

## Traditional Bulgarian *Artemisia* flavored wines – a review

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### Abstract

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Even though the interest in aromatized wines is growing in Europe and they are an important part of European culture, the Bulgarian *Artemisia*-flavored wines (with the collective name *pelin* after the colloquial name of the herb) have remained outside the attention of wine industry and research. The tradition of *pelin* production is more than 170 years old and has its local variants in different parts of the country. Its multi-step technology of production includes addition of fresh fruits together with different dry herbs that are combined according to the producer's preferences. The resulting wine is enhanced with biologically active substances derived from the herbal and fruit ingredients, therefore it can be positioned as a functional beverage in the currently growing market for products for overall health benefits and well being of humans thanks to their bioactive compounds. We compare Bulgarian *pelin* wines with similar beverages produced in the Balkans and the Italian *vermouth* on the basis of a critical assessment of the current state of knowledge from available published sources. A total of 73 taxa from 35 plant families were found published for the studied beverages. Bulgarian *pelin* wines were flavored with 25 plants, mainly locally sourced. *Pelin* wine has been strongly connected to Bulgarian rural traditions throughout the years and its production can contribute to the prosperity of rural areas in the country and development of wine and food tourism.

**Keywords:** Bulgaria, aromatized wines, *Artemisia*, functional beverage, traditional products

### Introduction

Agriculture and rural development are among the main foci of the European Union. Among the plant-based agricultural products, wine is of major importance, because the EU is the world-leading wine producer, and wine is its largest agri-food sector in terms of exports (European Commission, 2018; Pomarici and Sardone, 2020; Ohana-Levi and Netzer, 2023). In the last decades people have shown an increasing

interest in foods and beverages, which enhance their overall health and support their well-being (Bigliardi and Galati, 2013). In response to this need the term “functional foods” was first introduced in Japan in mid-1984 (Bigliardi and Galati, 2013) and referred to foods and beverages containing bioactive substances (among which are probiotics) that have positive physiological effects on humans. The COVID-19 pandemic additionally stimulated many young people to seek a safer living environment in rural areas, leaning towards

semi-subsistence agriculture that would ensure provision of cleaner and healthier foods and beverages (FAO, 2021). Probiotics promote healthy food digestion by converting complex nutrients into simpler forms (Maurya et al., 2021). Plant-based fermented products can be considered as dairy-free alternative sources of probiotics (Melini et al., 2019). On the one hand, wine is among the most ancient fermented products in human history and on the other – wine and its herbal variations were a part of ancient medicine practices (McGovern et al., 2009; McGovern et al., 2010; Tonutti and Liddle, 2010; Rathi & Rathi, 2018).

Aromatized wines based on *Artemisia absinthium* L. (common wormwood) are a part of the European culture, and are produced traditionally in many countries, under different names. McGovern et al. (2009) have found traces that imply addition of *Artemisia* and other medicinal plants in wines in vessels from Abydos (Egypt) dated ca. 3150 BCE. Earliest data on *Artemisia*-flavored wines in the Balkans (Thrace and Marmara regions) are described in Pedanios Dioscorides' De Materia Medica (ca. 1 century CE), where different translations affiliate the used herbage to *A. absinthium* and/or *A. pontica* L. (Tobyn et al., 2011). In Southeastern Europe denominations are also related to the common name of *Artemisia* spp.: in Bulgaria – *pelin*, in Romania – *vin pelin* and in Moldova – *vin cu pelin* (Ciocarlan and Ghendov, 2015; Colibaba et al., 2016). In Serbia this type of wine beverage is called *bermet* and it is typical for the Vojvodina region (Gorjanović et al., 2020). The word *vermouth* was derived from the German word for wormwood „*wermut*“ when it reached France (Panesar et al., 2011). The *vermouth* is further strongly connected to Italian culture, which indicates the transfer of the drink through different borders in West Europe.

The growing interest in functional beverages and the recent positive migration towards rural areas piqued our scientific interest towards Bulgarian aromatized wines, which have been outside the contemporary scientific interest so far and are not widely offered on the market. At the same time scientific research on the properties and production of similar aromatized wines are increasing internationally (Georgieva et al., 2017; Pereira et al., 2019; Gorjanovic et al., 2020; Jiménez et al., 2020; Liang et al., 2021).

The aim of our study is to assess the current state of knowledge and to identify the information gaps connected to the Bulgarian aromatized wines called “*pelin*” based on *Artemisia* spp.

## Materials and methods

Available literature on aromatized Bulgarian wormwood wines was analyzed using digital and manual collection

methods based on selected keywords such as “*wormwood wine Bulgaria*“, “*aromatized wine Bulgaria*“, “*pelin*” and “*p(e/i)linash*” (an old word for *pelin* wine). The keywords were used both in English and Bulgarian language. Paper-print only publications published before 1990 (e.g. books, research articles, periodical press articles, compendiums, etc.) and on-line research databases (Web of Science, Scopus, CABI, ERIH+, and EBSCO) were assessed without time limitations about the technology of production, ingredients, distribution and cultural aspects. Relevant information from Bulgarian legislation acts and gray literature (theses, reports, etc.) were added to range over different aspects of *Artemisia*-flavored wines. Papers published in English and Bulgarian were equally reviewed. Obtained results for Bulgarian *Artemisia*-flavored wines were compared to recent data on similar beverages from the Balkans (Serbian *bermet* and *prokupac*, Romanian *vin pelin*) and Italian *vermouth*.

## Results and Discussion

Information on wormwood wines in Bulgaria was found scarce and fragmented. The major part of it is related to artisanal, small-scale production.

### Bulgarian wormwood wines – cultural importance and traditional production

According to the current Bulgarian legislation for production of wines and spirits (Bulgarian Council of Ministers, 2001), *pelin* wine belongs to the group of „*Special wines*“, subcategory ‘*aromatized wines*’. The beverage exists in two forms – the traditional *layered pelin* and its industrially produced version, *ordinary/blended pelin*. According to this regulation, the *layered pelin* is produced by adding fresh grapes from permitted or recommended varieties, freshly cut apples and quinces and the necessary dry herbs to one-year old wine. *Blended pelin* is flavored by adding a tincture from 12 herbs of which the herbage from *Artemisia* species is not less than 20 percent from the total weight; the rest of the herbs that could be added in different proportions, are not particularly described.

One of the earliest written records of wormwood wine in Bulgaria can be read in Zachary Knyazheski's ethnographic work from 1846, „*Customs of the Bulgarians at weddings, births and baptisms of children and at burials*“ (Minkova, 2007). The drink called *pelinash* was a part of the Bulgarian cuisine and was used as an aperitif before main meals, during various celebrations. Therefore the Bulgarian tradition of preparing wormwood wine can be considered at least 170 years old. Another source with information about preparation of *pinash* is by Rakovski (1859), who described in

detail the preparation method, mentioning specifically only *Artemisia* spp. and grape bunches for flavoring of the wine or grape must without the pomace. In his study on food, politics and ethnicity, Detchev (2007) discussed the symbols of the Bulgarian identity and habitus during the Ottoman ruling described by Zachary Stoyanov, and one of them is *pelin* wine, together with traditional foods and clothing. To have several barrels with wine, one of which with aged *pelin*, was a criterion for a “happy Bulgarian”. Therefore, it was not easy for the Bulgarian revolutionary leaders of the April Uprising in 1876 to convince Bulgarian peasants to leave behind their possessions, especially their homes, furniture, cornfields, vineyards, and the barrels with good old wormwood wine (Detchev, 2007). The lowlands in the southern foothills of the Balkan mountain were known as a center of *pelin* production at the end of the 19th century. According to Zaykov et al. (1982) *blended pelin* originated in the town of Karlovo, while the *layered pelin* in the neighboring town of Kalofer (Ivanov, 1972; Yankov, 1992). Evidence for that can be found in Ivan Vazov’s novel „Chichovtsi“ (1885), which is a part of the so-called „Sopot memories“ of the author. *Pelinash* is mentioned from the town of Sopot (the birthplace of the author) that is not far from the above mentioned towns. Ivanov (1972), describes the stages in the origin of the *blended pelin* in the town of Kalofer. Initially the aqueous extract of *A. absinthium* was used for stomach aches, but sugar was often added to temper its bitterness. Over time people discovered that wine extract of the plant not only had better medicinal properties, but also was more pleasant to drink. The medicine usage of wormwood herb was reported also earlier by Vatev (1905), where it was recommended to be drunk in spring for blood purifying.

Nowadays, *Osmarski pelin* from the village of Osmar, Shumen province, NE Bulgaria is probably the most renowned on the market, including being exported (Krumov, 2008). In 1994, the traditions in *pelin* making were revived by the Vichevs Brothers winery and wine has been produced until today. There is an annual contest for the best *pelin* during Trifon Zarezan celebration (Rumenov, 2011). *Artemisia absinthium* is used also in Isparih district, Razgrad province, where small branches from it are added to the wine (Kültür & Sami, 2008-2009). Currently, production of homemade wines and brandies has been reported as typical for the North Black Sea coast and adjacent regions with various medicinal plants used to flavor and color the final product (Boycheva et al., 2020). Another noteworthy wormwood wine is the *Karaisenski pelin*, Veliko Tarnovo province, Central North Bulgaria (Anastasova, 2000; Anastasova, 2001; Deneva, 2008, Lekova, 2004). According to Hrankov (1925) *layered pelin* is characteristic for the southern parts of the

country, where there is a multi-step production technology and the recipe combines different groups of plant resources. The *layered pelin* from the village of Zmeyovo, Stara Zagora province (Central South Bulgaria) is a popular representative of the traditional wormwood wines. Therefore, since 2007, the only annual festival dedicated to *layered pelin* has been organized on the weekend before Christmas’ Eve (Petrova, 2008; Bonev, 2013; Choreva, 2020). Koteva (2021) in her lexicological research on Bulgarian cuisine mentions homemade *layered pelin* prepared with red wine, „sweet wormwood“ (supposedly *A. vulgaris* which is common in the area) and fruits as a common drink in other villages in Stara Zagora district as well.

Standardized approach for industrial *pelin* production was developed much later. Kukunov et al., (1975), and Yankov (1992) described the production of the two varieties of *pelin* with recipes and proportions of the herbal ingredients. However, later on, the importance of *pelin* production together with the related knowledge seems to be fading away and despite the sporadic mentions, one of the latest publications on layered wormwood wine Bakalov (2011) defines its production as – an “inclined to forget tradition” and draws our attention to the danger of losing the tradition and the related knowledge.

#### Variations in the preparation of wormwood wines

Hrankov (1925) indicates three major ways for the preparation of *pelin*. The first one is when the dry *Artemisia* herbage (most probably *A. absinthium*, as it is called “bitter pelin” in Bulgarian, and the herbage is in small quantities) is added to the grape must (prepared from the healthiest grapes) and remains in it until the primary fermentation is completed. The *Artemisia* herbage (leaves and flowers, 150-200 g per 100 l of wine) is closed in a thick cloth bag to prevent small particles from the dry plants from entering into the wine. Same author reports a variation of this recipe in which hot aqueous extract from *A. absinthium* is prepared and added to the wine after the end of the fermentation, but allegedly the first approach results in a more “natural” beverage. According to another recipe bunches of healthy grapes (with thick skin to ensure slow cracking) and dry *Artemisia* herbage are put in alternating layers in wooden barrels to fill half of its volume and ready (still) wine is poured on top until the vessel is full. After some time the grapes begin to crack and the released sugar initiates weak secondary fermentation. This is the moment when the consumption of *pelin* wine starts. While *pelin* wine prepared in the first way can last longer and can be bottled, the *pelin* wine from the last method is for immediate consumption within a limited period of time. This latter method is the basis of the *layered pelin* that is described by Abrasheva

et al., (2008), Bakalov (2011), Dionisiev (1999). All authors describe the technology for the production of layered *pelin* in a similar way: a layer of grapes is placed on the bottom of the vessel (the layer ranges between 5–10 (Bakalov, 2011) to 20 cm (Abrashveva et al., 2008), on top of it is the herbage of dry aromatic plants, followed by the sliced apples and quince. The layers are repeated until  $\frac{1}{2}$  to  $\frac{2}{3}$  of the volume of the vessel is filled. The layers are compacted with a grid, and a filter is placed on the rim of the vessel. Then the vessel is filled to the top with still wine and is closed tightly to remove the air layer. Yeasts transform grape sugars into ethanol, carbon dioxide and secondary metabolites (Ciani et al., 2010). The use of different sweet fruits and dry herbs in the preparation of the *layered pelin* causes secondary alcoholic fermentation, which must take place at relatively low temperature – 12 to 15°C (Ivanov, 1972). Shortly after wine is poured onto the plant mixture, the fruits begin to release their sweet juices, and the beverage begins to slightly carbonate from the released carbon dioxide (Abrashveva et al., 2008; Hrankov, 1925; Ivanov, 1972). Artisans rely on fresh fruits and the dry herbs to source wild *Saccharomyces* strains and no starter cultures are added. The secondary fermentation also enhances the extraction of biologically active substances from the herbal ingredients (Abrashveva et al., 2008), while the unfermented sugar is responsible for the sweetening of the beverage (Bakalov, 2011). Zaykov (2010) recommends the addition of hot stones to the wine to accelerate the fermentation. Ivanov (1972) describes the method of aeration by delestage fermentation technique (also known as ‘rack and return’) so as to promote aerobic fermentation. This method (colloquially known as *pretochvane* or *pretakane*) is widespread as traditional knowledge among wine makers in Bulgaria and it is also used in preparation

of traditional plant fermented foods (Abrashveva et al., 2008; Bakalov, 2011). However, racking also causes loss of the carbon dioxide released during the fermentation (Ivanov, 1972) which is not favored by some producers. If the residual sugars from the fruits are not enough, sugar, honey or grape must may be added, depending on the personal taste preferences of the producer, which is also allowed in the regulations for commercial production of *pelin*. Raisins can be added as a sweetener as well (Zaykov 2010).

The final product is bittersweet, slightly fizzy and is ready for consumption before the Christmas holidays, after 30 to 40 days of steeping in the barrel and regular racking. The great variety of traditional wormwood wine is the reason why *pelin* is called „wine for one’s soul“ (Zaykov et al., 1982). Each craftsman produces wormwood wine according to their taste preferences and family traditions.

#### Plant species used in the preparation of *Artemisia*-flavored wines

Rakovski (1859) indicates that *pelin* preparation requires ripe red grapes, *Artemisia* herbage “that makes the drink bitter” and aged wine or grape must. Similar information about the main ingredients of *pelin* wine can be found in more recent publications (Hrankov, 1925; Ivanov, 1972; Kukunov et al., 1975). In various literature sources (Zaykov et al., 1982; Yankov, 1992; Dionisiev, 1999; Abrashveva et al., 2008; Bakalov, 2011) we find that not only *A. absinthium* is used, but also other medicinal plants (Table 1). Given the large number of *Artemisia* taxa in Bulgaria, 15 according to most recent data (Gussev, 2012) and their complex identification, further research is needed to precise what species are typical for different parts of the country (Table 1).

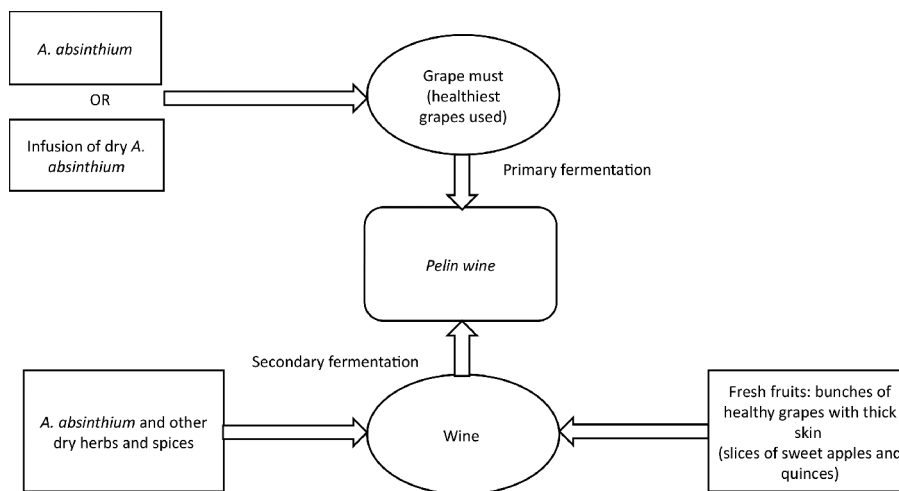


Fig. 1. Production scheme of *Artemisia*-flavored wines in Bulgaria

Table 1. Plant species used in the studied European aromatized wines

Taxon	Plant Family	Parts used	Origin	A	BG2	BG3	BG4	BG5	BG6	BG7	BG8	BG9	BG10	BG11	IT1	ROI	SER1	SER2
<i>Achillea clypeolata</i> Sm.	Asteraceae	H	L	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
<i>Achillea millefolium</i> L.	Asteraceae	H	L	0	0	0	0	1	0	1	1	1	0	0	1	1	1	0
<i>Alchemilla vulgaris</i> L.	Rosaceae	H	L	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Aloysia citrodora</i> Paláu	Verbenaceae	L	I/L	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Angelica archangelica</i> L.	Apiaceae	Fl	L	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Arctostaphylos uva-ursi</i> (L.) Spreng.	Ericaceae	H	L	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Armoracia rusticana</i> G.Gaertn., B.Mey. & Scherb.	Brassicaceae	R/Rh	L	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
<i>Artemisia absinthium</i> L.	Asteraceae	H	L	0	0	1	1	1	1	1	1	1	1	0	1	1	1	1
<i>Artemisia</i> sp.	Asteraceae	H	L	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Betula</i> sp.	Betulaceae	B	L	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Blitum bonus-henricus</i> (L.) Rehb.	Amaranthaceae	L	L	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
<i>Calendula officinalis</i> L.	Asteraceae	Fl	L	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Capsella bursa-pastoris</i> (L.) Medik.	Brassicaceae	H	L	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Centaurea benedicta</i> (L.) L. (syn. <i>Cnicus benedictus</i> L.)	Asteraceae	Fl	L	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Centaureum erythraea</i> Rafn	Gentianaceae	H	L	0	0	0	0	1	0	1	0	1	0	0	1	0	1	0
<i>Cerantonía siliqua</i> L.	Fabaceae	Fr, S	I	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Cinchona officinalis</i> L.	Rubiaceae	B	I	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Cinnamomum</i> spp.	Lauraceae	B	I	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
<i>Citrus × aurantium</i> L.	Rutaceae	Fr (peel)	I/L	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Citrus × sinensis</i> (L.) Osbeck	Rutaceae	Fr (peel)	L	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Citrus x limon</i> (L.) Osbeck	Rutaceae	L	L	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Coriandrum sativum</i> L.	Apiaceae	Fr	L	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0
<i>Crataegus monogyna</i> Jacq. (syn. <i>Crataegus oxyacantha</i> Thuill.)	Rosaceae	Fr	L	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Cydonia oblonga</i> Mill.	Rosaceae	Fr	L	0	0	0	1	1	1	1	1	1	1	1	0	1	0	0

Table 1. Continued

Taxon	Plant Family	Parts used	Origin	A	BG2	BG3	BG4	BG5	BG6	BG7	BG8	BG9	BG10	BG11	IT1	ROI	SER1	SER2
<i>Elettaria cardamomum</i> (L.) Maton	Zingiberaceae	S	I	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Equisetum arvense</i> L.	Equisetaceae	H	L	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Eucalyptus globulus</i> Labill.	Myrtaceae	L	I	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Euphorbia cyparissias</i> L.	Euphorbiaceae	R/Rh	L	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Foeniculum vulgare</i> Mill.	Apiaceae	S	L	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
<i>Gentiana</i> spp.	Gentianaceae	R/Rh	L	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
<i>Glycyrrhiza glabra</i> L.	Fabaceae	R/Rh	L	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
<i>Hibiscus rosa-sinensis</i> L.	Malvaceae	Fl	I	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Humulus</i> spp.	Cannabaceae	Fl (strobili)	L	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Hypericum perforatum</i> L.	Hypericaceae	H	L	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
<i>Imula helenium</i> L.	Asteraceae	R/Rh	L	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
<i>Juniperus communis</i> L.	Cupressaceae	Galbuli	L	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
<i>Laurus nobilis</i> L.	Lauraceae	L	L	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Lysimachia arvensis</i> (L.) U.Manns & Anderb. (syn. <i>Anagallis arvensis</i> L.)	Primulaceae	H	L	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Malus domestica</i> (Suekov) Borkh.	Rosaceae	Fr	L	0	0	0	1	1	1	1	1	1	1	1	0	1	0	0
<i>Matricaria chamomilla</i> L.	Asteraceae	Fl	L	0	0	0	0	1	1	1	1	1	0	0	1	1	1	0
<i>Melissa officinalis</i> L.	Lamiaceae	H	L	0	0	0	0	0	0	0	1	1	0	1	1	0	1	0
<i>Mentha</i> spp.	Lamiaceae	H	L	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
<i>Morus alba</i> L.	Moraceae	Fr	L	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Myristica fragrans</i> Houtt.	Myristicaceae	S	I	0	0	0	0	1	0	1	1	0	0	0	1	0	0	0
<i>Ocimum basilicum</i> L.	Lamiaceae	H	L	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0
<i>Origanum vulgare</i> L.	Lamiaceae	H	L	0	0	0	0	0	1	0	1	0	0	1	1	0	1	0
<i>Paris quadrifolia</i> L.	Melanthiaceae	H	L	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Pimpinella aromatica</i> M.Bieb. (syn. <i>Pimpinella anisum</i> L.)	Apiaceae	S	L	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
<i>Plantago lanceolata</i> L.	Plantaginaceae	H	L	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Polygonum aviculare</i> L.	Polygonaceae	H	L	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Pyrus communis</i> L.	Rosaceae	Fr, L	L	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0

Table 1. Continued

Taxon	Plant Family	Parts used	Origin	A	BG2	BG3	BG4	BG5	BG6	BG7	BG8	BG9	BG10	BG11	ITI	ROI	SER1	SER2
<i>Quercus</i> spp.	Fagaceae	B, Fr	L	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Rhaphispermum nigrum</i> (L.) Al-Shehbaz (syn. <i>Brassica nigra</i> (L.) W.D.J.Koch)	Brassicaceae	S	L	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
<i>Rheum rhabarbarum</i> L.	Polygonaceae	L (stalks)	L	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Rosa canina</i> L.	Rosaceae	Fr	L	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Rubus fruticosus</i> L.	Rosaceae	Fr	L	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Salvia rosmarinus</i> Spenn.	Lamiaceae	H	L	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Salvia</i> spp.	Lamiaceae	H	L	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0
<i>Sambucus nigra</i> L.	Viburnaceae	Fl	L	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0
<i>Senna alexandrina</i> Mill.	Fabaceae	H	I	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Sinapis alba</i> L.	Brassicaceae	S	L	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry	Myrtaceae	Fl	I	0	0	0	0	1	0	1	0	0	1	0	1	1	1	0
<i>Taraxacum</i> sect. <i>Taraxacum</i> F.H.Wigg.	Asteraceae	Fl	L	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Teucrium chamaedrys</i> L.	Lamiaceae	H	L	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
<i>Thymus</i> spp.	Lamiaceae	H	L	0	0	0	0	0	0	0	1	1	0	1	1	0	1	0
<i>Trigonella foenum-graecum</i> L.	Fabaceae	S	L	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Tussilago farfara</i> L.	Asteraceae	L	L	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Urtica dioica</i> L.	Urticaceae	L	L	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Vanilla planifolia</i> Andrews	Orchidaceae	Fr (pods)	I	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
<i>Viola tricolor</i> L.	Violaceae	H	L	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Viscum album</i>	Santalaceae	St, L	L	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Vitis vinifera</i> L.	Vitaceae	Fr	L	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0
<i>Zingiber officinale</i> Roscoe	Zingiberaceae	R/Rh	I	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0

Parts used: H – Herba; L – Leaves; Fl – Flowers; Fr – Fruits; B – Bark; R/Rh – Root/Rhizomes; S – Seeds; St – Stems.

Origin: L – Local; I – Imported.

A: Tobyn et al. (2011); BG2: Rakovski (1859); BG3: Hrankov (1925); BG4: Ivanov (1972); BG5: Zaykov et al. (1982); BG6: Yankov (1992); BG7: Dionisiev (1999); BG8: Abrasheva et al. (2008); BG9: Bakalov (2011); BG10: Zaykov (2010); BG11: Boycheva and Marinova (2018; 2020); ITI: Morata et al. (2019); ROI: Colibaba et al. (2016) and Slow Food Ark of Taste (2023); SER1: Gorjanović et al. (2020); SER2: Lakićević et al. (2022)

Coding: 0 = not used; 1 = used

A total of 73 plant species, belonging to 35 families, among which medicinal herbs, spices, and fruits were recorded. Herbal ingredients in Bulgarian *pelin* (total of 25 taxa) were found to be fewer in older sources while in more recent ones they reach 16 species (Bakalov, 2011). In the same time the Italian *vermouth* recipe mentions 36 species and the Serbian *Artemisia*-flavored wines include up to 44 plant ingredients, the latter possibly due to more recent developments (Lakićević et al., 2022). *Vermouth* and aromatized *prokupac* share nine common herbal ingredients that are present also in Bulgarian *pelin* wines. According to the sources assessed by us (Colibaba et al, 2016; Slow Food, 2023) seven species used in the Romanian *vin pelin* are common with the ones used in the Bulgarian *pelin* wines, however variations in the ingredients are allowed under the state regulations in Romania. Traditions to add fresh fruits are common only for Bulgarian and Romanian *pelin* wines, which could be related to the shared heritage, especially in Dobrudzha/Dobrogea region. Wine aromatisation with fruits and fruit juices is common in European countries, however, not so typical for *Artemisia*-flavored varieties (Egea et al., 2015). Examples from other South European countries (Italy and Spain) show preference to the addition of one or two plants (e.g., *Juglans regia* and *Castanea* seeds, *Juniperus communis* or *Vaccinium myrtillus* berries, etc.) in the production of aromatized wines, that are usually used as digestives (Pieroni 2000; Egea et al., 2015; Martínez-Francés et al., 2021).

Bulgarian recipes were based mainly on locally sourced ingredients and only two imported spices are mentioned:

*Syzygium aromaticum* (L.) Merr. & L.M.Perry and *Myristica fragrans* Houtt. Similarly, in the Romanian *vin pelin* only *S. aromaticum* is used. In the Italian *vermouth* a total of 8 imported herbal ingredients are added: *Cinnamomum* spp., *M. fragrans*, *S. aromaticum* (L.), *Vanilla planifolia* Andrews, *Cinchona officinalis* L., *Elettaria cardamomum* (L.) Maton, *Eucalyptus globulus* Labill. and *Zingiber officinale* Roscoe. In the Serbian *bermet* 6 species are imported – *Ceratonia siliqua* L., *Senna alexandrina* Mill., *Cinnamomum* spp., *Hibiscus rosa-sinensis* L., *S. aromaticum* and *V. planifolia*, while in *prokupac* wine, only *Cinnamomum* spp. is not locally sourced.

The high number of representatives of Asteraceae (Figure 3), used in the preparation of *pelin* wine, can be attributed to the array of essential oils, saponins, polyphenolic compounds, phenolic acids, sterols and polysaccharides that they contain (Rolnik and Olas, 2021). Similar is the reason for the high number of species from Lamiaceae that contain a large variety of monoterpenes such as thymol, carvacrol, and p-cymene, eugenol, (E)-cinnamaldehyde, menthol and L-menthol, cuminaldehyde, eucalyptol and eugenol, thymol, carvacrol, and methyl chavicol (Nascimento et al., 2020). The species from the two families are popular also in the Bulgarian ethnomedicine traditions (Georgiev, 2013). As the variety of used herbs is wide (due to personal preferences, local availability or other reasons, e.g. personal health issues), the Bulgarian legislation attributes the organoleptic characteristics of the *layered pelin* exclusively to the *Artemisia* species, especially *A. absinthium*, which is rich in absinthin, a bioactive compound, responsible for its bitterness

<p><b>Romania</b></p> <p><i>Cydonia oblonga</i> Mill. <i>Malus domestica</i> (Suckow) Borkh.</p>	<p><i>Artemisia absinthium</i> L. <i>Matricaria chamomilla</i> L. <i>Achillea millefolium</i> L. <i>Syzygium aromaticum</i> (L.) Merr. &amp; L.M.Perry</p>	
<p><b>Bulgaria</b></p> <p><i>Vitis vinifera</i> L. (whole bunches) <i>Achillea clypeolata</i> Sm. <i>Armoracia rusticana</i> G.Gaertn., B.Mey. &amp; Scherb. <i>Artemisia</i> sp. <i>Blitum bonus-henricus</i> (L.) Rehb. <i>Inula helenium</i> L. <i>Sinapis alba</i> L.</p>	<p><i>Centaurium erythraea</i> Rafn. <i>Coriandrum sativum</i> L.* <i>Melissa officinalis</i> L. <i>Hypericum perforatum</i> L.** <i>Myristica fragrans</i> Houtt.* <i>Ocimum basilicum</i> L. <i>Origanum vulgare</i> L. <i>Salvia</i> spp. <i>Sambucus nigra</i> L. <i>Thymus</i> spp.</p>	<p><b>Serbia*/Italy**</b></p>

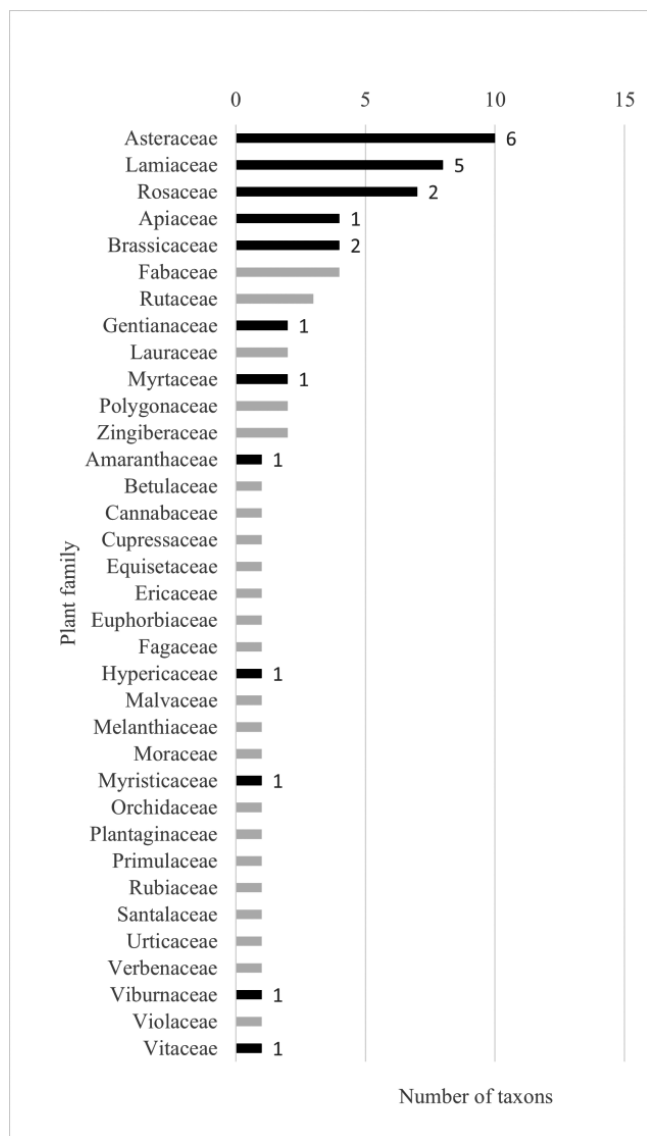
**Fig. 2. Plant ingredients found in two or more Bulgarian *pelin* wine recipes overlapping with Balkan varieties and Italian vermouth**

\*Missing in the Serbian wines;

\*\*Missing in Italian vermouth.



and characteristic odor (Morata et al., 2019). The common wormwood (*A. absinthium*), which is mentioned in 12 out of 14 literature sources, also contains  $\alpha$ - and  $\beta$ -thujone, which are the main components of the oil and range between 40% to 90% (Morata et al., 2019). The maximum permissible concentration for these two forms of thujone in alcoholic beverages produced with *Artemisia* species is 35 mg/kg European Commission (2008), as they are toxic, when consumed at high doses.



**Fig. 3. Number of taxa per plant family in the studied *Artemisia*-flavored beverages. Numbers of taxa next to bars in bold present the species used in Bulgarian *pelin* recipes**

Some plant species in the Bulgarian *layered pelin* have a functional role in the traditional production processes, apart from aromatizing the beverage. To keep the beverage fizzy, seeds from black mustard are added to the wine (Ivanov, 1972). The prolonged secondary fermentation can deteriorate the taste and qualities of the wine. Occasionally fermentation is terminated either by adding conventional chemical preservatives (sulfites) or by using roots from horseradish (*Armoracia rusticana* L.). Roots of *A. rusticana* are used in Bulgaria, Romania and Russia to flavor beverages and dishes, and to regulate the fermentation of pickled vegetables (Agneta et al., 2013). *Blitum bonus-henricus* is considered a medicinal plant and is used to enhance the frothiness of the *layered pelin* (Zaykov et al., 1982; Dionisie, 1999). The aerial parts of *Blitum bonus-henricus* are a rich source of bioactive compounds, among them 22 saponins of eight saponinogens (Kokanova-Nedialkova et al., 2020), which explains the traditional usage.

*Pelin* wine has the potential to be classified as a functional beverage, but further phytochemical research should be involved. The specifics of the preparation of *pelin* suggest its enhancement with biologically active substances which results in increased antioxidant activity. Similar studies have been conducted by Gorjanovic et al. (2020), but there is no information about Bulgarian *pelin*. Herbal maceration in different wines is poorly studied as well. Studies on these topics are important to assess the sustainability of the *layered pelin* production. The concentration of thujone in alcoholic beverages should also be controlled and certain norms have to be included in the Bulgarian legislation for the production of beverages aromatized with *Artemisia* spp. As *layered pelin* wine is predominantly a home-made product the quality of the herbs is not properly assessed, including the pollution of their accessions. Collecting herbs from the wild could cause overexploitation on their populations, thus cultivation of aromatic plants can be promoted among *pelin* makers (Schippmann et al., 2002; Wang et al., 2020).

## Conclusion

*Pelin* wine has an important place in the Bulgarian wine traditions and corresponds to the criteria for a regional or local traditional product (depending on the geographical scope of production) defined in the recently adopted Framework Program for Local Traditional and Regional Traditional Products by the Bulgarian Ministry of Agriculture and Food (2022-2032). Therefore the assessment of the potential of local traditional and regional traditional products and the promotion of their role for the local economy and the wellbeing of local communities are urgent. However, the information

about the various *pelin* wines in Bulgaria is scattered and currently detailed data on the variety of traditional artisanal production is limited. Agricultural products and traditions are closely related to other areas of human life and economy such as culture, health, nutrition, tourism, transport, etc. Wine tourism is one way for sustainable development in rural areas (Zheleva et al. 2020) and might be an appropriate way to promote *layered pelin*, as it is mainly distributed there and provides additional income for the local population. *Layered pelin* wines can be a part of the portfolio of small wineries and hence become a successful tool for their promotion. Therefore research on the business models of such wineries and their attitude towards *layered pelin* is also urgently needed.

In conclusion, the further research of the *layered pelin* will require an interdisciplinary approach to reveal its potential as a functional beverage on the one hand and on the other to ensure its preservation as a part of the cultural heritage sheltered in the Bulgarian rural areas.

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