

Functional food (functional fermented beverages and edible oils): when science meets bioeconomy and creates health lifestyle — Online Module

Functional fermented beverages – functional wines

Wines – link between pleasure and health

Definition of wine

The primary meaning of the word “**wine**” is the product of the fermentation by yeasts of the sugars in the juice of grapes resulting in an alcohol content of 9-15 % v/v (per cent by volume) (Clarke & Bakker, 2004).

There is much historical information on wine dating since Stone Age, some 6000 years ago from Mesopotamia and Egypt, as a symbol of Jesus blood in Christianity and as one of the most popular alcoholic drinks today over the world.

In terms of chemistry, wine is the *complex mixture* of a large number of compounds including *polyphenolic compounds* such as **anthocyanins** and **stilbenes** responsible for likely health effects and esters, alcohols, aldehydes, acids responsible for the smell and the taste of the wine.



<https://chich.com.au/macedonian-wines>

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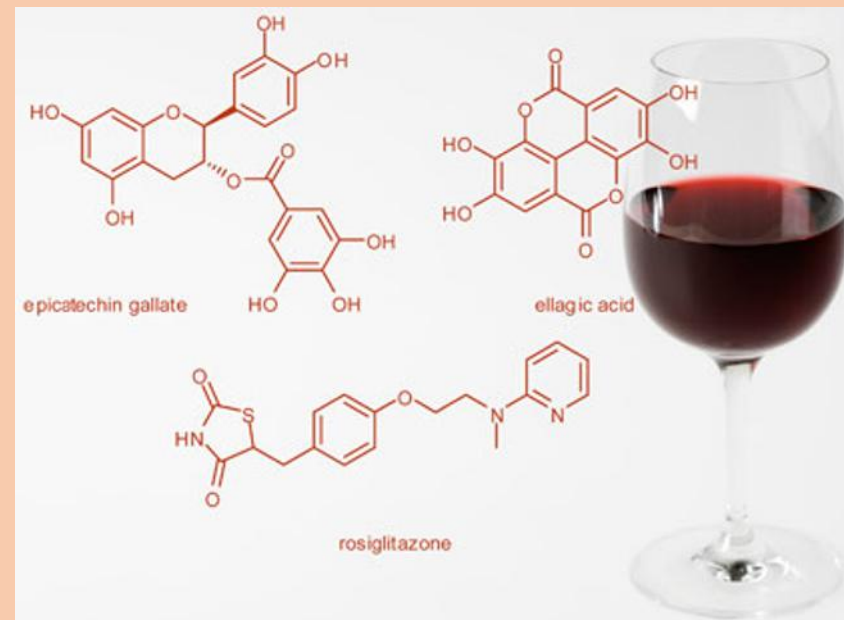
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Natural antioxidants in wines

Polyphenols

Polyphenols are the key compounds linked to the advantages of wine intake because of their antioxidant and free radical neutralizing qualities. The **anthocyanins** and **proanthocyanidins** are among the most significant compounds responsible for the quality of red wine, owing to their major antioxidant potential.

During ageing, the wine also changes its phenolic profile, since these molecules can be subjected to *oxidation processes*, *condensation*, and *polymerization* reactions and extraction from wood, usually associated to the changes in color and colloidal stability, flavor, bitterness, and astringency. They determine the overall quality (color and taste) of red wines and also exhibit *bactericide*, and *antioxidant properties* that apparently protect consumers from cardiovascular disease (Ribéreau-Gayon & Glories, 2006).



The medicine's in the (wine) bottle –
Food & Function Blog

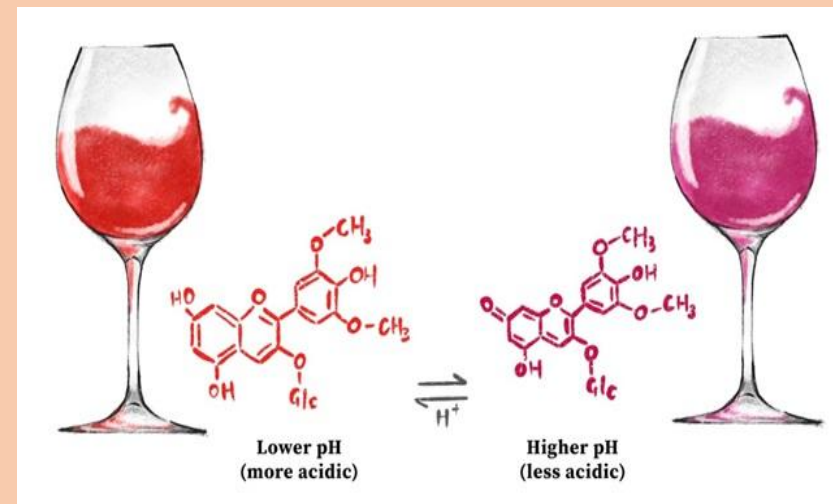
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Anthocyanins in red wines

Anthocyanins are the most abundant polyphenols responsible for the color of red grapes. The study of anthocyanins as natural colorants is an extensive area of investigation due to the growing interest of substituting synthetic colorants by natural ones. Anthocyanins (of the Greek *anthos* = flower and *kianos* = blue) are the most important water-soluble pigments of the plants. These pigments are responsible of the shiny orange, pink, red, violet and blue colors in the flowers and fruits of many plants. Anthocyanins exhibit a range of biological activities. The contribution of these substances to health-promoting effects is under current investigation. The most important property of anthocyanins is their antioxidant activity, which plays a main role in the prevention of neuronal and cardiovascular illnesses, cancer and diabetes (Castañeda-Ovando et al., 2009)



https://www.guildsomm.com/public_content/features/articles/b/gus-zhu/posts/behind-the-glass-the-chemical-and-sensorial-terroir-of-wine-tasting

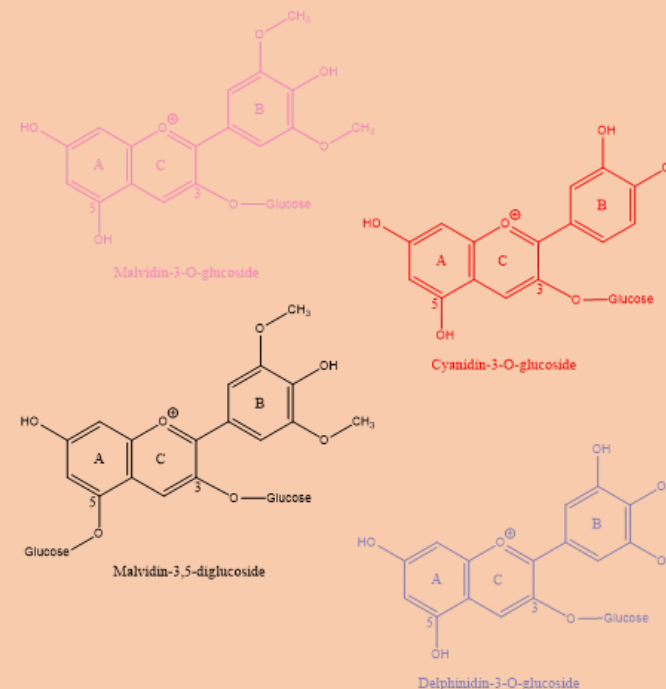
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Anthocyanins in red wines

Anthocyanin compounds are mainly located in the *grape skins*, with the exception of the Teinturier varieties that also contain *anthocyanins in the pulp*. The anthocyanins identified in grape skins and wines from *Vitis vinifera* are the 3-O-monoglucosides and the 3-O-acylated monoglucosides of five main anthocyanidins – delphinidin, cyanidin, petunidin, peonidin and malvidin – which differ from each other by the number and position of the hydroxyl and methoxyl groups located in the aromatic rings of the molecule. Acylation occurs at the C-6 position of the glucose molecule by esterification with acetic, p-coumaric and caffeic acids.



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Anthocyanins in red wines

Accumulation of anthocyanins starts at veraison, i.e. the period of berry ripening, when changes of colors occur (green color is changing to yellow- green for white grapes or red and different blue nuances for red grapes). The dominated anthocyanin is malvidin-3-O-glucoside (mv-3-glc), followed by peonidin-3-O-glucoside (pn-3-glc). With regard to monoglucosides and diglucosides anthocyanins, there was a distinct separation among the different species. The *V. vinifera* grapes only contained the monoglucoside anthocyanins, whereas *V. rotundifolia* grapes only diglucosides anthocyanins. Among the East Asian species and *V. amurensis*, *V. vinifera* hybrids, diglucosides anthocyanins were dominant in most grapes.



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Natural antioxidants in wines

Stilbenes

Resveratrol –the most popular antioxidant

Apart from anthocyanins, the next class of polyphenols responsible for the “French Paradox” is the class of **stilbenes**. Originally epidemiological studies indicated an inverse relationship between moderate wine consumption and risk of coronary heart disease, the so-called “French Paradox”. The “French paradox” refers to the comparatively low incidence of heart disease among the French population, in spite of a considerable fat intake (Renaud & de Lorgeril, 1992). Resveratrol occurs in two isomeric forms, the *trans*- and *cis*- configured isomers. *Trans*-resveratrol or trans-3,5,4'-hydroxystilbene is the most abundant form and is mainly located in grape skins (Bravo et al., 2008). *Cis*- resveratrol can be obtained from the trans-form by isomerization using heat or UV radiation. Glycosidic conjugate forms of *trans*- and *cis*-resveratrol are known as **piceids**.



<https://www.physalishealth.com/en/blog/resveratrol-longevity-lifestyle/>

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Natural antioxidants in wines

Resveratrol – the most popular antioxidant

The production of **stilbenoids** in grape berry tissues is considered a part of the general defense mechanism since they display strong antifungal and antimicrobial activities. Generally, stilbenes are known as phytoalexins which can be biosynthesized from grapevines as a defense to fungal diseases, such as *Botrytis cinerea* or abiotic stress, such as UV irradiation.



<https://seipasa.com/en/blog/botrytis-on-vines/>

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Resveratrol –the most popular antioxidant

Glycemic Control: Meta-analyses show that resveratrol may assist with blood sugar management in individuals with type 2 diabetes by subtly improving insulin sensitivity and reducing fasting blood glucose levels.

Cardiovascular Function: It supports the production of nitric oxide, which signals blood vessels to relax, potentially mitigating high blood pressure and improving endothelial function.

Neuroprotection: Preliminary findings suggest its anti-inflammatory effects can cross the blood-brain barrier, offering a theoretical pathway for protecting against age-related cognitive decline.

Longevity Claims: Despite initial media excitement attributing it to anti-aging or the "French Paradox", large-scale clinical trials have found no conclusive evidence that it extends lifespan or prevents frailty in healthy human populations. [1, 2, 3, 4, 5, 6, 7, 8]



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Antioxidant potential of wines

A common method for determination of the antioxidant activity of wines is the 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) radical cation (ABTS•+) method (Villaño et al., 2004). The TEAC (Trolox Equivalent Antioxidant Capacity) value which is measured for wine samples, expresses the concentration of a Trolox solution (6-hydroxy-2,5,7,8-tetramethylchroman-2-carboxylic acid) whose antioxidant activity is identical to that of the wine itself. This index is defined as the millimolar concentration of a Trolox solution whose antioxidant capacity is equivalent to a 1.0 mM solution of the sample under study.



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So, the question is **HOW TO PRODUCE FUNCTIONAL WINE?!**

IF THE WINE IS FULL WITH PHENOLIC COMPOUNDS, THEN WHO IS THE MAIN UNDESIRABLE CONSTITUENT? **ALCOHOL!**

How is possible to formulate functional wine?!

- to eliminate alcohol till 0.5% and
- to enrich wines by polyphenols

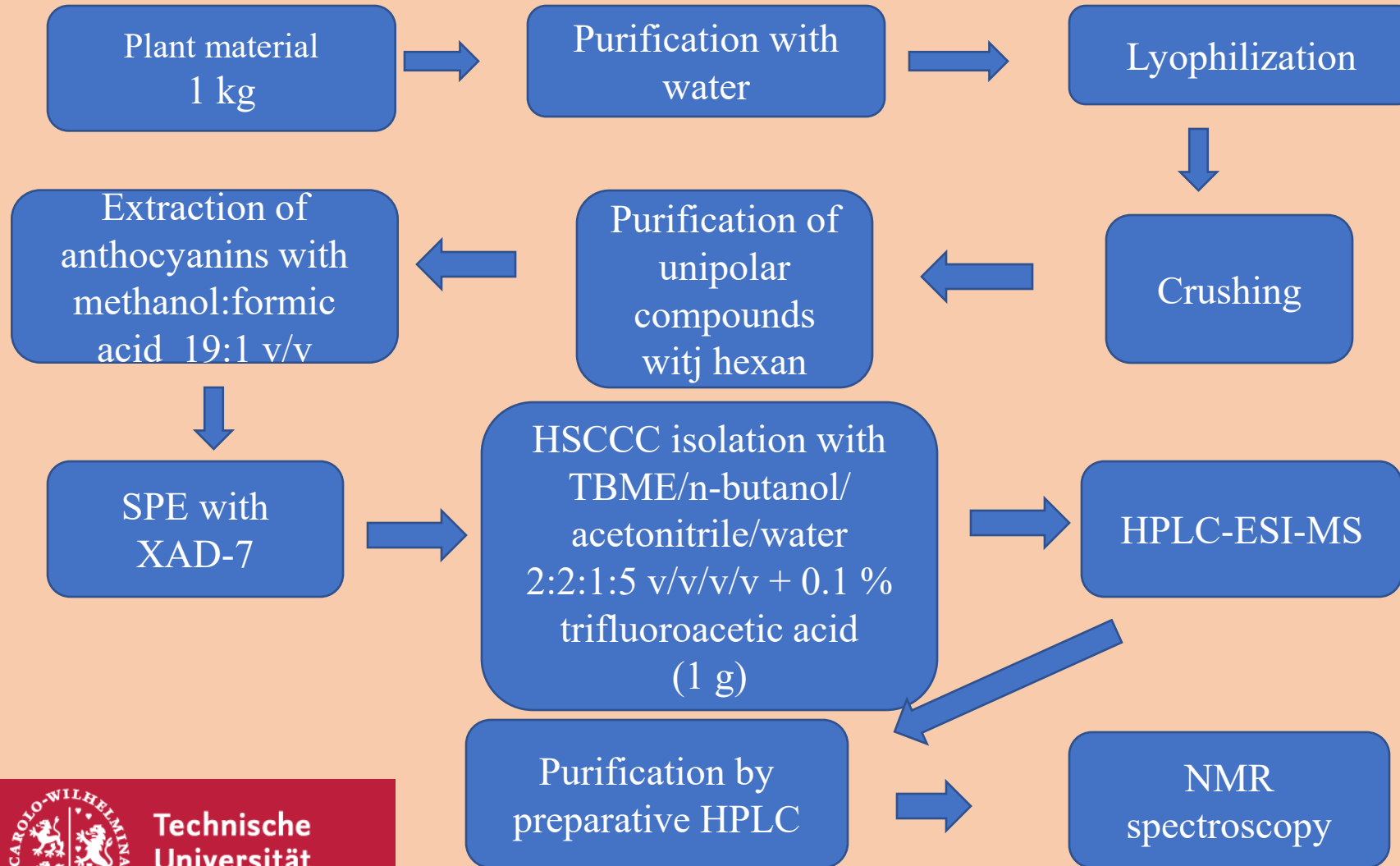
HOW TO FIND POLYOHENOLS WHICH ARE THE MOST SUITABLE FOR WINE?!

FROM GRAPE POMACE

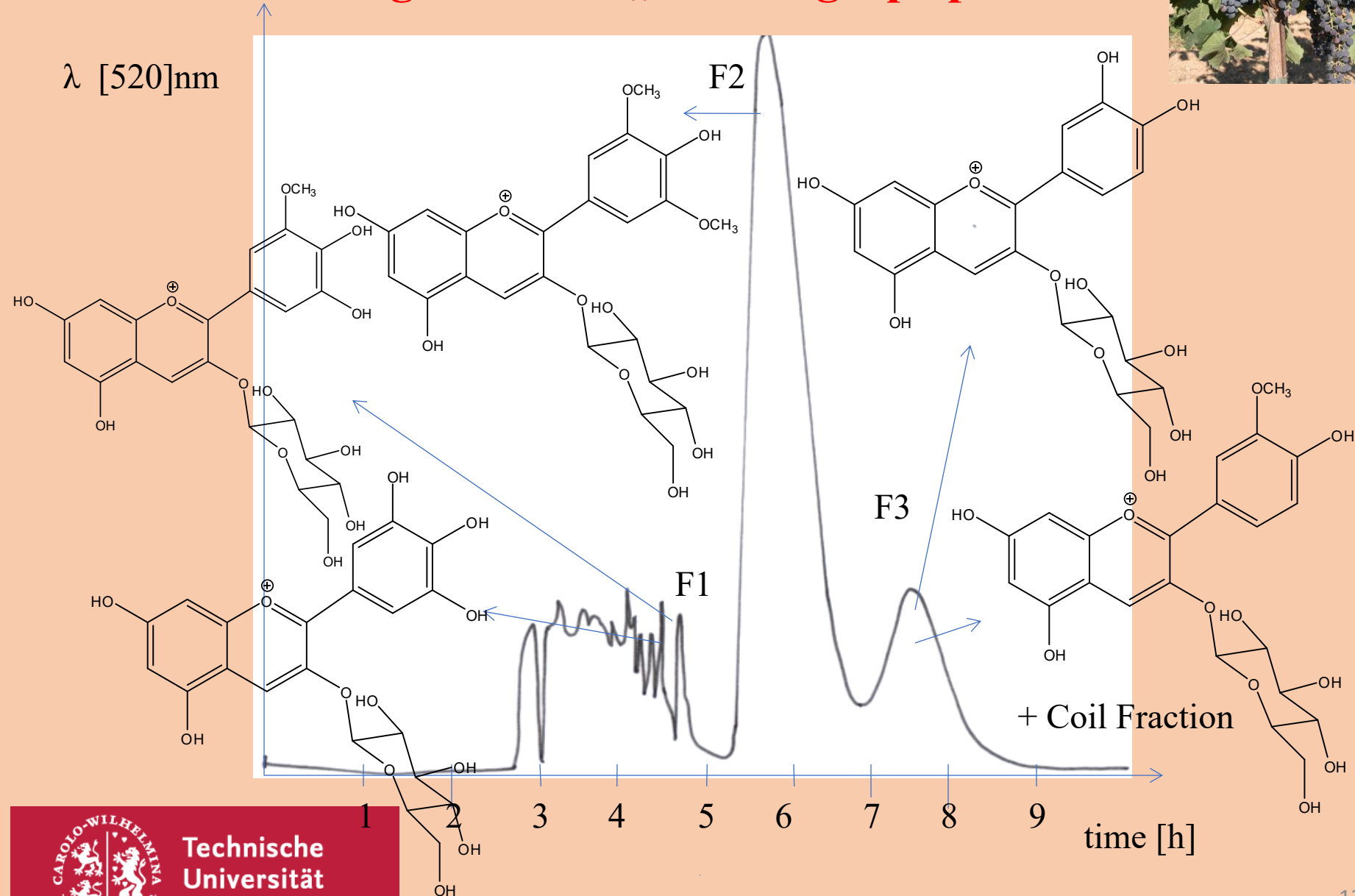
HOW?

BY ISOLATION FROM BY-PRODUCTS

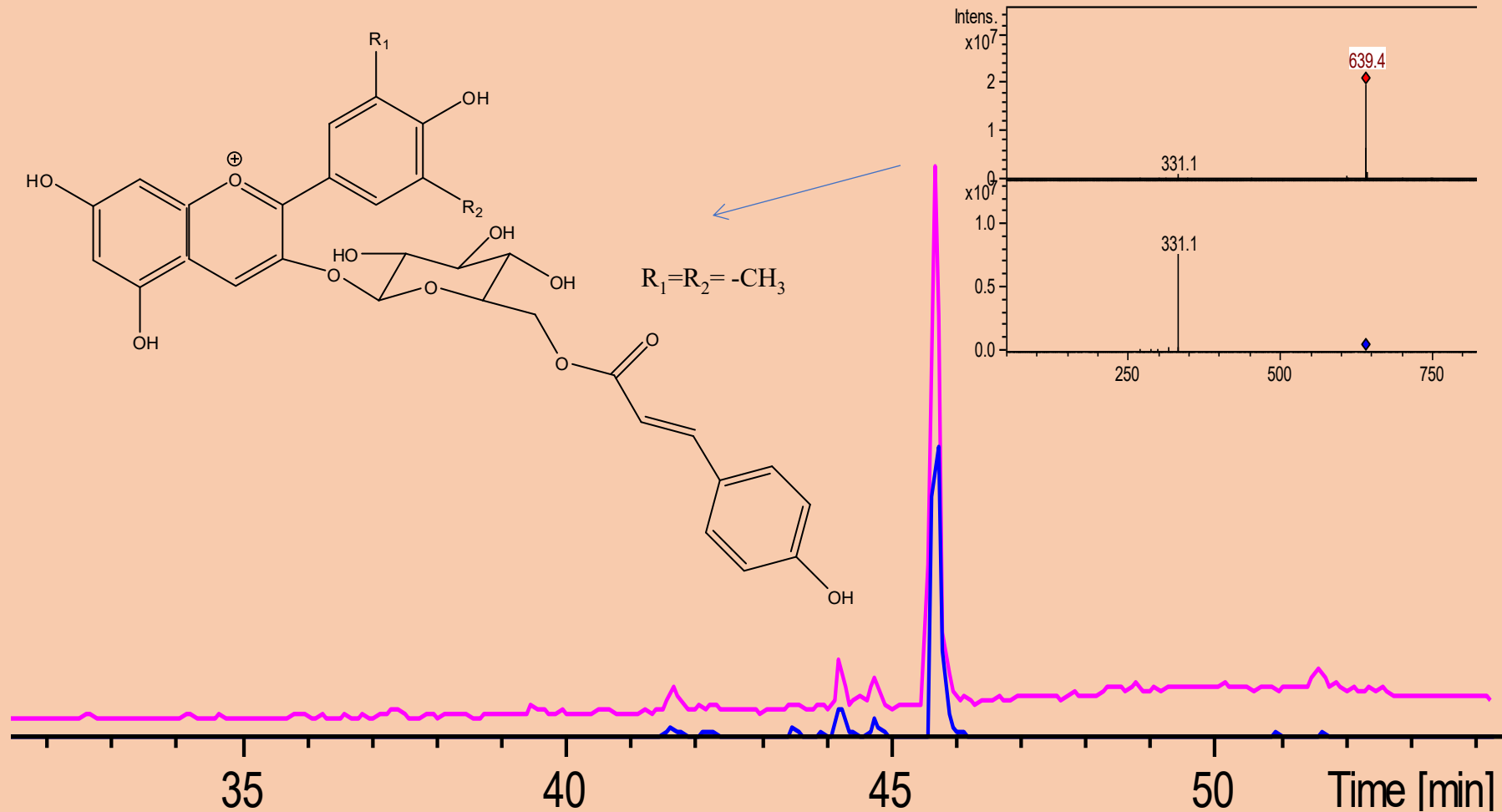
Isolation of anthocyanins from red grape pomace HSCCC



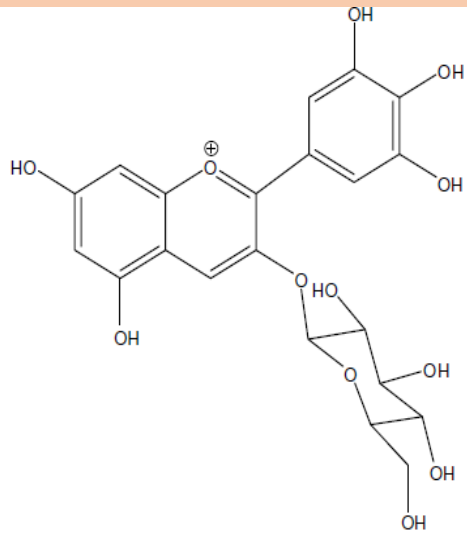
CCC chromatogram from „Vranec grape pomace“



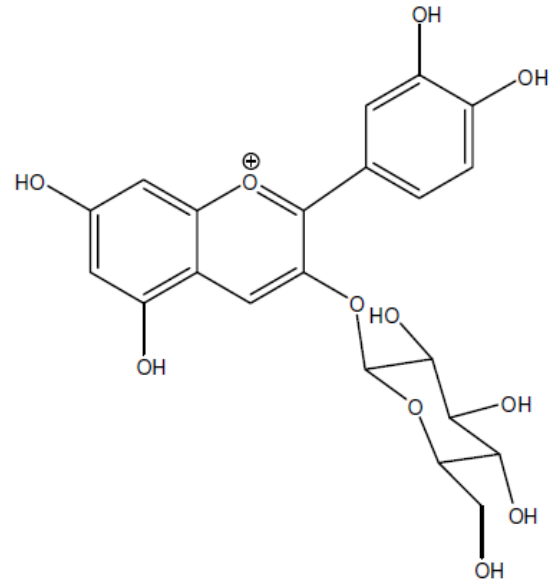
HPLC-ESI-MS chromatogram of malvidin-3-*p*-cumaroyl-glucoside



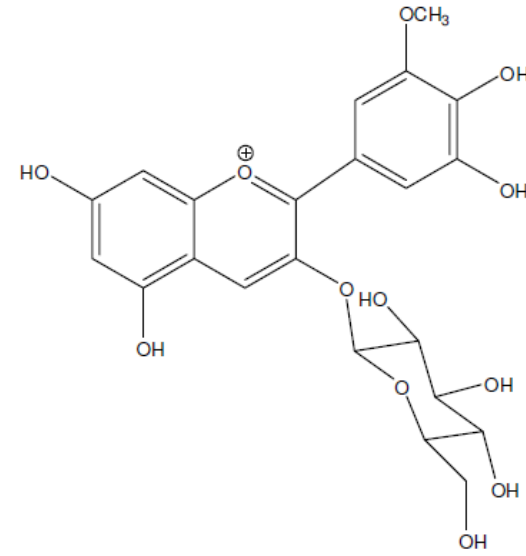
The colour of isolated pigments depends of pH value where pigments can be added. The value of pH 3-3,5 enables good color and hue of the natural pigments.



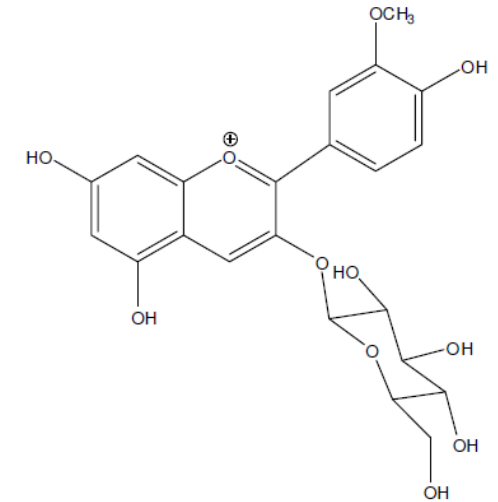
Delphinidin-3-O-glucoside



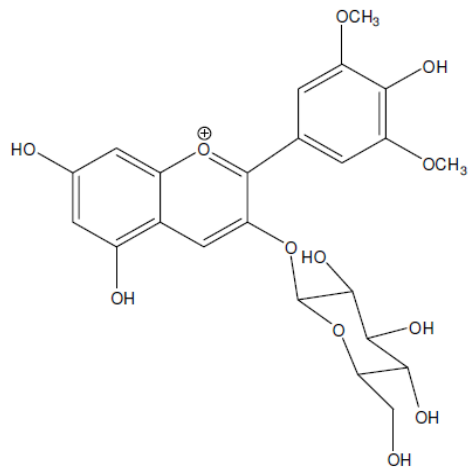
Cyanidin-3-O-glucoside



Petunidin-3-O-glucoside

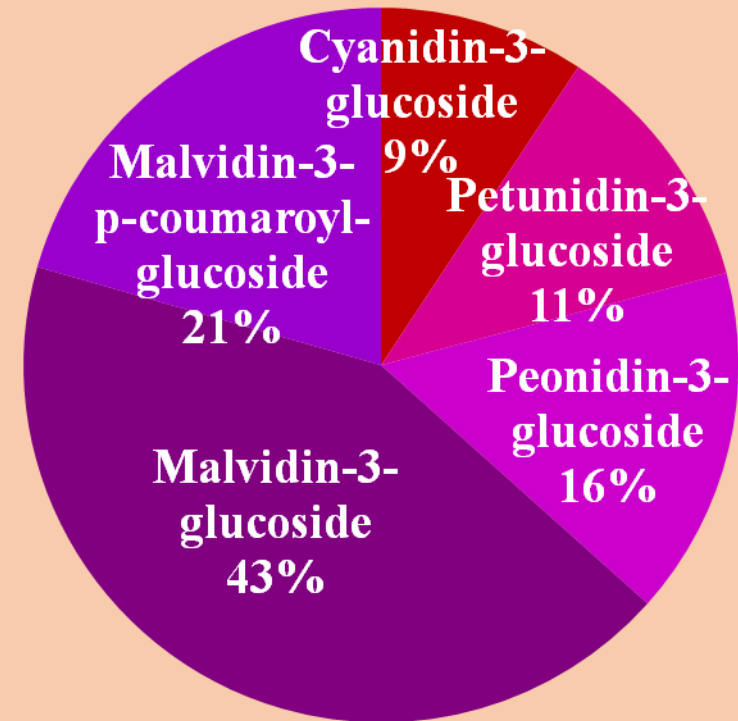


Peonidin-3-O-glucoside



Malvidin-3-O-glucoside

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



OR MAYBE BY ADDITION OF RESVERATROL IN WINE? IS THIS SIMPLE TASK?

Control infection with *Botrytis cinerea* is not the best choice for grapevine!

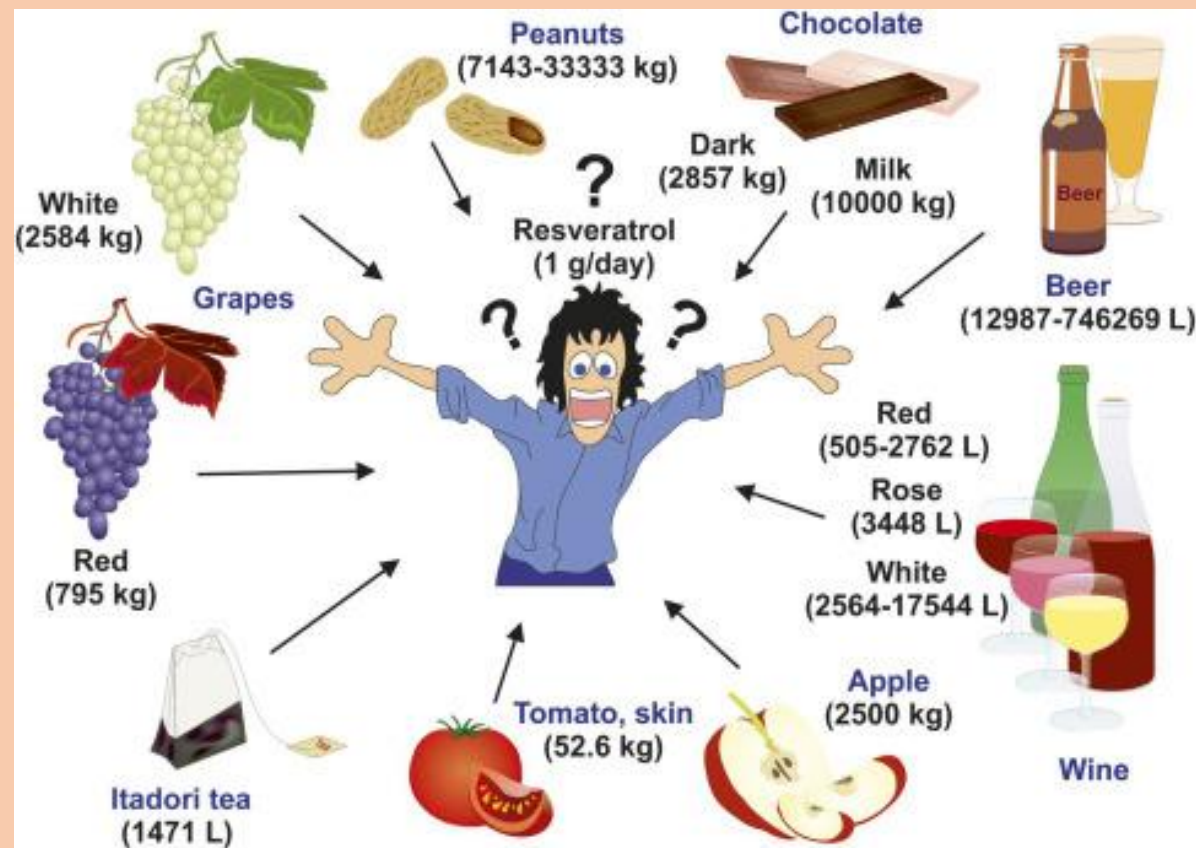
Postharvest grapes have been treated with **ultraviolet-C** light to produce stilbene-enriched grapes that were later used in a conventional winemaking process to obtain a red wine enriched in stilbenes (Guerrero et al, 2010).

Trans-resveratrol has been identified as the principal component responsible for the **blue fluorescence** of grapevine leaf tissue following fungal infection or exposure to *ultraviolet light*. The biosynthesis of this compound appears to be a nonspecific response of members of the *Vitaceae* to **infection or injury**. The compound is not detectable in healthy leaves but accumulates to between 50 and 400 µg/g fresh weight in infected or ultraviolet-irradiated leaves, and it is a major constituent (c.700 µg/g) of lignified stem tissue.

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Sabine Weiskirchen, Ralf Weiskirchen,
Resveratrol: How Much Wine Do You Have
to Drink to Stay Healthy?,
Advances in Nutrition, 7(4),
2016, 706-718,
<https://doi.org/10.3945/an.115.011627>.



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NON-ALCOHOLIC WINE?!

According to the Spanish dictionary, wine “is the natural food obtained exclusively by total or partial alcoholic fermentation of fresh grapes, squeezed or not, or grape wort.” **So, non-alcoholic wine falls within this definition** since it is made conventionally – fermenting the wort – and then the alcohol is eliminated through the dealcoholization process. Therefore, non-alcoholic wine is not grape juice, but rather a wine that is produced to the end and then finally undergoes a **dealcoholizing process**.

HOW?!

- REVERSE OSMOSIS
- LIOPHYLIZATION

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Reverse osmosis

The reverse osmosis technique consists of **passing the wine through a membrane that allows the alcohol to be separated from the wine. This membrane allows water and alcohol to pass through, but not the rest of the components.** Once the alcohol is separated, the rest of the components are recommended again to create the final non-alcoholic wine.

An advantage of this method is that it avoids heating the wine.



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NON-ALCOHOLIC WINE?!

Lyophilization

The lyophilization method consists of freezing wine and then introducing it into a *vacuum pressure chamber*. Then, part of the water and alcohol are eliminated through the sublimation process (direct change from the solid to the gaseous state). Once the alcohol is separated, the rest of the components are put back together to create the non-alcoholic wine.

The drawback of this technique is that **less aroma intensity** is produced in dealcoholized wine.



<https://www.barnalab.com/en/blog/wine-powder-freeze-drying/>

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**IS DEALCOHOLIZED AND
NON-ALCOHOLIC WINE
THE SAME?**

NO!

Dealcoholized wines have had their alcohol content removed, while non-alcoholic wines underwent limited fermentation to control the production of alcohol.



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- Wine gets its alcohol by fermenting the sugars from grape juice. This usually results in 7%-24% ABV (alcohol by volume) in most wines. But when we say “**dealcoholized**,” it means the **alcohol from a fully fermented wine has been removed either completely or partially**. Usually, dealcoholized wine has **less than 0.5% ABV**.
- Most of the time, **non-alcoholic wine is used as a synonym for dealcoholized wine** because the former is also described as wines with less than 0.5% ABV.
- Non-alcoholic wines are derived through a **reduction of alcohol content during fermentation** rather than dealcoholizing. “Non-alcoholic” is quite ambiguous because drinks described as such **are not entirely free from alcohol**.
- Some brands either omit the word “wine” after “non-alcoholic” or just call their products “**wine alternatives**.”

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Category	Dealcoholized Wines	Non-Alcoholic Wines
Ingredients	Usual wine grapes (Cabernet Sauvignon, Chardonnay, etc.)	Often unspecified wine grapes
Process	Vacuum distillation, reverse osmosis, and spinning cone technology	Reduction of fermentable sugars, and interrupted fermentation
Flavor Profile	Complex, dry, wonderfully aromatic with a good texture	Usually sweet and less tannic
Food Pairings	Savory, umami, light and, sweet dishes	Spicy foods, and desserts

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So, we can assume that moderate wine consumption has been associated with:

- a reduced risk of cognitive decline in older adults. A meta-analysis found that wine drinkers had a lower relative risk of cognitive decline than non-drinkers, suggesting potential protective effects.
- low- and no-alcohol wines offer a **promising alternative for individuals looking to reduce their alcohol intake while maintaining social interactions**. These products align with overarching health-conscious trends and present potential economic benefits for producers.

BUT, THE MAIN PROBLEM IS THE PRICES!

- to pay premium prices for these options poses a challenge, and further research is essential to comprehend the long-term social and health implications fully.

Benefits of Choosing Non-Alcoholic Wine



Better for our
liver



Dehydration
avoidance



Lower in
calories



Fewer sleep
disruptions



More stable
mood

 Reframe

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Questions and discussion please

