring leafy greens (also called "lush greens", *zlakove* in Bulgarian) by Bulgarians; hence, the information is scarce and scattered throughout the years. It indicates that collection from the wild was and still is unevenly popular around the country, with communities in mountainous areas adhering more frequently to such practices [39,45–48]. Therefore, similarly to other countries, the utilization of wild leafy greens in local culinary practices remains fairly unrecognized. It is due not only to the lack of archaeological evidence (which provides more information about the use of food crops) and the scarcity of ethnobotanical reports but also to the fact that wild greens have never been traded on the market [20,39,46,49,50], contrary to medicinal plants and mushrooms which were collected both for the internal market and for export, this being one of the traditional branches of the Bulgarian economy [51–53]. Their identification, collection, and consumption have remained closed in the house domain opposite to other Mediterranean countries, where such foods are marketed and specific collective terms for their consumption exist, e.g., (ta) *chòrta* in Calabria (Italy), Greece, and Cyprus; *mišanca*, *gruda*, *parapač*, etc., in Dalmatia; or *şxex* in Asia Minor and parts of Cyprus, among others [54–58]. The selection of wild greens for food was often based on their taste in search of palatable flavors [46,59]. The latter implied that the curiosity of the local people in their search for edible wild spring plants matches the unlimited options that exist in the wild. However, this approach presents possible risks related to the ingestion of toxic plants.

The ethnopharmacological application of edible and medicinal plants counters a long list, including treatment of coughs; hay fever and influenza; asthma; bronchitis; rheumatism; gastrointestinal, liver, renal, heart, brain, and skin disorders among many others [60–62]. Therefore, nowadays the interest of society and scientific organizations towards utilization of medicinal and edible plants as potential sources of pharmaceuticals, nutraceuticals, cosmeceuticals, and herbal health-promoting products for human well-being is constantly increasing [63]. However, the prevailing literature focuses more on the known medicinal plants, while the research on the health benefits of wild greens/ruderals used as food lags behind; hence, it needs more comprehensive research. Ruderals are species that occur on sites disturbed by human activities, such as roadsides, construction places surroundings, abandoned lots, railway lines, etc., that were found to be useful spots for foraging edible and medicinal plants (among other functionalities), especially in the urban and peri-urban areas [64–67].

In the current paper, we present the results of a several-year research study on the early spring consumption practices of ruderal plants in Bulgaria and link these results with a literature review on the bioactive compounds that have been registered in different parts of these plants that are known to benefit human health; we also make comments on their potential toxicity and/or adverse effects on the human body.

2. Materials and Methods

2.1. Study Area

Bulgaria occupies the central part of the Balkan Peninsula, Southeast Europe, bordering Romania (Danube River) to the north, Serbia and North Macedonia to the west, Greece and Turkey in Europe to the south, and the Black Sea to the east. The Balkan Mountain range, sprawling from West to the East, separates Bulgaria in northern and southern parts, thus impacting both the temperature and precipitation on both sides of the mountain. To the north, the climate is typical continental, while the southernmost lower parts of Bulgaria exhibit some Mediterranean features [68]. The territory elevation ranges substantially—from sea level to 2925 m. The territory of Bulgaria belongs to several biogeographical regions; therefore, the vascular flora is diverse and comprises 4064 species of spermatophytes affiliated to 921 genera and 159 families [69]. The arable land comprises about 50% of the country's territory, while forests account for 42%. There is an ongoing trend of arable land abandonment due to biophysical and economic factors [70]. Currently (2021), the urban population prevails, being nearly 3 times larger than the rural one [71].

2.2. Field Study and Research Approach

The presented data were collected during field studies in the period 2017–2022. It involved representatives of 94 households from small towns and villages in ten Bulgarian provinces—Blagoevgrad, Haskovo, Pazardzhik, Plovdiv, Sliven, Smolyan, and Sofia in the south; and Lovech, Montana, Pleven, and Vratsa in the north (Figure 1). The selection of participants was random or assisted by formal and informal community leaders (mayors, *chitalishte* (community center) managers, and/or educators). Participants engaged in semi-structured interviews focused on the various aspects of local plant knowledge related to food, spices, and medicines. Information on the consumption of annual and perennial synanthropic plant taxa thriving in disturbed habitats, including roadsides, riverbanks, field boundaries, fallows, and abandoned spaces in/along home yards and gardens, was specifically targeted as the most available foraging option. We also recorded the personal perceptions of the participants on the usage of wild edible plants and their attitudes towards the consumption of ruderals over the years by indirect questions about their current experience compared to the recollections from the past for their diet during the winter–spring period.

Figure 1. Map of the studied provinces (location of Bulgaria in the Balkan Peninsula on the bottom right).

The age of the participants was in the range of 35–85 years, with more than 60% being over 65 years of age. Female respondents prevailed (57.5% females to 42.5% males). Informed consent was verbally obtained from every participant prior to the interview. The guidelines prescribed in the Code of Ethics of the International Society of Ethnobiology [72] were followed during the field study, and their compliance was confirmed by the Scientific Council of the Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, acting as independent institutional Ethics Board (Decision No. 6/21/05/21).

Image data and/or reference specimens were collected for identification purposes; herbarium specimens were deposited as vouchers in the Herbarium of the Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences (SOM). Identification of the plants was carried out at least to the genus rank when collected as juveniles, and later on, with the help of our respondents, who provided photos of the mature plant, the species were determined. We used the *Handbook of Bulgarian Vascular Flora* for the taxonomical identification [73]. Plant names were aligned with the Plant List (2013) [74]. Field data were compared to the available recent and historical ethnographic and (ethno)botanical literature and cited references where accessible [39,46,47,75–81]. Data on traditional Bulgarian food involving wild vegetables were collected from culinary books issued between 1890 and 1952 [82–88].

Information about biologically active compounds and toxicity was retrieved from scientific literature databases—Web of Science, Scopus, and AGRIS (FAO)—as well as published books and reports.

3. Results and Discussion

3.1. Plant Diversity and Consumption Practices

We registered a total of 65 edible ruderal plant taxa to be collected by Bulgarians from the wild during spring months, of which 19 were mentioned only in the literature sources (Figure 2a,b). The plants belonged to 22 families (Table 1). Amaranthaceae and Asteraceae were most represented, with ten taxa each, followed by Brassicaceae with nine and Polygonaceae with four species. The rest of the plant families were had three or less taxa. The leaves (35 species) and young whole herbage (26 species) were the most frequently used parts. However, the young shoots (e.g., *Humulus lupulus* L. and *Rubus* L. spp.), flowers/inflorescences, (e.g., *Robinia pseudoacacia* L. and *Sambucus nigra* L.), and unripe fruits of *Malva* L. spp. and

Prunus cerasifera Ehrh. were also consumed. The latter is one of the most commonly used unripe fruits in Bulgaria cooked in various dishes, pickled, and snacked. Only the leaves of *Fallopia aubertii* (L. Henry) Holub, and unripe infruitescences of *Malva sylvestris* L. and other *Malva* species of the 10 plant species used as snacks did not have another way of consumption [47].

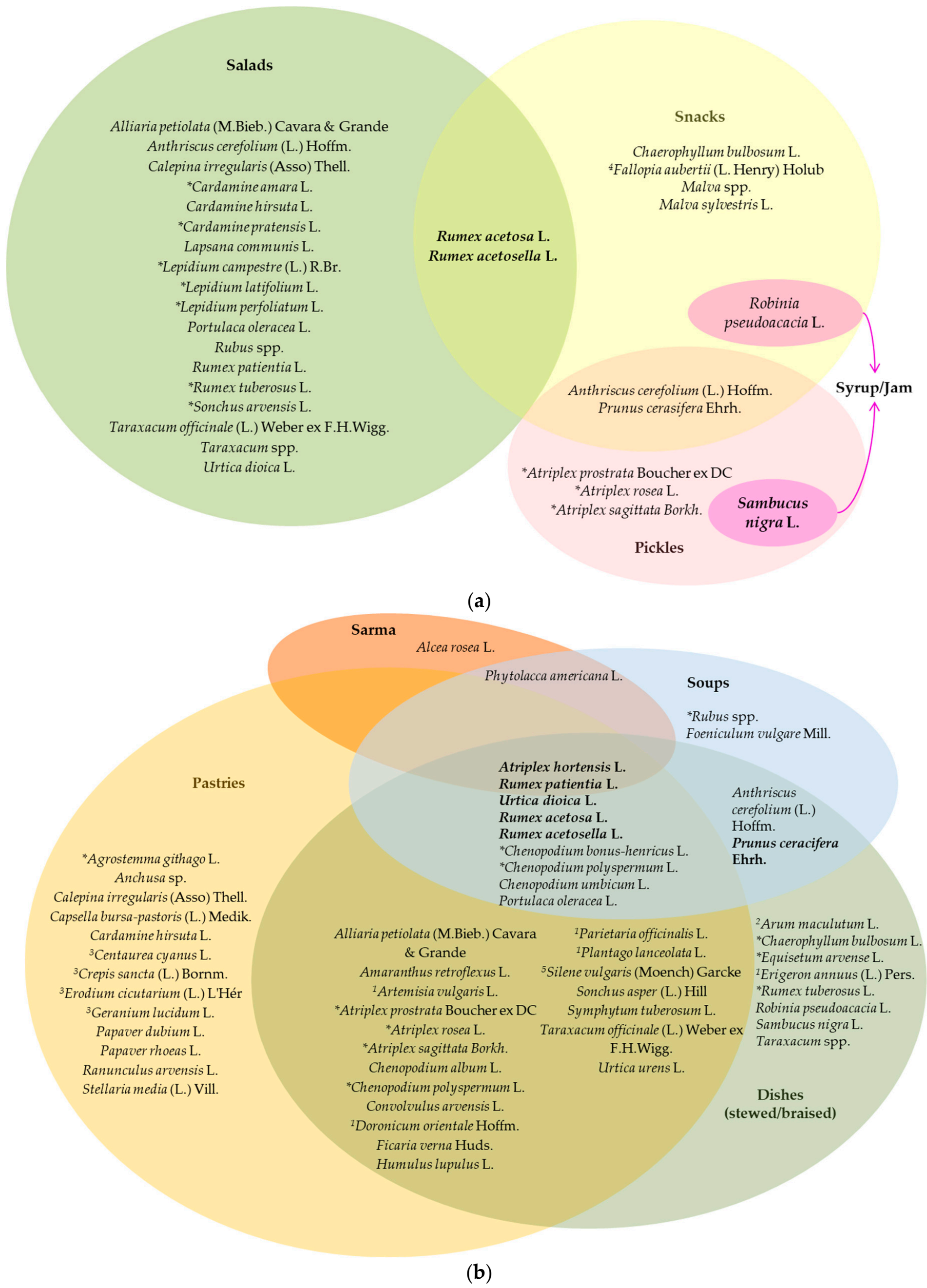

Figure 2. Ruderal plants used as spring food in Bulgaria and their way of consumption: (**a**) raw preparations (salads and snacks) and preserves and (**b**) cooked preparations (sarma category includes dishes made of leaves stuffed with vegetables, cereals with/without meat). Edible plants mentioned in traditional food cookbooks are shown in bold. Taxa from the current research are recorded in the following regions: [1] Blagoevgrad, [2] Sliven, [3] Haskovo, [4] Pazardzhik, and [5] Smolyan. * Species mentioned only in the literature sources.

Table 1. Number of ruderal taxa consumed as spring food in Bulgaria per plant family.

Plant Family	Number of Taxa	Number of Taxa Consumed Raw	Taxa Consumed Only Raw
Amaranthaceae	10	5	
Asteraceae	10	4	* *Lapsana communis* L. * *Sonchus arvensis* L.
Brassicaceae	9	7	* *Cardamine pratensis* L. * *Cardamine amara* L. * *Lepidium campestre* (L.) R. Br. * *Lepidium latifolium* L. * *Lepidium perfoliatum* L.
Polygonaceae	4	4	*Fallopia aubertii* (L. Henry) Holub
Urticaceae	3	2	*Parietaria officinalis* L.
Malvaceae	3	2	*Malva sylvestris* L.
Apiaceae	3	3	-
Caryophyllaceae	3	-	-
Rosaceae	3	3	-
Boraginaceae	2	-	-
Papaveraceae	2	-	-
Geraniaceae	2	-	-
Ranunculaceae	2	-	-
Plantaginaceae	1	-	-
Portulacaceae	1	1	-
Araceae	1	-	-
Fabaceae	1	1	-
Phytolaccaceae	1	-	-
Cannabaceae	1	-	-
Convolvulaceae	1	-	-
Adoxaceae	1	1	-
Equisetaceae	1	-	-

* Species mentioned only in the literature sources.

The number of the ruderals known to be used in different spring salads was about twice higher (18) compared to those used as snacks; however, only *Rumex acetosa* L. and *Rumex acetosella* L. were found in both categories. In Spain, the number of species used raw was similar to that of those cooked in various ways, and, very often, the snacked plant food turns into salads and dishes once having reached home [89]. Hence, the number of snack-only species was more than twice as high as salad-only ones and about 30% of the raw-consumed species that were used both in salads and as snacks. Shepherding practices, especially when performed by children, were related to a higher number of wild species used for snacking [90]. Thus, it is highly possible that significant traditional knowledge on wild edible plants in Bulgaria has been lost due to the gradual abandonment of pastoral transhumance practices and transition to the sedentary lifestyle of nomad herders reported to be evident since the Balkan Wars onwards (1920s onwards) [91]. The restructuring of agriculture under Communism (1944–1989) into state-owned industrialized farming cost even more, losing knowledge on gathering wild plants for snacking while shepherding and while walking to distant arable plots [92].

The association of consumption of weeds and ruderals with wartimes and poverty at the beginning of the twentieth century also added to their negligence as vegetables [93,94]. It was argued that, among the wild leafy greens consumed in North and Central Europe, those with a large biomass (e.g., *U. dioica*) prevailed, while the inhabitants of South Europe collected more diverse species with a small size, probably in quest of a variety of tastes, as well [95]. In more recent years, however, the use of large amounts of agrochemicals was considered an important factor for the shrinkage of the natural populations of some wild edible species, and this adds to the general reluctance/worry to collect/buy ruderal species growing in/near agricultural lands, roads, etc., for the elevated amounts of toxic pollutants in these environments [15,96,97].

Although many of the *Atriplex* and *Chenopodium* species (Amaranthaceae) that occur in the wild are well-known as leafy greens, the Bulgarian ethnographic literature draws attention mostly to the cultivated *Atriplex hortensis* L. The limited number of publicly acknowledged edible greens is visible also in the reviewed cookbooks from the end of the 19th to the first half of the 20th century, where not more than five species were mentioned, and this tendency did not change in the later years [39,83,84,86–88,98]. The early Bulgarian culinary literature favored few spring leafy greens, especially as a part of the Lenten fare and vegetarian dishes, namely, the leaves of the said *Atriplex hortensis* along with *Rumex acetosa* L., *R. patientia* L., *Urtica dioica* L., and the unripe fruits of *Prunus ceracifera* Ehrh. The common grounds for all of them, except for *R. acetosa*, were home gardens and settlement surroundings, where they were readily available at no cost and collected only for home consumption. Consequently, these vegetables rarely appeared on the market, except for *Rumex patientia*, *R. acetosa*, and *Urtica dioica*, which can be found sometimes together with *Allium ursinum* leaves on farmers' markets in the bigger cities [59].

Contrary to the great awareness of the health benefits of (wild) greens as part of the MD in other countries [30,99], the traditional collection of wild greens in Bulgaria seems to be limited and sometimes ignored even by rural communities. Hence, Bulgarian tradition for the collection and preparation of wild spring vegetables is in a dire situation, and most of the taxa are known only locally in the villages near the southern border both in the eastern and western part of the country. They have not reached broader audiences in Bulgaria, as seniors rarely manage to promulgate them even in their own communities, especially to younger generations [79] (Figure 3).

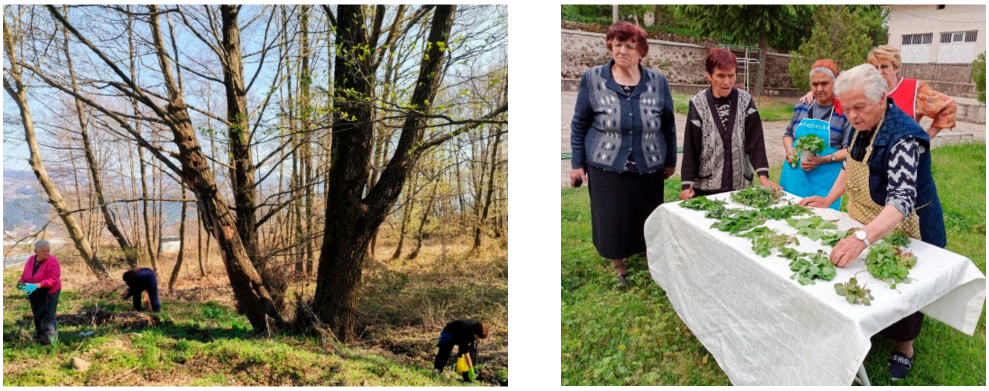

Figure 3. Gathering of spring wild vegetables alongside village road in SW Bulgaria (Gabrene village, Blagoevgrad Province).

Most of the ruderals recorded as edible during our field work are mentioned in the ethnographic and ethnobotanical sources for Bulgaria. However, during our field studies, we found another 11 taxa that are consumed in South Bulgaria. Eight of the latter are known as edible from other countries around Europe and Aegean Turkey [90,95,100–103], while the remaining three, i.e., *Centhaurea cyanus* L., *Erodium cicutarium* (L.) L'Hér, and *Geranium lucidum* L., were found to be used only as pastry fillings (*zelnik*) prepared by Anatolian Bulgarians living close to the Bulgarian–Greek–Turkish border [46]. In the case of *Crepis sancta* (L.) Bornm., our participants consume the young herbage, but the species has no local name, although the knowledge was ascribed to grandmothers.

A marked difference between Mediterranean and Bulgarian traditions in the collection of wild leafy greens is in the knowledge and use of representatives of the Asteraceae family of which, in Bulgaria, we confirmed the consumption of only seven species, a very limited number compared to the Mediterranean area [16,22,23,54,101,104–107]. Additionally, *Taraxacum sect. Taraxacum F.H.Wigg.*, *Artemisia vulgaris* L., and *Centaurea cyanus* L. are more popular as medicinal plants rather than food [73,105], and this was valid also for other species, such as *Plantago lanceolata* L. and *Urtica urens* L. The latter is used in traditional spring dishes in Italy, Crete, Belarus, and other countries, while, in Bulgaria, it is not popular as a food plant, and only *U. dioica* is used on a large scale, and the cultivated one has been marketed in stores in the recent years [22,32,95,108]. Contrary to the Mediterranean tradition to consume wild leafy vegetables as salads on their own and/or with eggs, Bulgarian culinary preparations are more focused on soups, stewing, braising, and shallow frying with wheat flower, rice, and other starchy ingredients, as well as in pastry fillings often with grains/rice that will absorb the moisture of the greens. Interestingly, the usage of flowers of *Papaver* species was not documented, while, in Central and Western Europe, they were a popular colorant for deserts, cheeses, and wines [109,110]. We witnessed some differences in the processing of the greens that are used in the filling for the *zelnik* pastry. In SE Bulgaria, the preparation includes only chopping and mixing of the gathered fresh greens because the ready *zelnik* is expected to have tender but springy bite. Therefore, a mixture of diverse edible greens collected from the wild is preferred to *Lactuca sativa* L. or *Portulaca oleraceae* L. that are grown in the home gardens but considered to have a soft, less crispy texture [46]. Along the same time, in SW Bulgaria, the young parts of the wild greens *Artemisia vulgaris*, *Erigeron annuus* (L.) Pers., *Plantago lanceolata*, and *Doronicum orientale* Hoffm. were thoroughly cooked, and consequently the mixture was used either as pastry filling or directly consumed as a spread on a slice of bread. Similarly, the leaves of *Arum maculutum* L. collected by the Roma community in the vicinity of Sliven (Central Balkan Mts.), were dried and, prior to cooking, boiled with several changes of the water to improve its palatability. However, the Roma people are not aware about the toxicity of the plant and do not relate the preparation technique to its reduction (Figure 4).

Figure 4. Dried *Arum maculatum* (snake dock, *zmiyski lapad* in Bulgaria) from Sliven province used for preparation of beef stews.

3.2. Bioactive Compounds and Potential Health Benefits

Edible ruderal plants, some of which are also traditionally used medicinal plants, are a source of primary nutritional substances (proteins, fats, sugars, vitamins, and minerals), as well as, secondary/specialized metabolites, including phenolic acids, flavonoids, anthocyanins, tannins, terpenoids, alkaloids, steroidal saponins, essential oils, glucosinolates, etc. [111]. The chemical structures of some of the molecules are presented in Figure 5. The phytochemical research usually addresses the plant parts that are used for medicinal purposes. Therefore, in some cases, we do not find published data for those plant parts that are used for food, particularly at the early stages of the plant ontogenesis. However, finding them in other plant parts is an indication that such compounds might be present, even though in small amounts. The preparation method is important, as well. Some of these compounds would break at high temperature; others would be better extracted or vice versa. For example, flavonoids were found to be more thermostable among other polyphenols [112]. Additionally, different cooking techniques were found to affect the content of phenolic compounds in various ways, e.g., pressure cooking, frying, and steaming being among least destructive [113]. However, these practices are not typical for the Bulgarian traditional cuisine, which favors slow-cooking techniques and baking, which could be found readily also in most Balkan countries [39,114–116]. Fermented leafy greens (e.g., *Atriplex* and *Malva*), as functional food, combine the benefits of the bioactive compounds in the plants with the benefits of microbial origin. This practice was reported by other Bulgarian authors in the past [75], but we have not recorded any of our respondents to ferment spring greens.

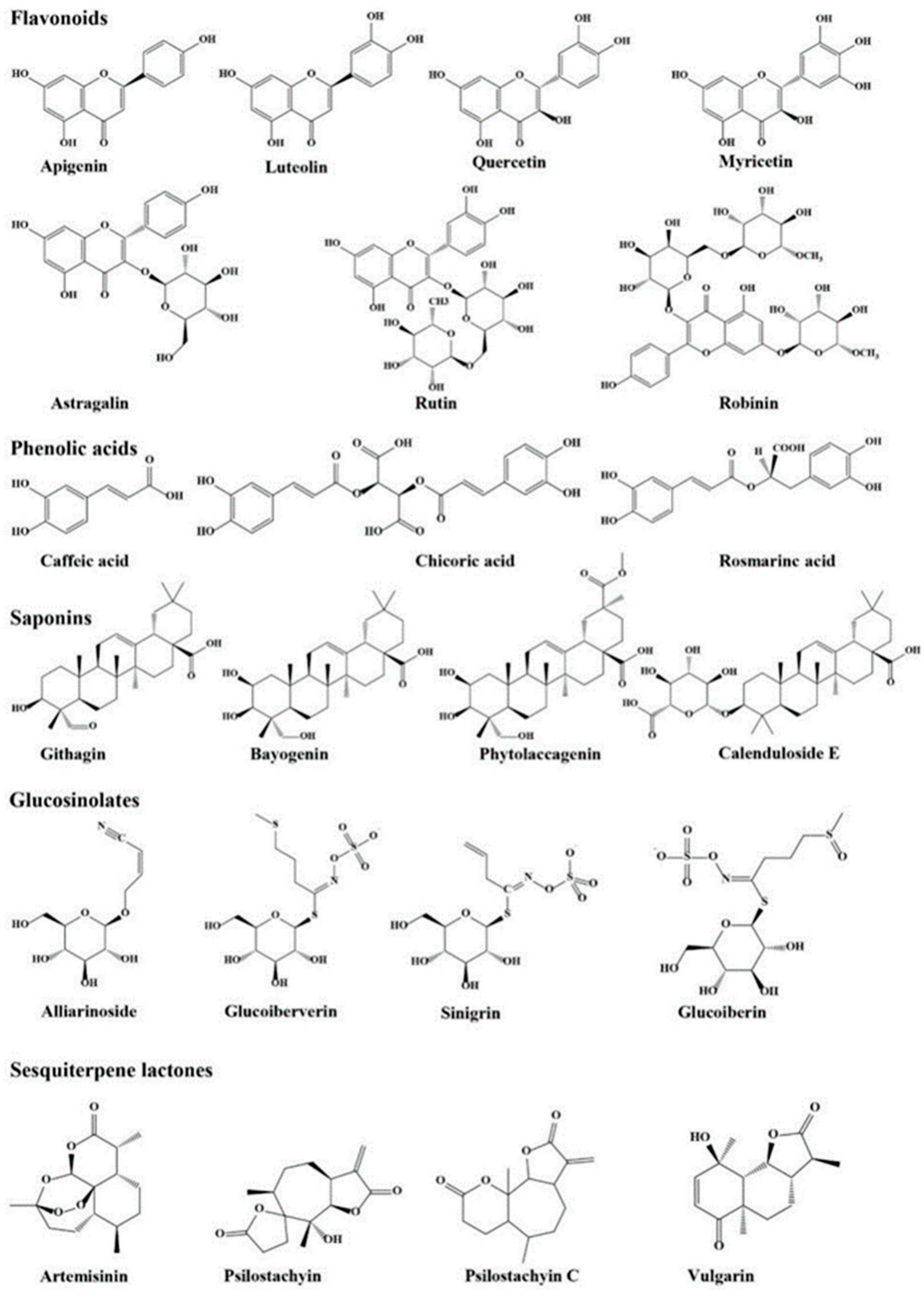

Figure 5. Chemical structures of some plant-derived compounds responsible for the biological activities reported for the taxa covered in the study.

Most commonly found biologically active compounds typical for the consumed taxa belonged to polyphenols—mainly flavonoids and phenolic acids and their derivatives, respectively, 74% and 51% of the taxa (Figure 6). Other important nutritives, such as fatty acids (20%), tocopherols (18%), and carotenoids (11%), were reported. Details on major metabolites and toxic substances in spring edible ruderals consumed traditionally in Bulgaria are presented in Supplementary Table S1. Quercetin, kaempferol, apigenin, and their derivatives and caffeic, p-coumaric, and chlorogenic acids were most frequently reported among the flavonoids and phenolic acids, respectively. Their numerous biological activities are proven by in vitro and in vivo tests and comprise antimicrobial, antioxidant, and wound-healing activities; reduce the risk of myocardial infarction, cancer development, have anti-inflammatory, and immunomodulatory functions; and protect the central nervous system and others [112–115,117].

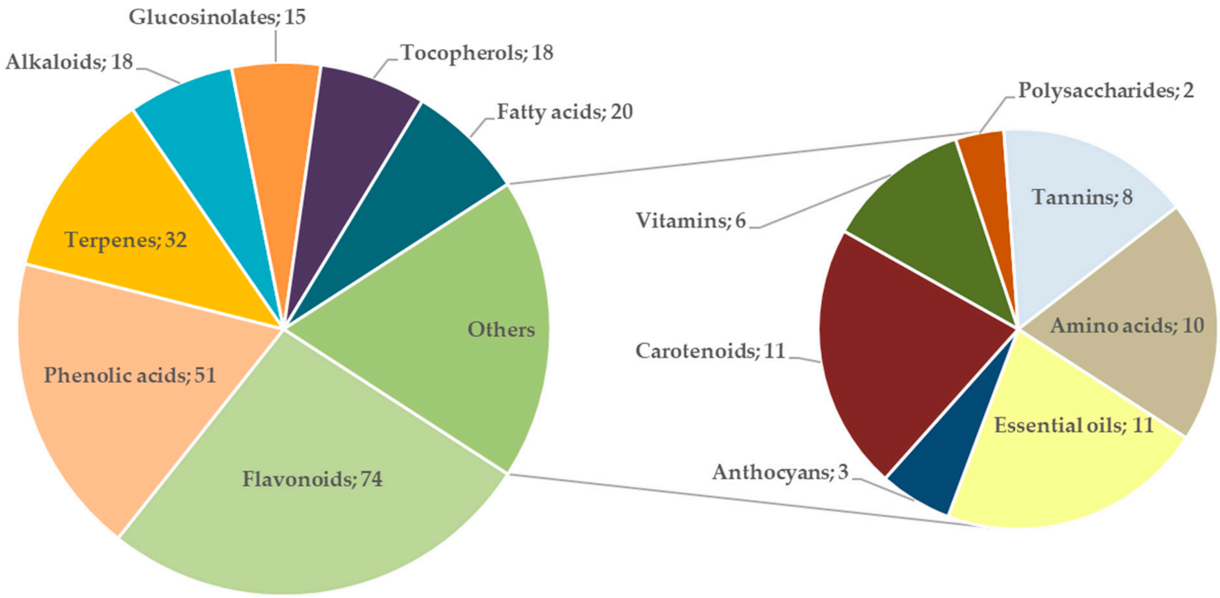

Figure 6. Major groups of compounds (calculated as percentage of the taxa) reported for the screened edible ruderals consumed in Bulgaria.

3.3. Potential Medicinal Benefits

The species from Amaranthaceae and Asteraceae that are the most frequently consumed spring edible ruderals are also frequently used as medicinal plants in treatments of gastrointestinal discomfort, disorders of the nervous system (insomnia, epilepsy, depression, and excessive stress exposure), wound healing, hepatitis, lymphadenitis, and gynecological diseases, among many others [118,119]. The complex applications of these plants were related to the flavonoids, phenolic acids, terpenes, sesquiterpenoid lactones, alkaloids, saponins, etc., contained in them [55,119]. *Artemisia vulgaris* has been frequently used in the treatment of gastrointestinal cancer, and the activity was due to the presence of the flavonoid hispidulin [120]. *Artemisia vulgaris* water extract had very low toxicity (>500 µg/mL) against colorectal cancer (SW-480 cell line), revealing the tissue-specific effect of the plant species [121]. The cytotoxic and anti-proliferative activity of *C. cyanus* towards a large panel of cancer cells was due to the presence of phenolic acids (chlorogenic, caffeic, ferulic, and p-coumaric) and flavonoids (isoquercetin, apigenin, and luteolin) [122].

The methanol extract of *Crepis sancta* aerial parts contains eudesmane-type sesquiterpenoids and different methoxylated flavonols that exhibit antiulcer activity [123]. The high polyphenolic and flavonoid content in the 50% methanol extract of *Chenopodium album* was responsible for its antiarthritic activity. The main effect was correlated with the inhibition of the NF-kB protein [124]. The flavonoid fraction of *C. album* containing mainly rutin and quercetin was found to possess dose-dependent antidiabetic properties [125]. The water extract of *Sonchus arvensis* had a strong anti-gout effect, expressing anti-inflammatory activity on monosodium urate crystal–induced gout arthritis in Wistar rats [126].

The quenching of reactive oxygen in different species prevents the potential damage of biological macromolecules, such as proteins, lipids, carbohydrates, and nucleic acids, and reduces the risk of causing immunodeficiency syndrome, arteriosclerosis, diabetes, gastric ulcer, cancer, and the aging process [127–130]. Polyphenols, and especially flavonoids, are secondary metabolites that are known to serve various and important roles in the plant organism, such as UV-screening and antioxidant and regulatory functions, thus contributing to the adaptation of the plant organism to the environment and its changes [131–133]. Plants tend to produce more phenolic compounds, such as flavonoids, phenolic acids, and anthocyanins, under various abiotic stresses (cold, drought, heat, etc.) [134]. Hence, the early spring frosts can be considered to be a trigger for the accumulation of secondary metabolites in the wild greens and hence perform their benefits to the consumers. The antioxidant activity of the customary popular *Urtica dioica* was related to the presence of caffeic and p-coumaric acids derivatives, as well as quercetin and kaempferol derivatives in aqueous extracts [135,136]. Similarly, in *Centaurea cyanus* (that is newly recorded as edible plant), the main compounds were found to be chlorogenic, caffeic, ferulic, and p-coumaric acids, as well as iso-quercitrin and coumarin, which presented anti-hemolytic and anti-hypertensive, but not anticancer, activity in vitro of the aqueous extracts [55,137]. On the other hand, *Rumex acetosella* exhibited high radical scavenging activities mainly due to the luteolin and apigenin derivatives [138,139].

The antioxidant activity assessment of *Erodium cicutarium* (L.) L'Hér in water and methanol extracts from four locations in Croatia revealed that the plants from the Plitvice locality showed the highest antioxidant activity according to FRAP, DPPH, and ABTS assays. The observed results were explained by the highest amount of some phenolic acids, such as protocatechuic, 5-*O*-caffeoylquinic, and p-hydroxybenzoic acid; and the flavonoids hyperoside, narcissin, and quercitrin [140]. We considered that the methanol extract of *Doronicum orientale* Hoffm. could be an alternative source of natural agents in the management of the oxidative stress. The major compounds in this extract were found to be the flavonoids hesperidin, hyperoside, and luteolin-7-glucoside, as well as the phenolic acids chlorogenic, protocatechuic, gallic, and caffeic acids [130]. The flavonoid content in *Ficaria verna* Huds. was much higher in the flowers than the leaves, with the dominant ones being hyperoside (5.0 mg/g dry weight) and quercetin (3.5 mg/g dry weight) [141]. This species could be regarded as a promising natural plant source of antioxidants with a high potential for phytopreparations. The whole herb extract had the highest total phenolics and total flavonoids (mg quercetin/g) content compared to the leaves and flowers extracts only. The total herb extract inhibited approximately 80% of the DPPH radical, which was comparable to the activity of vitamin C and quercetin [142]. The methanol extract of *Ranunculus arvensis* L. might potentially substitute the usage of the synthetic antioxidants butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) and highest total flavonoid content of rutin equivalents dry extract [143]. *Rumex acetosella* exhibited one of the highest radical scavenging activities towards DPPH (31 mg TE/g), correlated with the total flavonoids and phenolic acids content as major compounds that were reported to be the luteolin and apigenin derivatives [111]. The ethyl acetate and acetone extract of *Portulaca oleracea* L. were characterized by the highest flavonoid content (115.49 and 89.65 mg/g quercetin equivalents) compared to the nonpolar extracts, such as n-hexane and chloroform. The same extracts were characterized by the highest antioxidant activity and α-glucosidase inhibitory activity. These results reveal the potential of *P. oleracea* in the management of skin disease, such as age spots and melisma, by controlling the biosynthesis of melanin, as well as in treating diabetes type 2 by reducing the blood sugar [144]. The ethanol extract of *Anchusa officinalis* L. showed the strongest antioxidant and antibacterial activity, which was correlated with the highest concentrations of phenolic compounds (total phenolics of 104.03 mg gallic acid/g extract) compared to other organic extracts [145].

Based on its traditional application for the treatment of pneumonia, the methanol extract of *Anthriscus cerefolium* Hoffm. proved to be effective in inhibiting the biofilm formation of *Staphylococcus aureus* clinical isolate. Its minimum inhibitory concentration (1/2 MIC = 69.88%) was superior to that of streptomycin (1/2 MIC = 55.64%). The extract also inhibited the preformed yeast biofilm of two standard yeast strains (*Candida albicans* and *C. tropicalis*), as well as one clinical isolate, *C. krusei*, at MIC = 5.00 mg/mL, while that of fluconazole was 2.00 mg/mL [146]. Along with its wound-healing potential, *Stellaria media* revealed a strong antibacterial capacity, as well. Due to the differences in the architecture of the bacterial cell wall, the extract had a greater effect towards the Gram-positive (G^+) *S. aureus* (15.33 mm zone of inhibition) than the Gram-negative (G-) *Escherichia coli* (9.66 mm zone of inhibition). Among the individual extract components, vanillic, caffeic, chlorogenic acids, and luteolin possessed antibacterial activity [147]. The ethanol extract of *Anchusa officinalis* showed the strongest antioxidant (53.53% inhibition of DPPH radical) and antibacterial activity, which was correlated with the highest concentrations of phenolic compounds (total phenolics of 104.03 mg gallic acid/g extract) compared to other organic extracts. The ethanol extract has the lowest MIC value, i.e., 3.94 μg/mL, towards *Proteus vulgaris*, *Salmonella enteritidis*, *Enterococcus faecalis*, *Enterococcus faecium*, *Salmonella typhimurium*, and *Candida albicans*. On the other hand, the chloroform extract was the most active (IC_{50} = 102.28 μg/mL) one towards mouse fibroblast carcinoma [145]. Glucosinolates seem to be characteristic compounds for the family Brasicacea and identified several species, such as *Alliaria petiolata* (M.Bieb.) Cavara and Grande, *Calepina irregularis* (Asso) Thell, *Cardamine hirsuta* L., *Cardamine pratensis* L., and *Lepidium campestre* (L.) R. Br., and are mainly characterized by their antioxidant, antibacterial, analgesic, anti-inflammatory, and anticancer activity [148,149]. The subcritical CO_2 extract of *Lepidium latifolium* L. containing glucosinolates or their products exhibited antimicrobial properties that were measured through the agar diffusion method, achieving a 20.2, 17.1, 18.3, and 19.3 mm growth inhibition zone for *S. aureus*, *E. coli*, *Kl. pneumoniae*, and *C. albicans*. These values were similar (ranging between 12 and 16 mm) to those of ampicillin at 100 μg/disc [133]. The representatives of *Lepidium* that were found to be consumed in salads in Bulgaria in the past were also found to be a good source of polyunsaturated fatty acids, together with soy and other pulses [150]. Their consumption, along with the consumption of other cruciferous vegetables, has been associated with a reduced risk of cancer (including in organs such as the lungs, stomach, breast, prostate, pancreas, colon, and rectum), and this effect has been assigned to the isothiocyanate content [151]. The in vitro anti-glioblastoma activity of methanol extract of *Anthriscus cerefolium* against the A172 glioblastoma cell line (IC_{50} = 765.21 μg/mL) was devoted to the presence of 32 phenolic compounds mainly presented by hydroxybenzoic and ferulic acids derivatives, as well as quercetin and luteolin glucosides. The extract has shown to be selective, having no toxicity (IC_{50} = 800 μg/mL) towards the control human gingival fibroblasts cells HGF-1 [152]. The ethyl acetate and acetone extract of *Portulaca oleracea* were characterized by the highest flavonoid content (115.49 and 89.65 mg/g quercetin equivalents) compared to the nonpolar extracts, such as n-hexane and chloroform. Along with the presence of essential oils and phenolic compounds, *Geranium lucidum* L. contains alkaloids (palmatine, columbamine, pseudo columbamine, and geraniin), which determine its potential similarly to other *Geranium* species to possess anticancer activity [153]. Essential oils are another important substance found in plants. A major part of the oil from *Artemisia vulgaris* extracted from the aerial parts was constituted by monoterpenoids (72%) and sesquiterpenoids (26%). Among the major volatile compounds identified were 1.8-cineole (28.9%), sabinene (13.7%), camphor (13.0%), camphene (9.1%), β-caryophyllene oxide (6.5%), α-, and β-thujone (13.5%). The essential oil is characterized by promising antioxidant, antimicrobial, and anticancer properties. The essential oil of *A. vulgaris*, extracted from the aerial parts and mainly composed of 1.8-cineole and β-thujone, exhibited antibacterial activity against *E. coli*, *S. enteritidis*, *P. aeruginosa*, *K. pneumonia*, and *S. aureus*, as well as antifungal against *C. albicans* and *Aspergillus niger*. On the other hand, the essential oil extracted from the roots did not have any antimicrobial activity due to the low level of 1.8-cineole and the lack of β-thujone in the roots. *Artemisia vulgaris* might be a promising source of new anticancer agents, since it induced apoptosis in the HL-60 leukemic cell line. The observed apoptosis was mediated by caspase-dependent pathways, involving caspase-3, -9, and -8, which were initiated by Bcl-2/Bax/Bid-dependent loss of mitochondrial membrane potential, leading to the release of cytochrome c to the cytoplasm to activate the caspase cascade [154]. Three acyclic hydrocarbone monoterpenoids β-myrcene, cis-β-ocimene (its trans isomer), limonene, α-terpinene, p-cymene, and Δ^3 carene were identified in the essential oil of the leaves of *Chenopodium polyspermum* L. These compounds were mainly responsible for its antimicrobial and especially antifungal activity towards *C. albicans* and *A. niger* [155]. Hops essential oil exhibited potential anticancer, anti-inflammatory, analgesic, and sedative effect on human health. The anticancer activity was attributed to its compounds, such as β-caryophyllene and β-caryophyllene oxide. These compounds have the potential to inhibit the growth and proliferation of various cancer cells, including those of colon, pancreas, breast, cervix, and prostate [156].

The bioactivity-guided investigation of the methanol extract of *Crepis sancta* (L.) Bornm. aerial parts revealed that the extract was very effective in the treatment of ethanol-induced gastric ulcer in male albino rats. Contributing to this activity are the seven isolated methoxyflavonoids, namely kumatakenin, penduletin, pachypodol, chrysosplentin, jaceidin, casticin, and 3.5.7-tri-*O*-methyl-6-methoxykaempferol [123]. An aqueous extract of *Centaurea cyanus* L. presented anti-hemolytic and anti-hypertensive activity in vitro. The main compounds present in the extract were chlorogenic, caffeic, ferulic, and p-coumaric acids, as well as isoquercitrin and coumarin. However, the extract showed no activity against several cancer cells, such as lung adenocarcinoma (cell line A549), colorectal adenocarcinoma (Caco-2), and human hepatoma carcinoma (HepG2) cells [157]. The 70% ethanol extract of *Stellaria media* (L.) Vill., which is rich in flavonoids, revealed promising wound-healing properties investigated on normal human dermal fibroblasts (NHDFs) [147,158]. The saponin-rich fraction of *Chenopodium bonus-henricus* L. possessed better hepatoprotective activity than the flavonoid-rich fraction. The saponin fraction showed in vitro hepatoprotective and antioxidant activities comparable to those of flavonoid complex silymarin (60 μg/mL) in a model of metabolic bioactivation induced by CCl_4. The fraction, compared to silymarin, significantly reduced the cellular damage caused by CCl_4 in rat hepatocytes, preserved cell viability and glutathione level, decreased lactate dehydrogenase leakage, and reduced lipid damage [159].

3.4. Toxicity and Community Awareness

Many of the spring greens consumed by Bulgarian communities are reported to contain anti-nutritive compounds (e.g., alkaloids, furanocoumarins, saponins, tannins, oxalates, etc.) that might induce acute toxic effects or affect humans and/or animals after prolonged consumption. Insufficient knowledge of plants and their bioactive composition poses dangers for collectors and buyers at farmers' markets [97,99,160–162]. According to the Toxic Plants–Phytotoxins Database, for 59% of the studied taxa, there is no evidence of toxicity in humans, and only 3% fall into the group of strong toxic plants [163].

Pyrrolizidine alkaloids that occur in Boraginaceae are not toxic per se but require bioactivation to the toxic dehydropyrrolizidine alkaloids (so called "pyrroles"), which occurs primarily in the liver [164–166]. Selection trough tasting was applied to the representatives of this family which are used in a juvenile state, and they are consumed only after thermal processing, which reduces the effect of the hepatotoxic unsaturated pyrrolizidine alkaloids. The tasting during the gathering, the stewing of the greens to prepare the pastry filling, and the subsequent baking of the dish and the small amounts of the two taxa (*Symphytum tuberosum* L. and *Anchusa* sp.) used in the green mixtures minimize the risk from their consumption.

The representatives of Ranunculaceae (*Ficaria verna* Huds. and *Ranunculus arvensis* L. [143]) contain the toxic glycoside ranunculin, which, in the case of dermal contact, is converted to protoanemonin, the toxicity of which may cause third-degree skin burns, leading to dermal–epidermal separation and the formation of bullous lesions. The clinical condition is called phytodermatitis [167]. *Ranunculus arvensis* is traditionally used in the Far East to treat arthritis, asthma, gout, high fever, and psoriasis, but it is highly allergenic in spring during the flowering period [143]. The two species participate in small quantities in the pastry fillings both in South and SW Bulgaria and are collected only after the tasting of the herbage and discarding all bitter and/or flowering plants. Prior to the consumption, the green mass that includes the two species is first stewed, and afterwards the whole dish is baked in the oven [143]. Hence, the negative effect is abolished, as proven by [168] and other authors [168].

The furanocoumarins in many plants may cause a phototoxic reaction when they come in contact with skin that is exposed to UV-A light. This is due to their ability to react with nucleobases in DNA under the influence of UV-A radiation, resulting in crosslinks in DNA [169]. Coumarins and furanocoumarins serve as potent defense compounds in Apiaceae, but, in humans, they can cause mutations or even cancer [170]. *Anthriscus cerefolium* was listed together with *Foeniculum vulgare* Mill. and other species from the family to contain furanocoumarins and other toxic compounds [171]. However, the negative impact could be alleviated when applied in mixtures [172]. Additionally, recent research on herba *Anthrisci cerefolii* showed a decreased proliferation rate of glioblastoma cells while being non-toxic to the control cell line [152]. The cytotoxic effect of *Anthriscus* extracts is due to podophyllotoxin-related lignans, which are currently of interest due to the high availability of these ruderal species [173,174].

Tropane alkaloids are commonly used as anti-colic and spasmolytic drugs (scopolamine) in both digestive- and urinary-tract spastic conditions. Moreover, atropine is commonly used in ophthalmological eyedrops to enlarge pupils, paralyze the accommodation reflex, and enable the ophthalmic examination. Tropane alkaloids or their derivatives (containing tropane core) are potential anticancer agents with potential beneficial effect during the treatment of human multiple myeloma (RPMI 8226), lung carcinoma (A549), breast adenocarcinoma (MDA-MB-231), and mouse skin melanoma (B16-F10) cell lines [175]. On the other hand, the consumption of *Convolvulus arvensis* L, which contains tropane alkaloids, may cause diarrhea, colic, gastrointestinal ulceration, and intestinal thickening and fibrosis, as shown for the roots of this species, mainly when ingested by animals [143,167,176–179]. However, when collected as food in early spring, only young leaves are selected, and afterwards, they undergo thermal treatment as parts of the pastry filling that should alleviate the risk (see above).

While different approaches, e.g., cooking or steeping in water before preparation, to eliminate or at least reduce the amount of toxic compounds are well documented in the Mediterranean area, Bulgarian ethnographical sources claim that “poisonous plants” were taboo in the traditional cuisine [25,39,180]. This could be related also to the rare use of cooked or blanched vegetables as salads and/or snacks in Bulgaria that was confirmed during our field studies where only blanched branch shoots of *Pistacia terebinthus* L. were presented in a salad form. About 41% of the currently listed taxa are reported to be non-toxic, and, in many cases, the reported toxicity for certain species was related to parts which were not consumed, or it is related to alkaloids, saponins, or glucosides that are in relatively small amounts in the seedlings or shoots during the collection time. Another case was the use of the leaves of *Phytolacca americana* L. for the preparation of *sarmi* (green leaves stuffed with a mixture of rice, chopped allium, and spices). The vegetative parts of the plant contain saponins (mainly phytolaccatoxin and phytolaccagenin) in greater amounts than in the fruits and was known to cause stomach and intestinal discomfort if not properly cooked [181]. The first application of this invasive weed was related to the use of its pokeberries for fortification of the wine color and is also reflected in the Bulgarian name of the plant *amerikanski winoboj* (American wine-colorant) [80]. Still, when the participants from the local community in Belasitsa Mt. talked about the use of the leaves of *P. americana* for *sarmi* preparation, they used another colloquial name, *butima* (Figure 7). The leaves are used either fresh in spring—soaked in hot water boiled after they are stuffed with the filling—or dried and stored for later on. In the latter case, the leaves are again soaked in hot water and then cooked until ready.

Figure 7. *Phytolacca americana* L. is used diversely throughout the season—leaves are used for preparation of *sarmi* (**left**) and the fruits (**right**) for color fortification of wines and as ink in the past (Gabrene village, Blagoevgrad Province).

Our respondents from the Central Balkan Mts. used a similar approach when preparing leaves from *Arum maculatum*. Although they were not specifically aware of the toxic effects of the plant, they applied combined drying and continuous boiling of the leaves before consumption to improve their taste. In fact, this practice can be regarded also as traditional knowledge inherited from previous generations that resulted in the reduction of the toxicity of the leaves. A similar approach was found to be effective in the elimination of the oxalates of *Arum palaestinum* Boiss. traditionally consumed in Palestine, thus reducing possible injuries and inflammation of skin and mucosa, and negative impacts on the stomach, intestines, and kidneys [182]. However, the same authors revealed that boiling significantly reduces the total amount of phenolics; hence, the benefits of its consumption are diminished.

While the awareness of common poisonous plants could be regarded as adequate, at least in rural communities under study, anti-nutritional compounds such as oxalates and phytates that are abundant in the popular *Rumex acetosa*, *Urtica dioica*, and some *Chenopodium* species should be considered an important issue, as the first forms insoluble calcium oxalate salts found in more than 50% of patients with renal lithiasis in Bulgaria, and the second reduces the number of the macro- and micronutrients in the food [163,183–186]. Additionally, the gathering of those plants along roadsides in and near arable fields treated with pesticides should be avoided so as to reduce incidental intoxications with other environmental pollutants [97].

When the toxic effects of some early spring greens are discussed, we should bear in mind several facts that stem from the local traditional knowledge and practical needs of our respondents. Firstly, Asteraceae and Amaranthaceae families participate in the green mixtures not only by having the highest number of species but also because they prevail in quantities, as their leaves and young shoots have big biomass. Secondly, the species from the two families that are consumed are not reported to contain toxic compounds. Thirdly, the plant species that contain toxic compounds participate more rarely and in lesser amounts in the green mixtures on the one hand, and, on the other, the mode of preparation always involves thermal treatment, which is reported to reduce the harmful effects.

4. Conclusions

Foraging for spring vegetables is an important part of the traditional ecological knowledge that involves not only various information on local flora but also on biologically active substances, including toxic ones. The preservation of those traditions, together with the promotion of agroecological practices, and hence the reduction of the use of pesticides, could contribute to food security in the current turbulent socioeconomic situation and ensure the supply of valuable biologically active compounds at minimal or no cost. However, the diminishing of the number of the keepers of such knowledge hampers its intergenerational transfer. Therefore, it is crucial to promote and (re)integrate this knowledge into formal and informal education, especially among children and vulnerable groups (people living in poverty, refugees, homeless, etc.). The inclusion and valorization of this traditional knowledge as a part of local tourism services and the promotion of sustainable practices for nature conservation could encourage the development of new businesses in the rural areas and ensure more diverse local food, as well.

Understanding the traditional food practices related to foraging early spring greens can trigger further research on the chemical compounds in plants, i.e., in different stages of ontogenesis or under different types of processing. The increase of the knowledge about the benefits of plant food can also contribute to the increase of share of the plant-based food in the diet of contemporary people.

Supplementary Materials: The following supporting information can be downloaded at https://www.mdpi.com/article/10.3390/d15030435/s1. Supplementary Table S1. Ruderals used as traditional spring food in Bulgaria. References [187–317] are cited in Supplementary Materials.

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