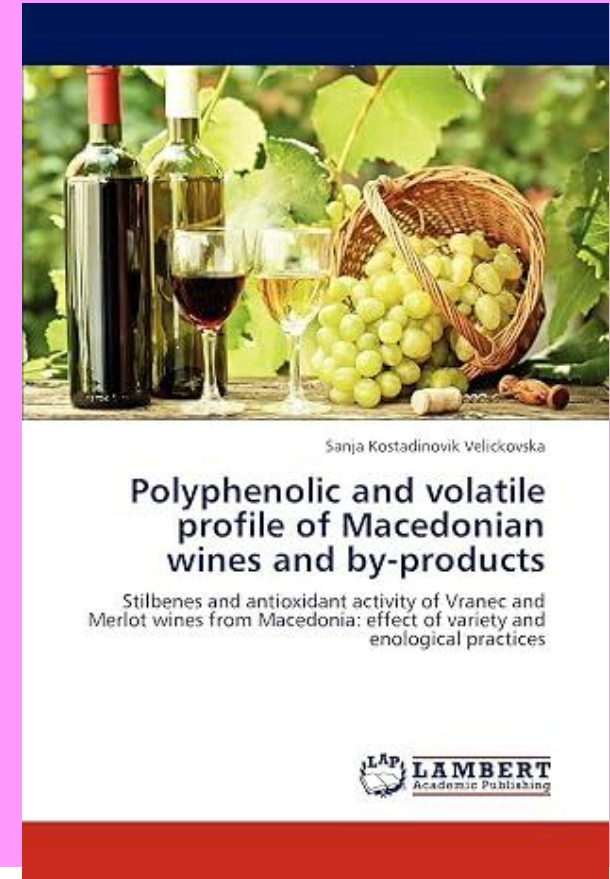


The grapevine is a plant of the sun, but it loves the shadow of its master – Leonardo da Vinci



1. Introduction

Grapes (*Vitis* spp. L.) are among the world's most significant horticultural crops, garnering considerable attention for their polyphenol content [1–3]. Polyphenols represent a major class of phytochemicals in grapes—primarily stilbenes (resveratrol), flavanols, proanthocyanidins, anthocyanins, and phenolic acids—which are distributed in varying concentrations throughout the skin, flesh, and seeds [3]. These compounds exhibit a broad spectrum of health-promoting properties, including antioxidant, anti-inflammatory, anticarcinogenic, and antibacterial activities [1–4].

The *Vitis* genus comprises 80 species divided into two subgenera: *Muscadinia* Planch. and *Euvitis* Planch. Most cultivated grapevines belong to the *Euvitis* subgenus, including two of particular economic importance: *V. vinifera* (the Eurasian group), which accounts for the majority of the world's varieties, and *V. labrusca* (the American group). Conversely, species belonging to the East Asian group remain of limited viticultural importance [5]. *V. labrusca* (including its hybrids) and *V. vinifera* cultivars—such as Isabel, Concord, Bordô, and Niagara—are the primary varieties used in the global grape processing industry for the production of wine, juice, raisins, table grapes, and grappa. These cultivars dominate the industry in the world's ten largest producing countries, accounting for more than 85% of production in the USA and Brazil.

1.1. Anatomy of bunch

The bunchstem (BST)—comprising the peduncle, rachis, and pedicels—is the primary structure determining bunch compactness in grapevine cultivars. The BST serves as the vascular connection between the shoot and the berries, making it critical for supplying water and metabolites to the developing fruit [5]. However, extreme temperatures can cause BST dysfunction, leading to berry shrivel and subsequent losses in yield and quality.

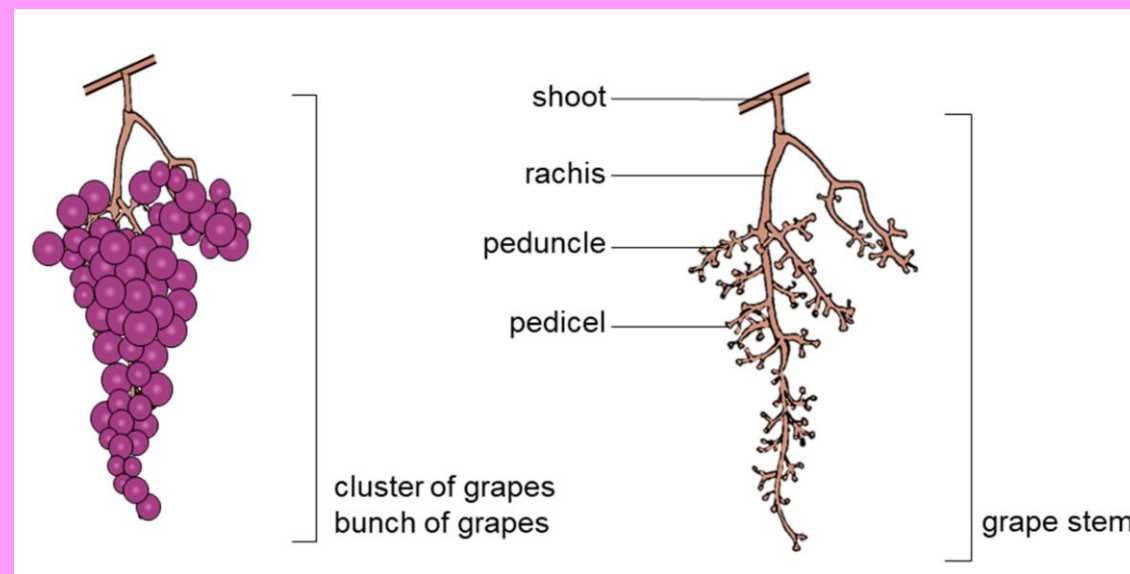


Fig.1. The bunchstem (BST)—comprising the peduncle, rachis, and pedicels (Blackford et al., 2021)

1.1. Anatomy of bunch

- **Peduncle:** The main stalk that attaches the entire grape cluster to the grapevine shoot. It delivers water and nutrients.
- **Rachis:** The central axis or backbone of the cluster where the side branches come off.
- **Pedicel:** The tiny individual stems that connect each single grape berry to the branches of the rachis [7]



<http://www.youcellar.com/en/bunch-grape-vine.php>

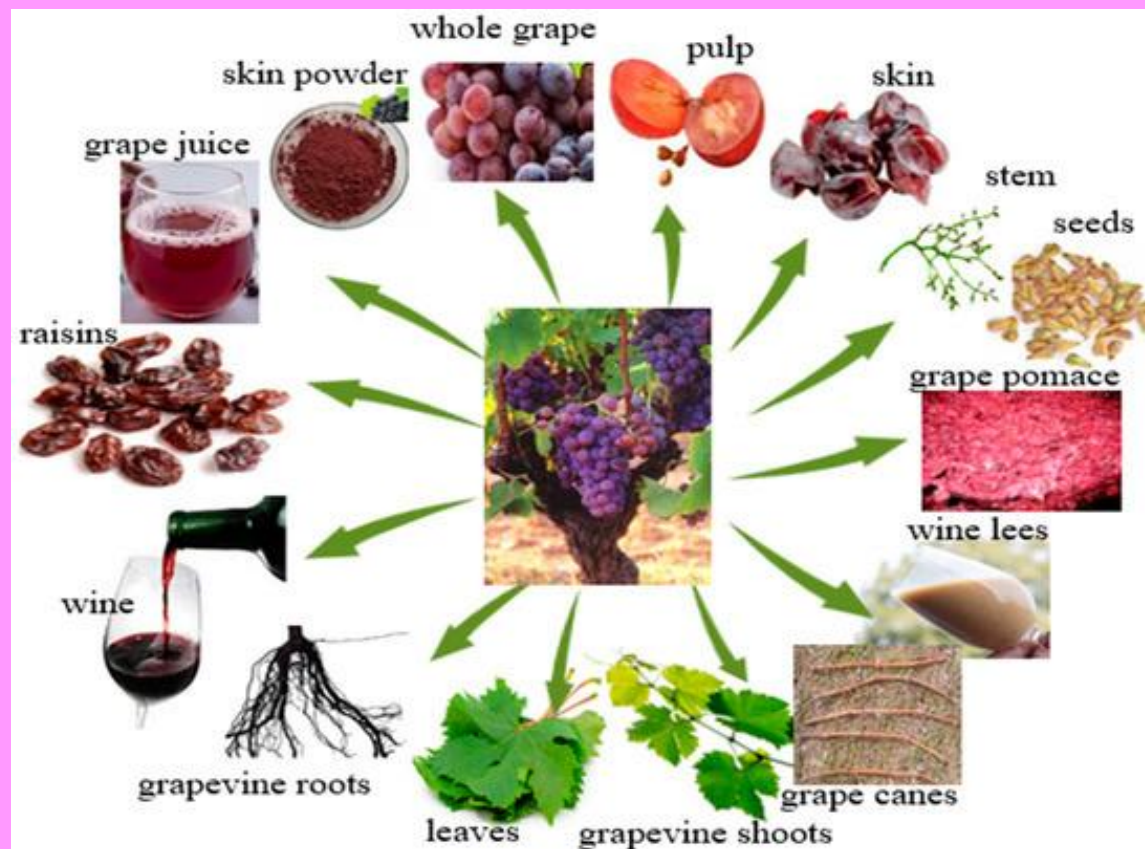
Grapes and Health — Online Module (Week 1): Session Distribution

The grape and its derivatives: anatomy of the bunch, must, skin, seed and pomace. Overview of the wine sector

1.2. Grape must

Grape must is freshly crushed grape juice (usually by hands) that includes the skins, seeds, and stems of the grapes, serving as the first step in winemaking [8].

What we can obtained from gapes?!



Grapes and Health — Online Module (Week 1): Session Distribution

The grape and its derivatives: anatomy of the bunch, must, skin, seed and pomace. Overview of the wine sector

Grapes during the maturation process rich deep red color, full body, soft tannins, and fruity aromas, these characteristics can only be achieved with grapes that have reached high phenolic maturity. Well-ripened grapes contain a high concentration of anthocyanins, which provide the wine with a deep red color. Additionally, fully ripe grapes exhibit low astringency and bitterness, likely due to a reduction in the proportion of seed proanthocyanidins [9,10].



Ayaz et al., 2020

1.2.1. Chemical composition of grape must

According to the Waterhouse et al., 2024 grape must is typically obtained from the gentle pressing of the grapes, containing:

- *Water* is the most abundant component (70%-80%) resulting grape must in liquid state;
- *Sugars* (150–250 g/L) which depends of the maturity of grape. The main sugars are glucose and fructose, which act as the main carbon and energy source for yeast during alcoholic fermentation;
- *Organic Acids* (5–20 g/L): The main organic acids are tartaric acid and malic acid, with lower amounts of citric acid, which dictate the pH and acidity of the juice and future wine;
- *Nitrogenous Compounds* (0.1–1.0 g/L) usually includes free amino acids, ammonia, and small peptides/proteins that serve as essential nutrients for yeast metabolism during the process of fermentation;
- *Phenolic Compounds* includes flavonoids, anthocyanins (in red grapes), and tannins extracted from skins and seeds, contributing to color, texture, astringency, and flavor;
- *Minerals and Salts* contains potassium, calcium, magnesium, and phosphates acting as counter-ions to organic acids and supporting yeast health and
- *Vitamins and Aroma Compounds* in very small amounts such B-complex vitamins, vitamin C, and volatile terpenes or varietal aroma precursors [11].

1.2.1. The main differences in production composition of red and white grape must

The main differences during the production of grape must is its contact with skin and seeds or more precisely *the maceration*.

While red grape must is usually macerated to enable efficient extraction of phenolic components which are responsible for color, astringency and taste of the red wines, the white grape must consists of the pulp and skin and seeds are completely removed without process of maceration.

The white must is usually pale, clear, or golden color. Most grape juice from both green and dark grapes is naturally colorless inside while red must usually has deep red or purple color because alcohol and heat during fermentation pull the pigments out of dark grape skins [12].



1.2.1. The main differences in chemical composition of red and white grape must.

- White Grape Pomace (WGP): Retains higher initial concentrations of certain unfermented extractives, featuring rich amounts of (+)-catechin, (-)-epicatechin, and condensed tannins. Total phenolic content generally spans 11.8–32.1 g GAE/kg.
- Red Grape Pomace (RGP): Often features a higher total phenolic ceiling (10.4–64.8 g GAE/kg) because red skins macerate during fermentation, yet it is exceptionally rich in anthocyanins (pigments) and quercetin, though some soluble phenolics are partially lost to the red wine [13]



1.3. Red grape skin composition

Anthocyanins: Natural pigments responsible for the red, purple, and blue colors of the grape; major types include malvidin, cyanidin, and delphinidin glucosides.

Resveratrol: A well-known stilbene phytoalexin concentrated in the outer layer, recognized for its antioxidant properties.

Flavonols: Includes quercetin and kaempferol glycosides, which contribute to UV protection and color stability.

Hydroxycinnamic Acids: Comprises tartaric esters such as caftaric and coutaric acids.

Dietary Fiber & Tannins: Insoluble fibers and condensed tannins make up the structural dry matter of the skin [12].



1.3. White grape skin

- *Flavonols*: The most abundant phenolic group in white skins (such as quercetin glycosides and rutin), responsible for UV protection and contributing to wine structure and color
- *Hydroxycinnamic Acids*: Tartaric esters such as caftaric, coutaric, and fertaric acids, which are primary antioxidant constituents.
- *Flavan-3-ols*: Includes monomeric units like (+)catechin and (-)epicatechin, alongside small dimeric procyanidins
- Dietary Fibers & Oligosaccharides: Insoluble cell wall polysaccharides and functional oligosaccharides [14].



1.3. Red grape seeds composition

- *Proanthocyanidins* belongs to oligomeric proanthocyanidins (well-known as grape seed proanthocyanidins or condensed tannins) representing the majority of the seed's phenolic pool.
- *Flavan-3-ols*: belongs to high levels of monomeric catechins and epicatechins, alongside epicatechin gallate.
- *Phenolic Acids*: the minor constituent is usually gallic acid [12]



Grapes and Health — Online Module (Week 1): Session Distribution

The grape and its derivatives: anatomy of the bunch, must, skin, seed and pomace. Overview of the wine sector

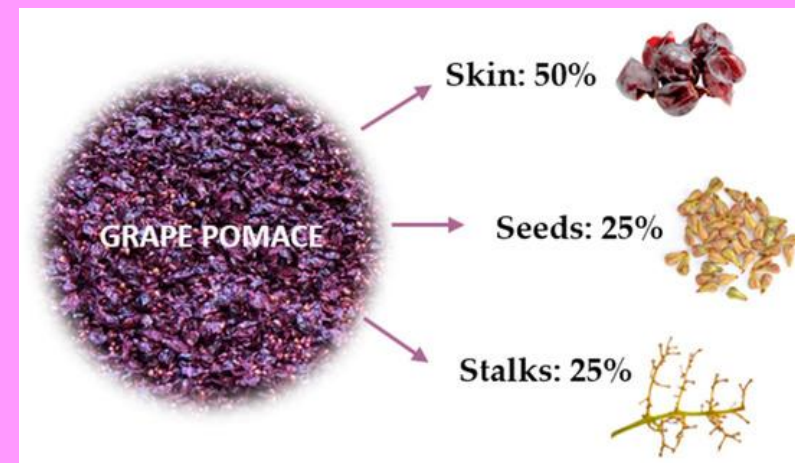
1.3. White grape seed composition

- *Flavan-3-ols* and *Proanthocyanidins*: Comprise up to 60–70% of the grape's total polyphenol content, dominated by monomeric catechins, epicatechins, and complex procyanidin polymers (condensed tannins) like procyanidin B1 and B2.
- *Lipids* (Grape Seed Oil): High concentration of fatty acids (primarily linoleic acid, oleic acid, and palmitic acid) within the seed matrix
- *Phenolic Acids*: Minor amounts of gallic acid and other bound phenolic derivatives [14].



Chemical composition of red grape pomace

According to the Lopes et al., 2025, phenolic compounds are the most abundant and widely distributed group of natural products found in plants, with grape pomace serving as a particularly rich source [56]. These secondary plant metabolites are chemically characterized by an aromatic ring bearing one or more hydroxyl substituents. In grapes, these compounds are found throughout the seeds, skins, and stems [58]. Phenolic compounds are categorized into various classes based on similarities in their chemical structures and precursors. Ranging from simple to complex, they are primarily divided into two main categories: flavonoids and non-flavonoids. The predominant compounds include anthocyanins, hydroxybenzoic and hydroxycinnamic acids, flavan-3-ols (catechins and proanthocyanidins), flavonols, and stilbenes [15].



Lopes, J.d.C. et al., 2025

Chemical composition of white grape pomace

According to Bocsan et al., 2022 white grape pomace is rich source of high content of phenolic acids (p-hydroxyphenylacetic acid, vanillic acid, homovanillic acid, homoprotocatechuic acid, gentisic acid, syringic acid, 4-O-methylgallic acid, 3-O-methylgallic acid, dihydro-3-coumaric acid, hydroferulic acid, hydrocaffeic acid, isoferulic acid) and flavanols (catechin, epicatechin, procyanidin B1), flavonoid glyco side (hyperoside, isoquercitrin, rutin, quercitrine), flavonoid aglycons (quercetin, luteolin), and protocatechuic acid. It was also reported that white grape pomace has a high quantity of gallic acid, procyanidin B3-4, epicatechin, and procyanidin gallates [16].



<https://nmc-magazine.com/uc-davis-study-challenges-decades-of-assumptions-about-grape-pomace/>

Chemical composition of red grape pomace

Anthocyanins are natural pigments responsible for orange, pink, red, violet and blue colours in the flowers and fruits of many plants which are using as colorants in food and beverages industry.

Anthocyanins (of the Greek *anthos*=flower and *kianos*=blue) are under huge investigation due to the growing interest of substitution the potential cancerogenic synthetic colors which are still using in food industry. Grape skin contains a great number of anthocyanins, the concentration varies greatly according to the variety and is influenced by cultivar, season and environmental factors. The most abundant anthocyanins in red grapes are 3-glycosides, 3-acetylglycosides and 3-p-coumaroyl-glycosides of malvidin (Mv), peonidin (Pn), delphinidin (Dp), petunidin (Pt) and cyanidin (Cy) [17].

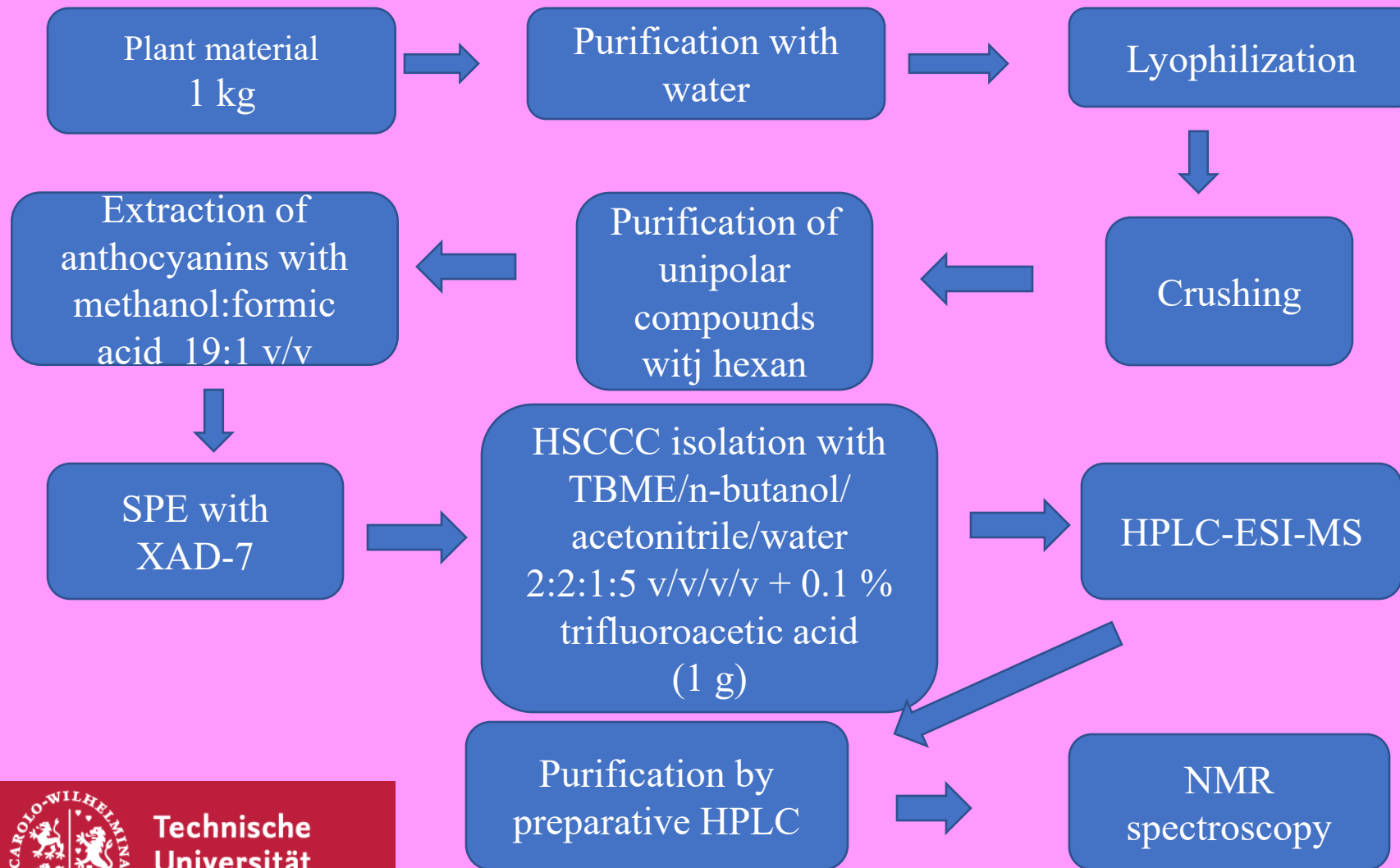
IDEA! ISOLATION OF VALUABLE ANTHOCYANINS FROM RED GRAPE POMACE – IT WAS MY PHD WORK!

Grapes and Health — Online Module (Week 1): Session Distribution

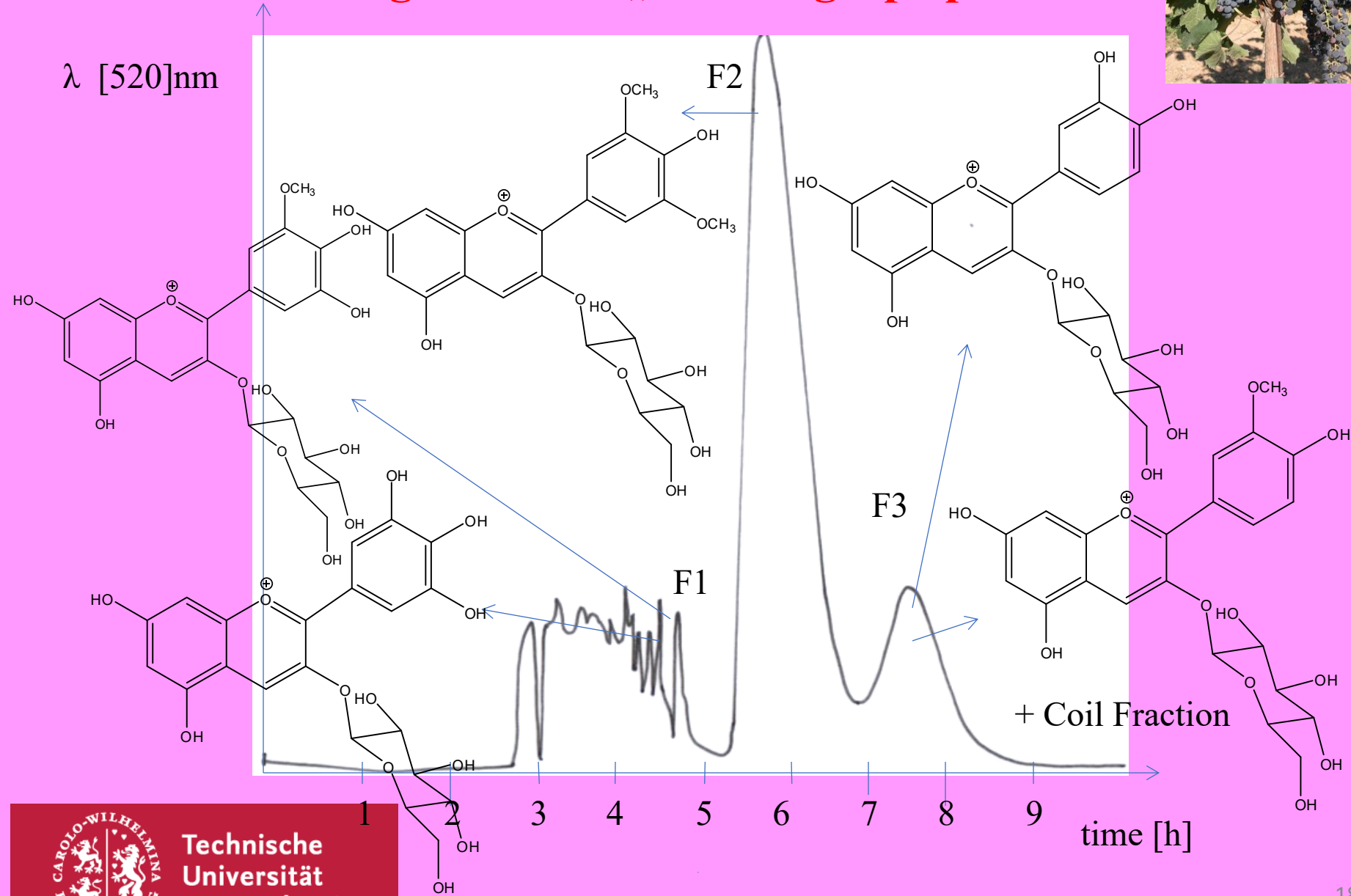
Overview of the wine sector



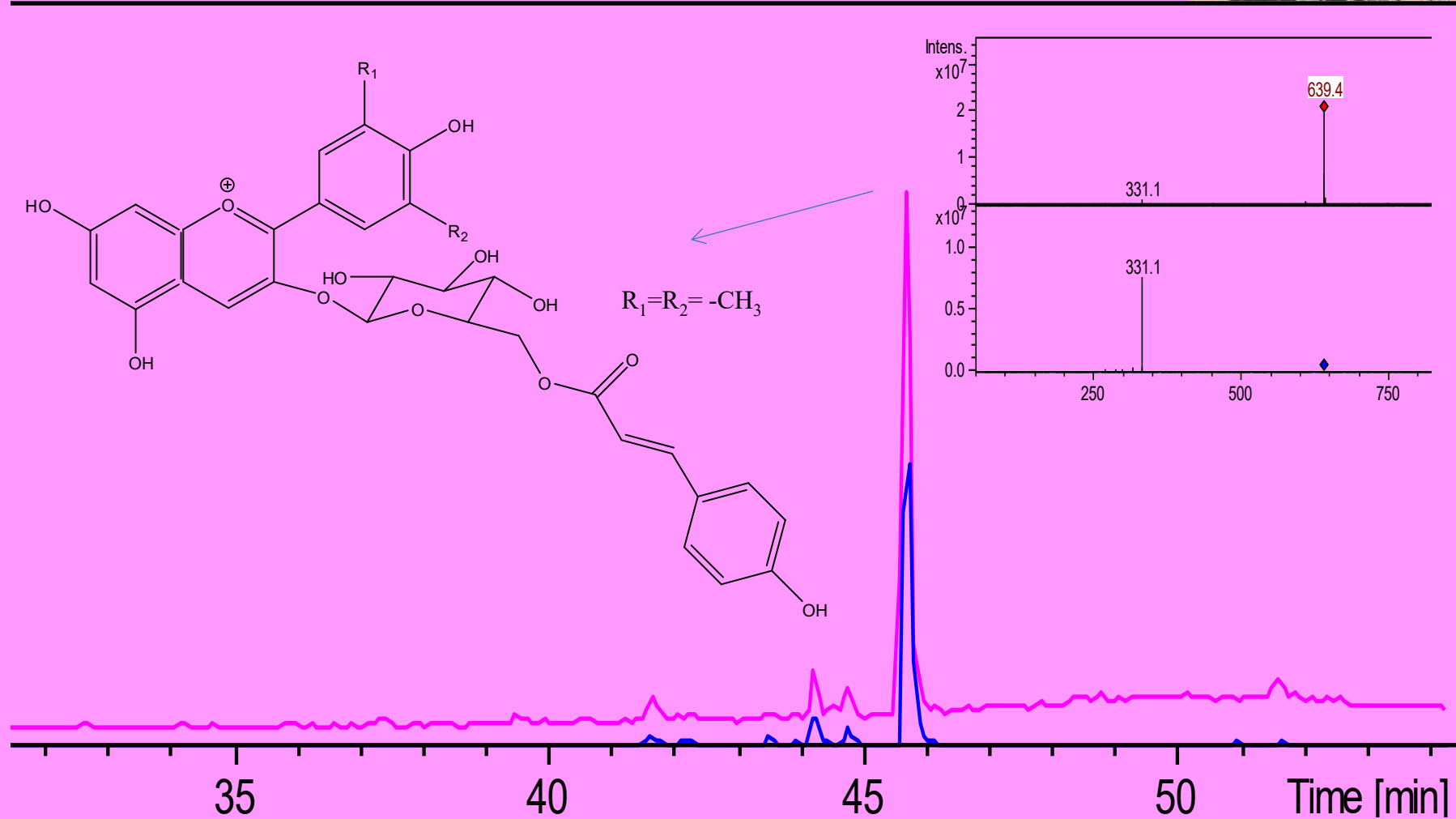
Isolation of anthocyanins from red grape pomace HSCCC



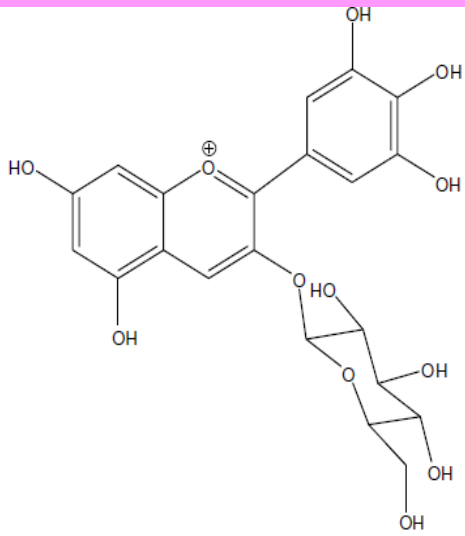
CCC chromatogram from „Vranec grape pomace“



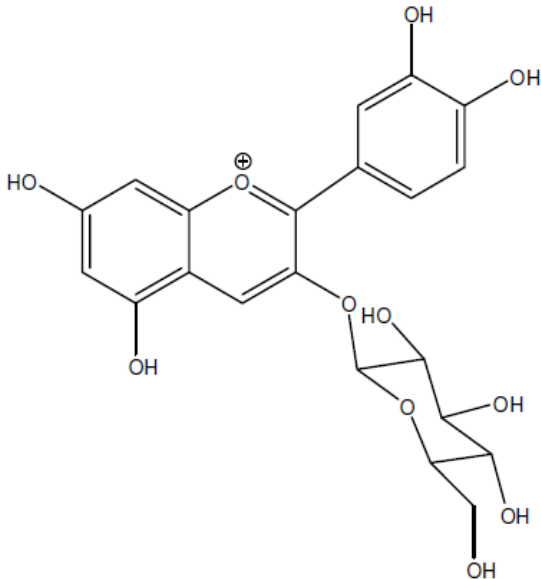
HPLC-ESI-MS chromatogram of malvidin-3-*p*-cumaroyl-glucoside



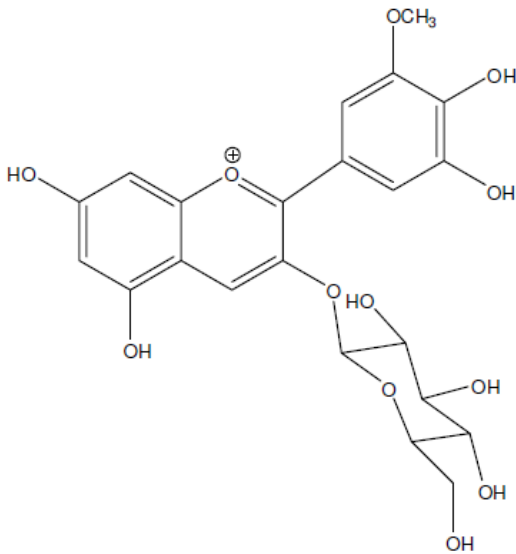
The colour of isolated pigemnts depends of pH value where pigemnts can be added. The value of pH 3-3,5 enables good color and hue of the natural pigments.



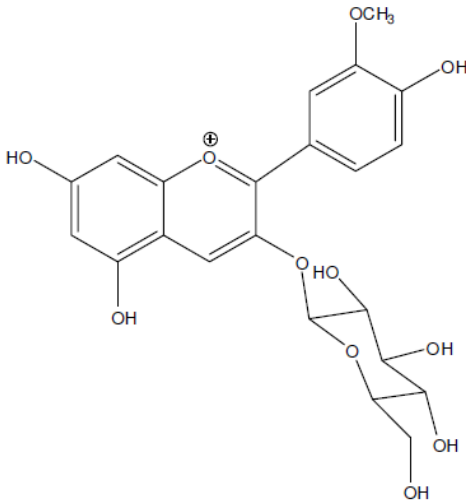
Delphinidin-3-O-glucoside



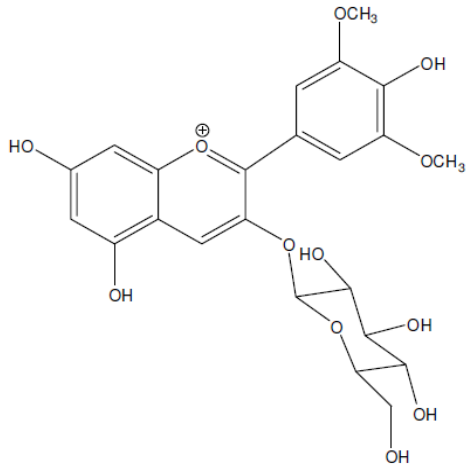
Cyandin-3-O-glucoside



Petunidin-3-O-glucoside

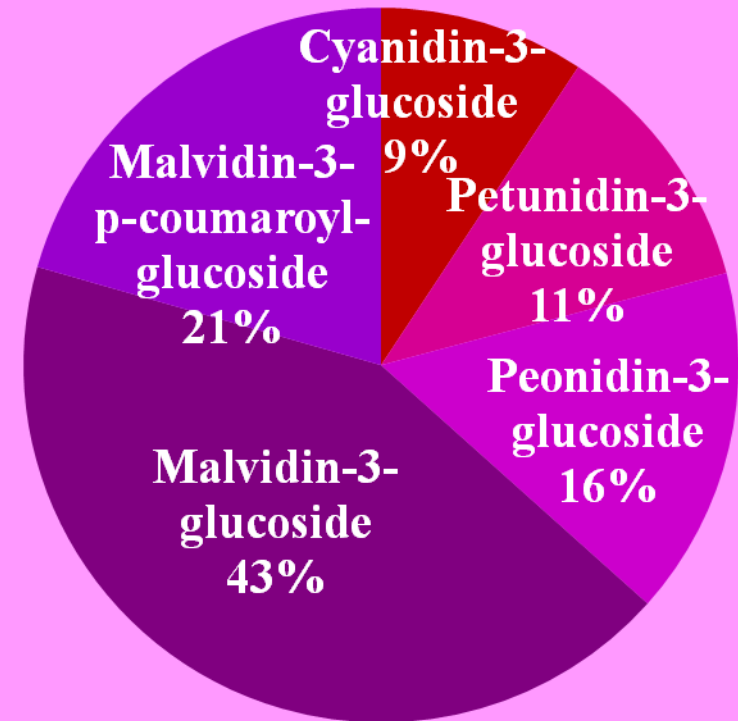


Peonidin-3-O-glucoside



Malvidin-3-O-glucoside

Color of the all 5 pigments isolated from „Vranec“ grape variety



The grape and its derivatives: anatomy of the bunch, must, skin, seed and pomace. Overview of the wine sector

Vranec“

“Vranec” is the most widely cultivated and the most important variety in the Republic of Macedonia being used for production of high-quality red wines. Outside the Republic of Macedonia, it is primarily planted in Montenegro (autochthonous variety), Serbia and Croatia (Dalmatia). Within Macedonia, it is planted in the wine region of Povardarie, the most famous region for wine growing and winemaking, where more than 80 % of the Macedonian vineyards are located. The berry is medium sized with elongated shape. The skin is dark-blue colored, covered with bloom. With regard to susceptibility to diseases, “Vranec” is sensitive to downy mildew (*Plasmopara viticola*) and more resistant to powdery mildew (*Uncinula necator*) and grey mold (*Botrytis cinerea*). In addition, this grape variety is sensitive to low winter temperatures. It is high yielding, producing fruit that is deeply colored. The wines produced from this variety have intense dark red, ruby color and strong aroma of mixed dried plums, blackberries and currants (Kostadinović Veličkovska et al, PhD thesis, 2012).



The grape and its derivatives: anatomy of the bunch, must, skin, seed and pomace. Overview of the wine sector

„Merlot“

“Merlot” is widely cultivated throughout the world, and it is one of the primary grapes in the Bordeaux wine region. It is also cultivated in the Republic of Macedonia, especially in Tikveš, Skopje, Ovče Pole, Ohrid and Kumanovo vineyard areas. The cluster of “Merlot” is medium sized, with pyramidal and pyramidal-round shape (Fig. 7). The berry is small and round, with thick and firm skin, covered with bloom. This variety gives the highest yields at fertile and temperate moist soils and it is middle resistant to drought. With regard to disease susceptibility, “Merlot” is high resistant to powdery mildew and grey mold, and sensitive to downy mildew. This grape variety shows middle resistance to low winter temperatures. Merlot wines have ruby-red color and aroma of ripe grapes, honey and mixed caramelized forest fruits (Kostadinović Veličkovska et al, PhD thesis, 2012).



The grape and its derivatives: anatomy of the bunch, must, skin, seed and pomace. Overview of the wine sector

„Pinot Noir“

The name “Pinot Noir” is derived from the French words for "pine" and "black" alluding to the grape variety's tightly clustered dark purple pine cone-shaped bunches of fruit. Some viticultural historians believe this shape may have given rise to the name. Pinot noir tends to produce narrow trunks and branches. In the vineyard it is sensitive to light exposure, cropping levels, soil types and pruning techniques. In the winery it is sensitive to fermentation methods, yeast strains and is highly reflective of its *terroir* with different regions producing very different wines. Its thin skin makes it highly susceptible to bunch rot and other fungal diseases. The vines themselves are prone to downy mildew, leaf roll, and fanleaf. These complications have given the grape the reputation of being difficult to grow. Ancient Romans knew this grape as Helvenacia Minor and vinified it as early as the first century (Kostadinović Veličkovska et al, PhD thesis, 2012).



“Muscat de Frontignan”

“Muscat de Frontignan” is perhaps the oldest known and the most abundant white grape variety in Macedonia known as “Temjanika”. It is one of several related varieties of Muscat. It most likely originated in Ancient Greece and expanded into Italy and France in Roman times. There is a record of its export from the French port of Frontignan during the region of Charlemagne, well over 1100 years ago. Muscat de Frontignan has a wide geographical distribution but is often grown in small quantities. It grows in Mediterranean France, Greece, Hungary, Italy, Spain, Argentina, South Africa, Australia, and the United States, especially California. It is also grown in the Republic of Macedonia (Tikveš, and Skopje wine-growing region). The cluster of “Muscat de Frontignan” is small or middle large, with cylindric or cylindric-conical shape, medium filled or compact, and berries are small with round shape. The skin is thin, transparent, with green-yellow color. The wines have an intense, transparent, golden yellow color and aroma of grapefruits, pineapple, banana and melon (Kostadinović Veličkovska et al, PhD thesis, 2012).



Grapes and Health — Online Module (Week 1): Session Distribution

The grape and its derivatives: anatomy of the bunch, must, skin, seed and pomace. Overview of the wine sector

“Muscat Ottonel”

Muscat Ottonel was cultivated for the first time in Angers in 1852. Bunches are small to medium, cylindrical with medium-sized, spherical berries, clear yellow with a delicately musky flavour.

Alexandria Riesling wine was a mixture of different Muscat varieties and its wine-making procedure is unknown but, any enzymatic treatment is not applied during vinification.

Furthermore, Bistro Bianco wine was produced from “Chardonnay” grape variety without addition of any enzyme for glucosidically breakage of bond volatile compounds (Kostadinović Veličkovska et al, PhD thesis, 2012).



Grapes and Health — Online Module (Week 1): Session Distribution

The grape and its derivatives: anatomy of the bunch, must, skin, seed and pomace. Overview of the wine sector

“Chardonnay”

Chardonnay is a widely cultivated variety in the world, originating from France, from the Champagne and Burgundy regions. The cluster of “Chardonnay” is small or middle large, with cylindric or cylindric-conical shape, medium filled or compact, and berries are small with round shape. The skin is thin, transparent, with green-yellow color. For cultivation, this variety needs middle fertile, deep and temperate moist soils. It is particularly sensitive to drought and highly resistant to low winter temperature. Chardonnay wines have intense, transparent, golden yellow color and fruity aroma (Kostadinović Veličkovska et al, PhD thesis, 2012).



Overview of the wine sector

The European Union is the world's leading wine producer. Between 2020 and 2025, average annual production reached 157 million hectolitres. In 2023, the EU accounted for 44% of global wine-growing areas, over 60% of total production, and 48% of consumption. Wine currently ranks as the EU's third-largest agri-food export sector, representing 7.3% of the total agri-food export value in 2024 ([Monitoring EU agri-food trade, February 2025](#))

The wine sector is a cornerstone of the EU's agri-food industry, providing essential social and economic support to rural areas. By creating stable jobs and bolstering local economies, it plays a key role in curbing rural depopulation while helping to preserve Europe's unique cultural heritage and landscapes.



[New requirements in E.U. wine labelling regulations: May 30, 2023](#)

Overview of the wine sector

Many winemakers who sell wine in Europe have been busy preparing their compliance with Regulation (EU) 2021/2117 and several other regulations related to wine labelling. The most obvious change with the current Regulation E.U. 2021/2117 is the requirement to provide ingredient, nutrition, energy, and allergen information along with wines sold in the E.U. starting December 8, 2023.

- Clarification on where allergens and intolerances can be displayed
- Clarifications related to additives that vary from bottle to bottle including packaging gases
- There are new rules for wines less than 10% ABV and less than 0.5% ABV

NUTRITION DECLARATION		
Type	Per 100ML	Per 50ML
Energy	275kJ	138kJ
	66kcal	33kcal
Fat	1g	0.5g
of which		
Saturates	0g	0.0g
Carbohydrate	1g	0.5g
of which		
Sugars	1g	0.5g
Protein	0g	0.0g
Salt	0g	0.0g

ABV – (Alcohol by Volume)

[New requirements in E.U. wine labelling regulations: May 30, 2023](#)

Grapes and Health — Online Module (Week 1): Session Distribution

The grape and its derivatives: anatomy of the bunch, must, skin, seed and pomace.

Overview of the wine sector

Overview of the wine sector in North Macedonia

A landlocked country on the Balkan Peninsula, North Macedonia is defined by its lakes, rivers, and a unique climate—a blend of Mediterranean and continental influences—that makes it an ideal region for viticulture.

In the heart of the country, throughout the Vardar River Valley, the roadsides are lined with dense vineyards and numerous wineries. These sites tell a centuries-old story of winemaking, a craft inextricably linked to the land. Wine is deeply embedded in the nation's culture and folklore, woven into countless songs, stories, legends, and traditions. Chroniclers of Macedonian folk tales from the 19th and early 20th centuries consistently noted that wine was an indispensable part of local customs and rituals. Today, there are 99 registered wineries in the country, collectively producing just over 100 million liters of wine annually.

The nation boasts 28,213 hectares of vineyards, managed by roughly 20,000 individual growers alongside several

<https://investnorthmacedonia.gov.mk/invest-wine-industry/>



Grapes and Health — Online Module (Week 1): Session Distribution

The grape and its derivatives: anatomy of the bunch, must, skin, seed and pomace.

Overview of the wine sector

Overview of the wine sector in North Macedonia

Wine production is mainly spread over three macro-areas: the western region (Pelagonia-Polog) with 1,817 hectares, the central region (Vardar River Valley or Povardarie) with 24,644 hectares and the eastern region (Pchinja-Osogovo) with 1,733 hectares. Each of these regions is divided into **16 wine districts**. Most of the production is concentrated in Povardarie, where the famous Tikvesh wine district hosts some of the oldest wineries in the country.

Among the indigenous varieties, Stanušina, a Macedonian red grape, is gaining attention for its unique flavor profile, reminiscent of red currant, pomegranate, cherry and raspberry, with good acidity and body.



REFERENCES:

1. Nile SH, Kim SH, Ko EY, Park SW. Polyphenolic contents and antioxidant properties of different grape (*V. vinifera*, *V. labrusca*, and *V. hybrid*) cultivars. Biomed Res Int. 2013;2013:718065. doi: 10.1155/2013/718065.
2. de Almeida Sousa Cruz, M.A., de Barros Elias, M., Calina, D. et al. Insights into grape-derived health benefits: a comprehensive overview. Food Prod Process and Nutr 6, 91 (2024). <https://doi.org/10.1186/s43014-024-00267-z>
3. Das R, Bhattacharjee C, Chapter 43 - Grapes, Nutritional Composition and Antioxidant Properties of Fruits and Vegetables, Academic Press, 2020, 695-708, <https://doi.org/10.1016/B978-0-12-812780-3.00043-X>.
4. Zoffoli J.P., B.A. Latorre B.A., 9 - Table grape (*Vitis vinifera* L.), In Woodhead Publishing Series in Food Science, Technology and Nutrition, Postharvest Biology and Technology of Tropical and Subtropical Fruits, Woodhead Publishing, 2011, 179-214e, <https://doi.org/10.1533/9780857092885.179>.
5. Blackford M, Comby M, Zeng L, Dienes-Nagy Á, Bourdin G, Lorenzini F, Bach B. A. Review on Stems Composition and Their Impact on Wine Quality. Molecules 2021, 26, 1240. <https://doi.org/10.3390/molecules26051240>
6. Benlloch-Tinoco M, Carranza-Concha J, Camacho MM, Martínez-Navarrete N, Chapter 22 - Production of Raisins and its Impact on Active Compounds, Processing and Impact on Active Components in Food, Academic Press, 2015, 181-187, <https://doi.org/10.1016/B978-0-12-404699-3.00022-6>.
7. Holzapfel B, Rossouw G, Bittau B, Meunier A, Dry I. Bunchstem and bunch structure of grape cultivars and its implication for abiotic and biotic stress. ISHS Acta Horticulturae 1362: XXXI International Horticultural Congress (IHC2022): International Symposium on Breeding and Effective Use of Biotechnology and Molecular Tools in Horticultural Crops. 10.17660/ActaHortic.2023.1362.29
8. Căpruciu R. Resveratrol in Grapevine Components, Products and By-Products—A Review. Horticulturae 2025, 11, 111. <https://doi.org/10.3390/horticulturae11020111>

REFERENCES:

9. Kurt-Celebi A, Colak N, Hayirlioglu-Ayaz S, Kostadinović Veličkovska S, Ilieva F, Esatbeyoglu T, Ayaz FA. Accumulation of Phenolic Compounds and Antioxidant Capacity during Berry Development in Black ‘Isabel’ Grape (*Vitis vinifera* L. x *Vitis labrusca* L.). *Molecules* 2020, 25, 3845. <https://doi.org/10.3390/molecules25173845>.
10. Meléndez E, Ortiz MC, Sarabia LA, Íñiguez M, Puras P. Modelling phenolic and technological maturities of grapes by means of the multivariate relation between organoleptic and physicochemical properties, *Analytica Chimica Acta*, 761, 2013, 53-61, <https://doi.org/10.1016/j.aca.2012.11.021>.
11. Waterhouse, A.L., Sacks, G.L. and Jeffery, D.W. (2024). Grape Must Composition Overview. In *Understanding Wine Chemistry* (eds A.L. Waterhouse, G.L. Sacks and D.W. Jeffery). <https://doi.org/10.1002/9781394258406.ch20>.
12. Kostadinović S, Wilkens A, Stefova M, Ivanova V, Vojnoski B, Mirhosseini H, Winterhalter P. Stilbene levels and antioxidant activity of Vranec and Merlot wines from Macedonia: Effect of variety and enological practices, *Food Chemistry*, 135(4), 2012, 3003-3009, <https://doi.org/10.1016/j.foodchem.2012.06.118>.
13. Ciani M, Comitini F, Chapter 4 - Use of Non-Saccharomyces Yeasts in Red Winemaking, *Red Wine Technology*, Academic Press, 2019, 51-68, <https://doi.org/10.1016/B978-0-12-814399-5.00004-9>.
14. El Rayess Y, Nehme N, Azzi-Achkouty S, Julien SG. Wine Phenolic Compounds: Chemistry, Functionality and Health Benefits. *Antioxidants* (Basel). 2024 Oct 28;13(11):1312. doi: 10.3390/antiox13111312.
15. Lopes, J.d.C.; Madureira, J.; Margaça, F.M.A.; Cabo Verde, S. Grape Pomace: A Review of Its Bioactive Phenolic Compounds, Health Benefits, and Applications. *Molecules* 2025, 30, 362. <https://doi.org/10.3390/molecules30020362>.
16. Bocsan IC, Măgureanu DC, Pop RM, Levai AM, Macovei ȘO, Pătrașca IM, Chedea VS, Buzoianu AD. Antioxidant and Anti-Inflammatory Actions of Polyphenols from Red and White Grape Pomace in Ischemic Heart Diseases. *Biomedicines*. 2022; 10(10):2337. <https://doi.org/10.3390/biomedicines10102337>.
17. Kostadinovic Velickovska S, Mirhosseini H, Borgeva E. Isolation of Anthocyanins by high-speed countercurrent chromatography and application of the color activity concept to different varieties of red grape pomace from Macedonia. *Journal of Nutrition and Food Science*, 3 (6), 2013

Grapes and Health — Online Module (Week 1): Session Distribution

The grape and its derivatives: anatomy of the bunch, must, skin, seed and pomace. Overview of the wine sector

Questions and discussion please

QUESTIONS
and
DISCUSSIONS

