



Polyphenols in Tikveš white wines and their effects on human health

Dr. Andreja Vanzo



Agricultural Institute of Slovenia

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Hydroxycinnamates - the most abundant class of phenolics in free-run juice and in white wines

FLAVONOIDS

Flavanols=grape tannins:

seeds +++

skin ++

pulp +

Flavonols (quercetin):

skin ++



Hydroxycinnamates:

pulp +++

skin ++

seeds ++

NONFLAVONOIDS

Hydroxybenzoic acids:

skin +

seeds ++

Stilbenes (resveratrol):

skin +++

seed ++

pulp +

+ indicates level of synthesis

Glutathione and phenolics – bioactive compounds: key factors of white wine quality

Aromatic potential:

Flavor:

**Tannins: bitterness,
astringency –
„phenolic taste“**

Aroma:

**-Glutathione and HCA
responsible for
aromatic stability of
young fresh wines
-Volatile phenols -
derivatives of HCA**



Wine color:

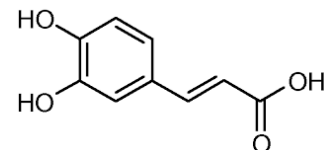
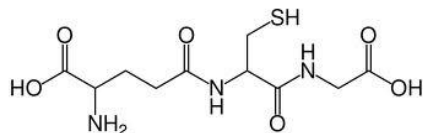
**Too much oxygen and
too little glutathione --
oxidized phenolics:
browning**

Wine stability:

**Antioxidant and
antimicrobial effect.**

Hydroxycinnamates and glutathione in white wines

- Most dominant phenolic molecules in white wines: **caftaric acid** and its derivative with glutathione: 2-S-glutathionyl caftaric acid (**grape reaction product**) - increased in white wine by using oxidative juice handling.
- Most dominant antioxidants in white wines: **caftaric acid** and **glutathione**.



Hydroxycinnamates in Tikveš white wines

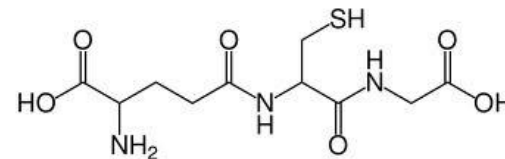
	Total HCA mg/L (as caftaric acid)	caftaric mg/L	GRP mg/L	coutaric mg/L	fertaric mg/L	caffeic mg/L	coumaric mg/L	ferulic mg/L
Chardonnay	83,4	41,3	26,9	12,2	4	17,5	7,5	0,8
Chardonnay	93,1	60	26,1	18,1	4,2	7,6	2,5	0,6
Chardonnay	68,4	23,8	26,8	11,5	3,9	21,5	6,7	0,8
Temjanika	287,3	213,3	7,7	45,9	4,1	15,3	7,6	1,1
Temjanika	132,2	75,5	22,1	40,8	4,7	5,5	4,3	1,6
Temjanika	63,6	19,7	9,1	10,7	3,5	19,7	8,2	1,9
Traminec	24	3,3	21,1	5,9	4,3 0	2	2,1	6,4
Muškat Otonel	58,7	30,1	18	16,6	4,2	4,7	2,8	0,3
Muškat Otonel	98,5	55,6	20,9	29,2 0	4,5 0	5,6	3,2	0,5
Sauvignon Blanc	30	8,8	36,5	14,4	2,2	3,3	1,2	0,2

Hydroxycinnamates in other white wines

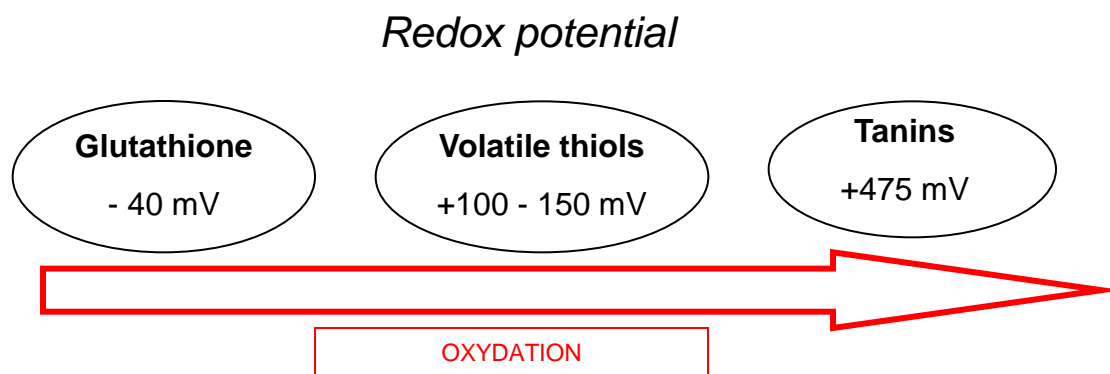
Chardonnay (n=8) (mg/L)	Pinot Blanc (n=6) (mg/L)	Sauvignon (n=13) (mg/L)	Zelen (Slovenian local variety) (n=8) (mg/L)	Malvasia Istriana (n=66) (mg/L)	Temjanika (Macedonian local variety) (n=3) (mg/L)
66	50	74	151	102	161



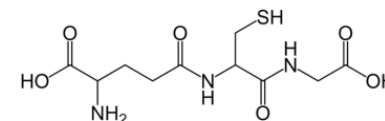
Glutathione



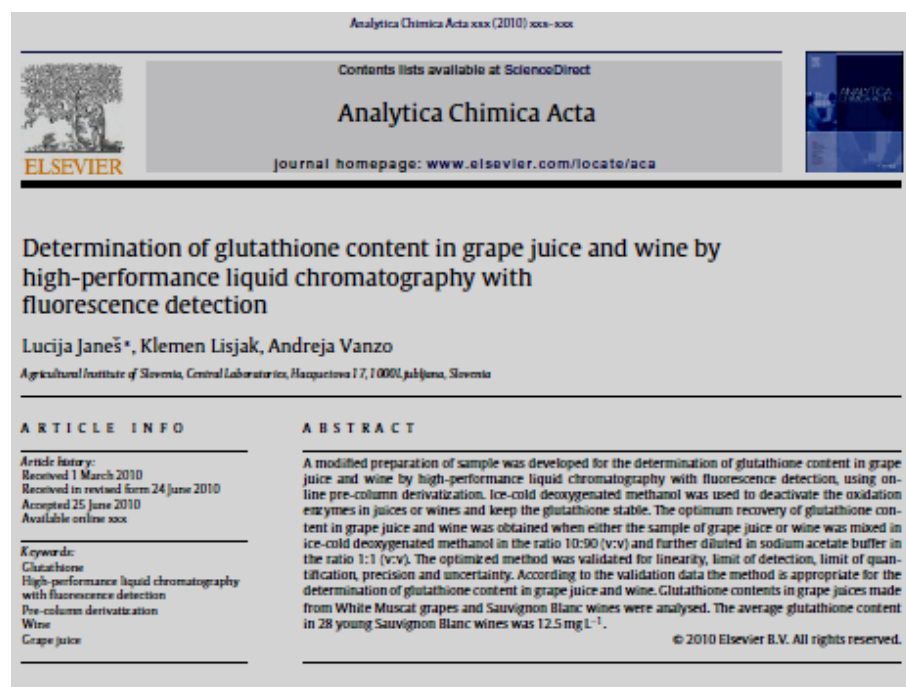
- Protects must and wine from oxidation, preserves wine aroma and prevents wine browning.
- During grape pressing could be quickly lost (90% in 5min) due to oxidation.



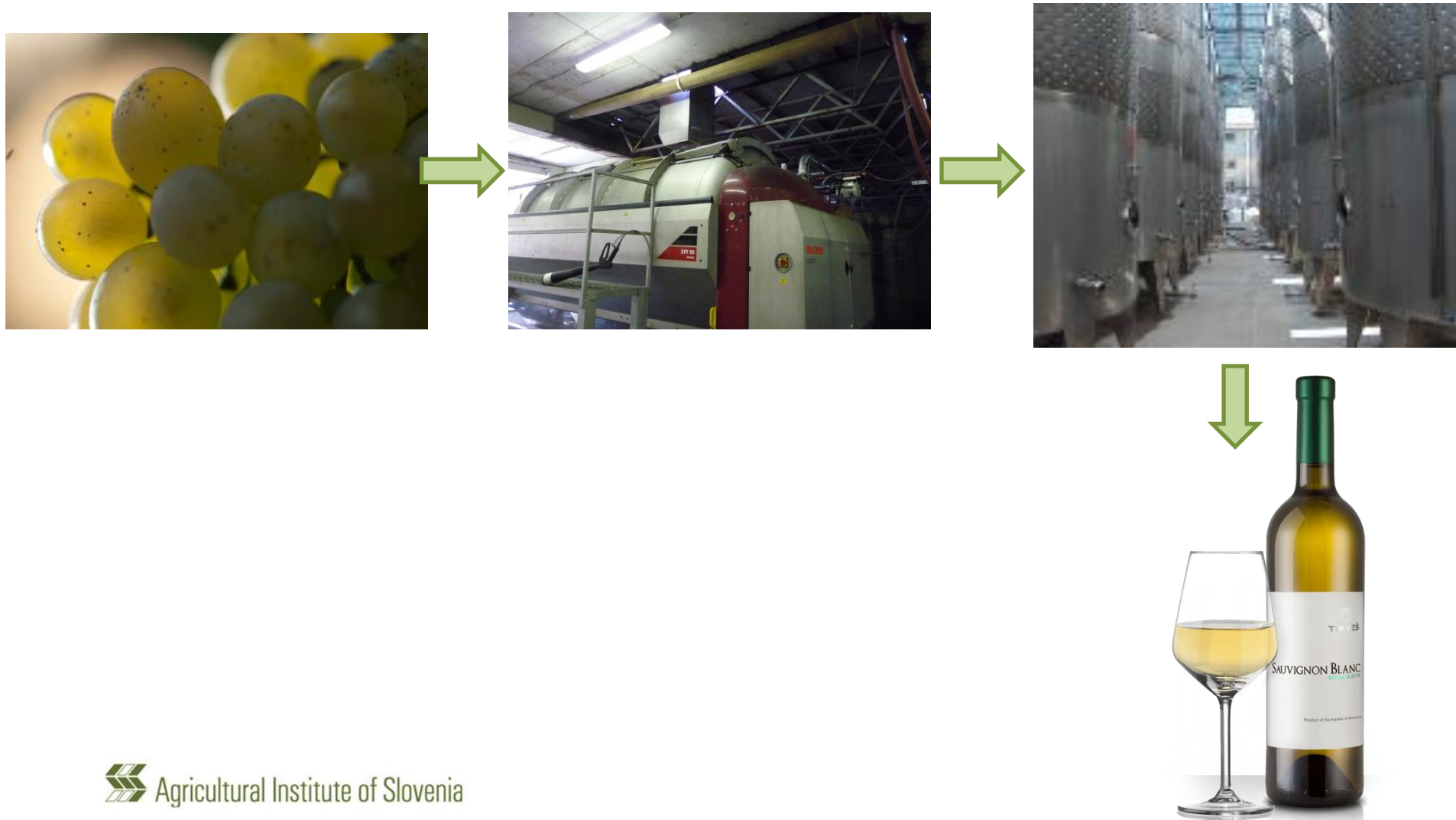
Glutathione in Tikveš white wines



Vintage 2015	Glutathione (mg/L)
Sauvignon Blanc 0,75 L	7,4
Temjanika 0,75 L	10,7
Chardonnay 0,75 L	13,3
Alexandria white cuvee 0,75 L	15,3
Sauvignon CVT-25	9,7
Chardonnay TFL-17	10,4
Chardonnay FRI-5	13,6
Alexandria white cuvee TFL-10	11,0
Temjanika FRI-3	11,0
Alexandria rose-cuvee TFL-20	8,0
Malvasia Istriana (n=39, 2013)	5,6
Malvasia Istirana (n=9, 2014)	0,1

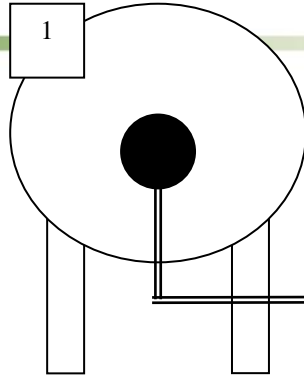


Glutathione as marker of oxidation



Hyperreductive (oxygen free) pressing

Preša

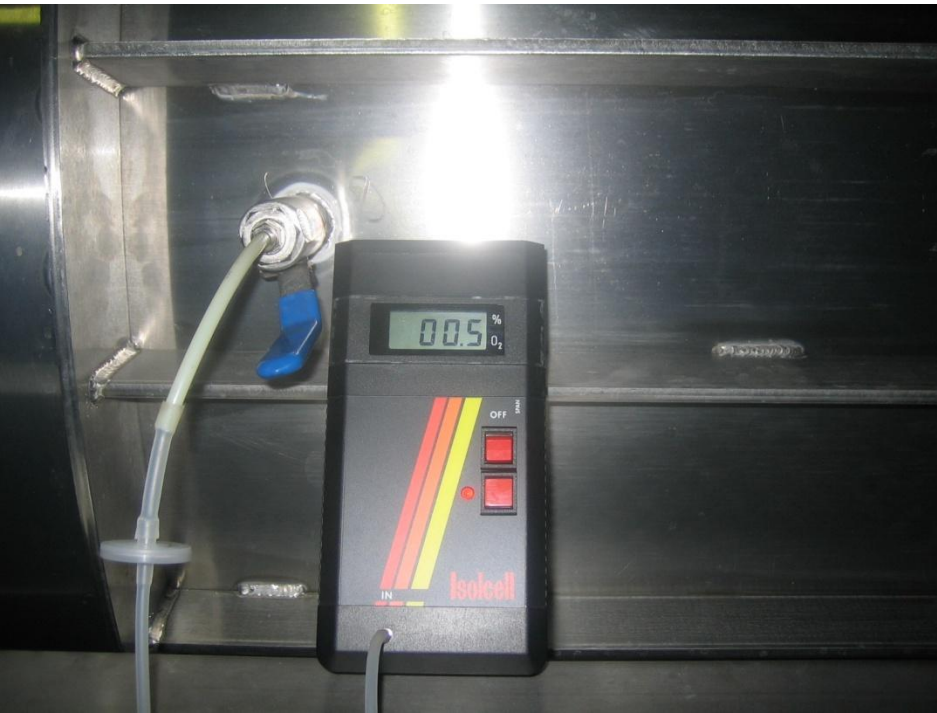


Membrane 'balon' za
skladištenje inertnog
gasa

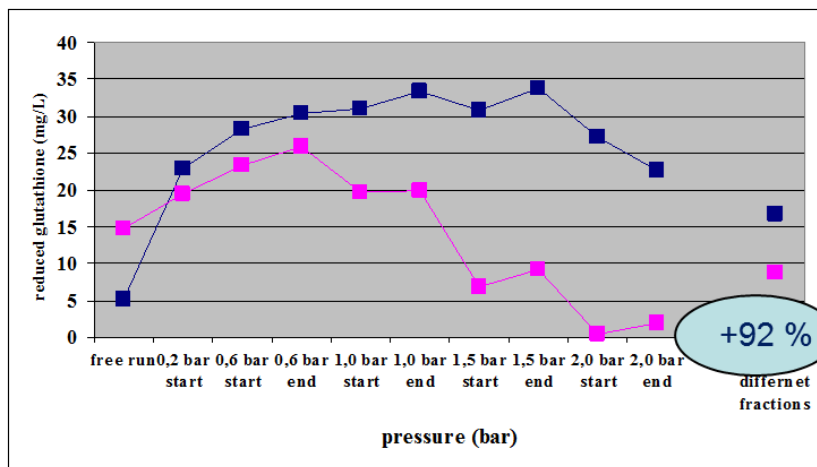
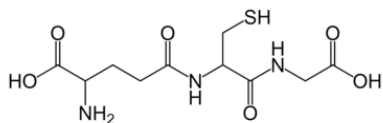
Vakum pumpa

Buffer tank

fermentacijski tank

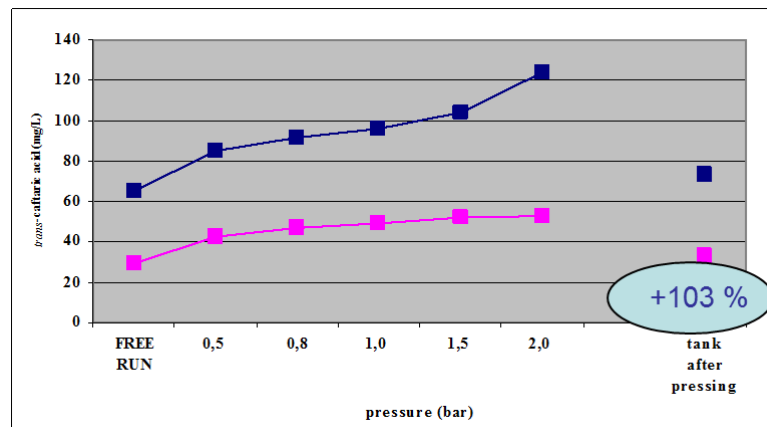
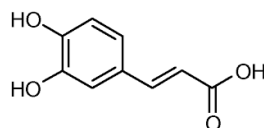


Glutathione and HCA preservation during hyperreductive pressing



Legend

- hyperreductive (N₂) pressing
- classic (O₂) pressing



Hiperreductive pressing



Classic pressing

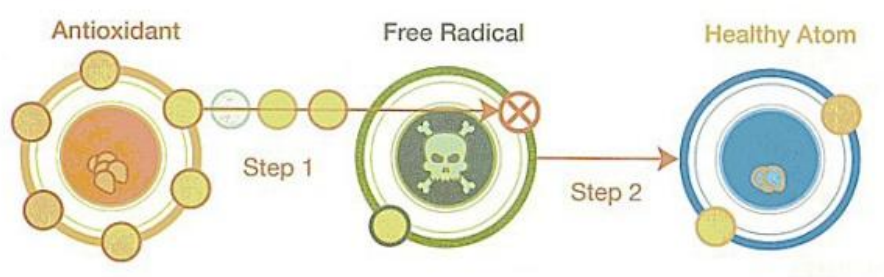


Oxygen management - important in preserving white wine antioxidants



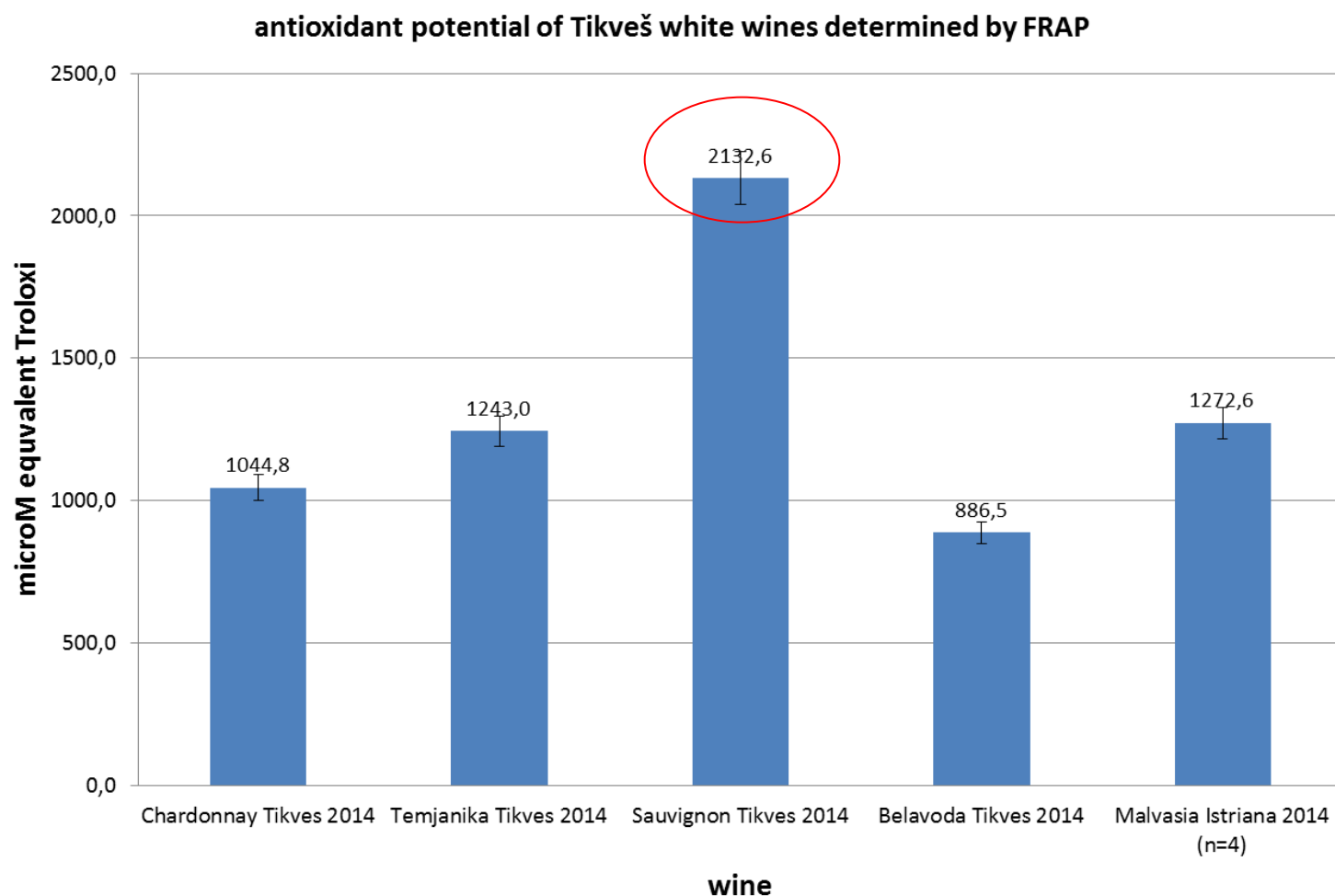
Phenolics – bioactive compounds important for human health

Antioxidant capacity of white wines



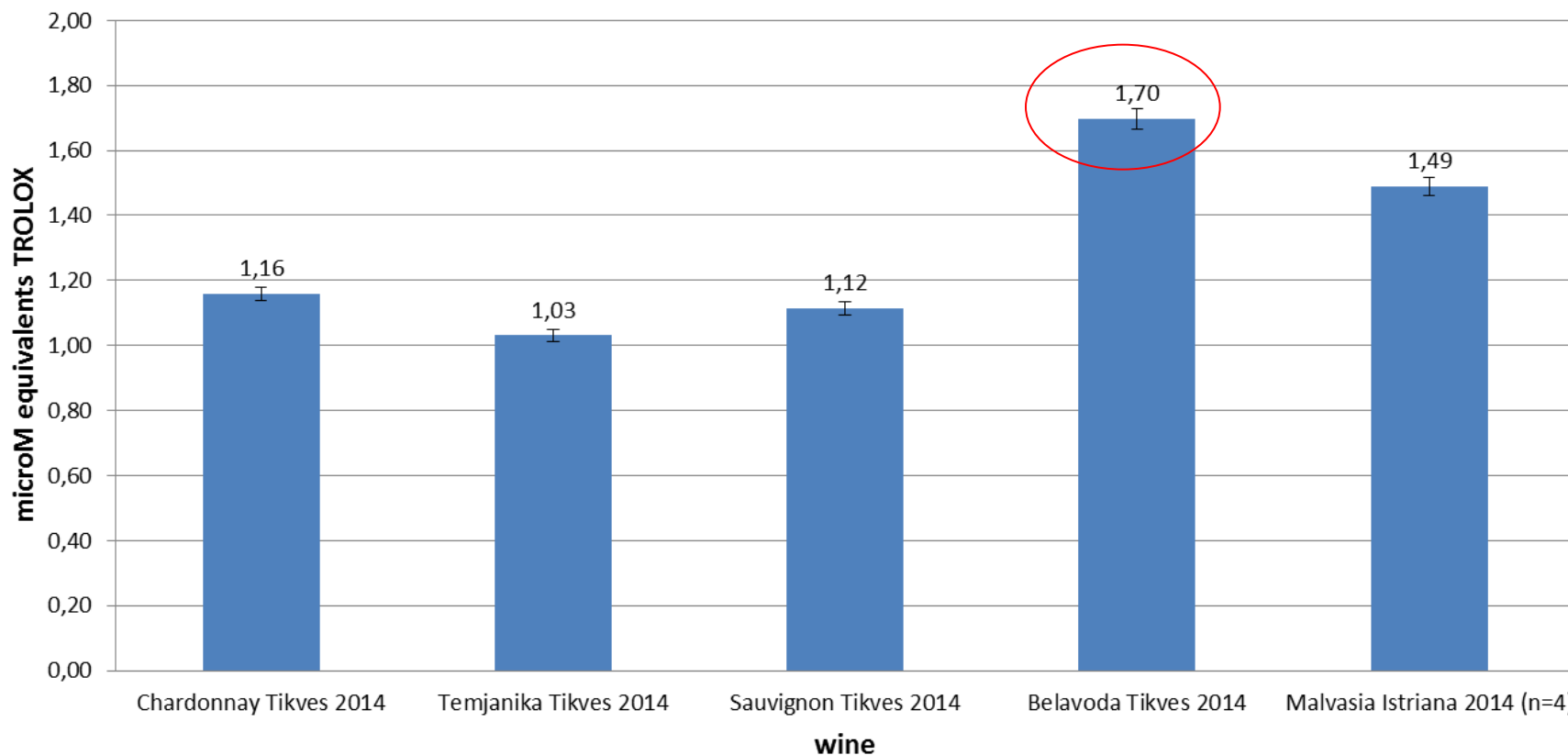
- Grape & wine polyphenols are well-known for their antioxidant capacity, which is not single reaction but includes multiple mechanisms.
- As no single method is able to assess them all, it is usually recommended to use more than one technique (*in vitro* tests).
- Spectrophotometric FRAP, ABTS assays are based on electron transfer, fluorometric ORAC assay is based on hydrogen transfer.
- An automated microplate (96-well) reader was used (MultiSkan Spectrum). The difference in absorbance was correlated with Trolox standard curves.

FRAP (Ferric reducing antioxidant power) assay



ABTS (ABTS \bullet^+ radical cation reacts with wine polyphenols)

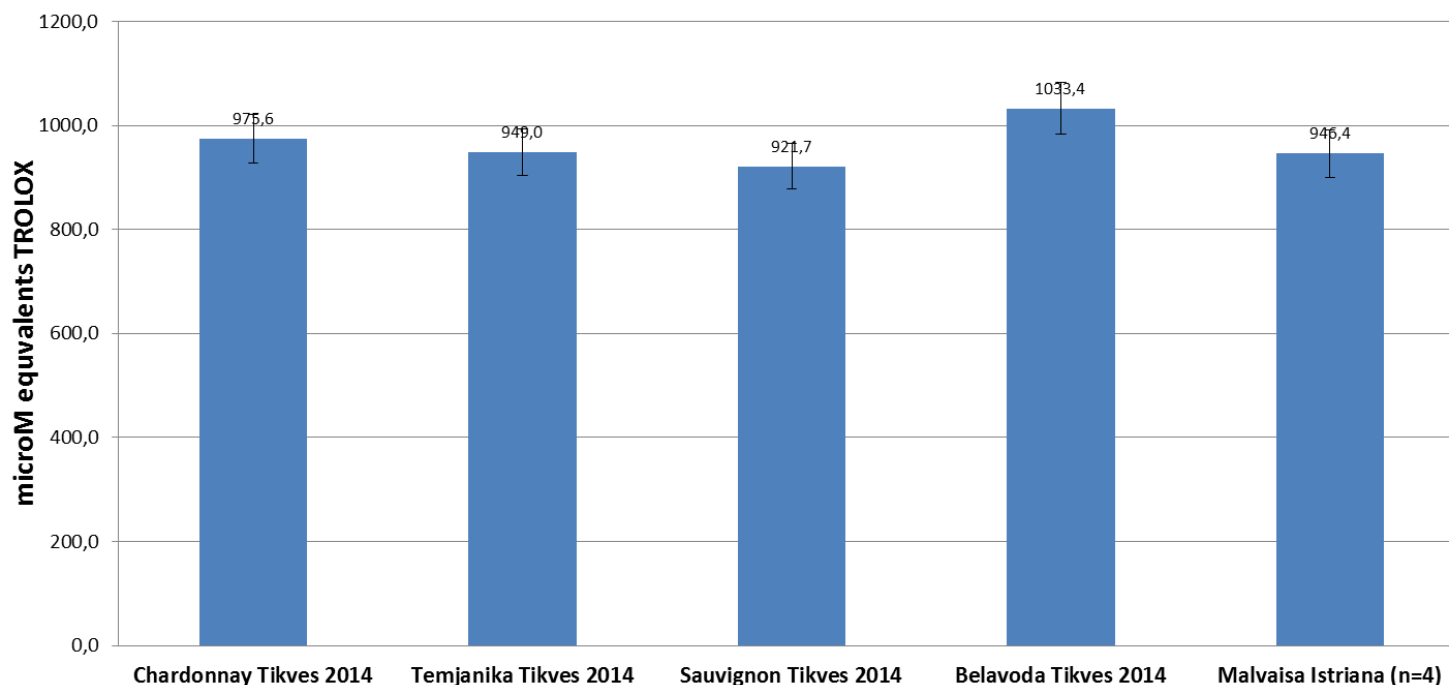
antioxidant potential of Tikveš white wines determined by ABTS



- Good correlation with total polyphenol concentration: $R^2=0.918$. More polyphenols \rightarrow better antioxidant capacity

ORAC (oxygen radical absorbance capacity) assay

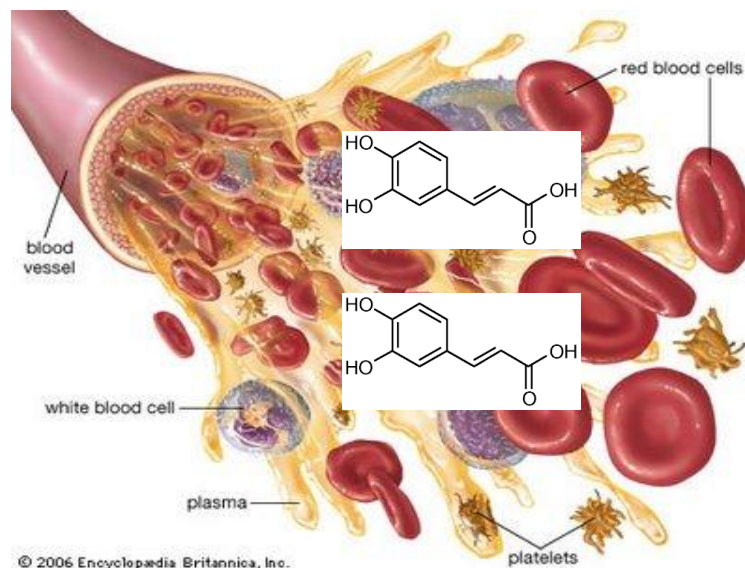
antioxidant potential of Tikveš white wines determined by ORAC



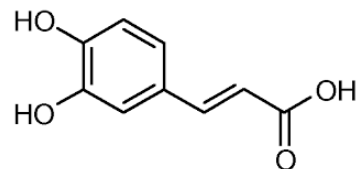
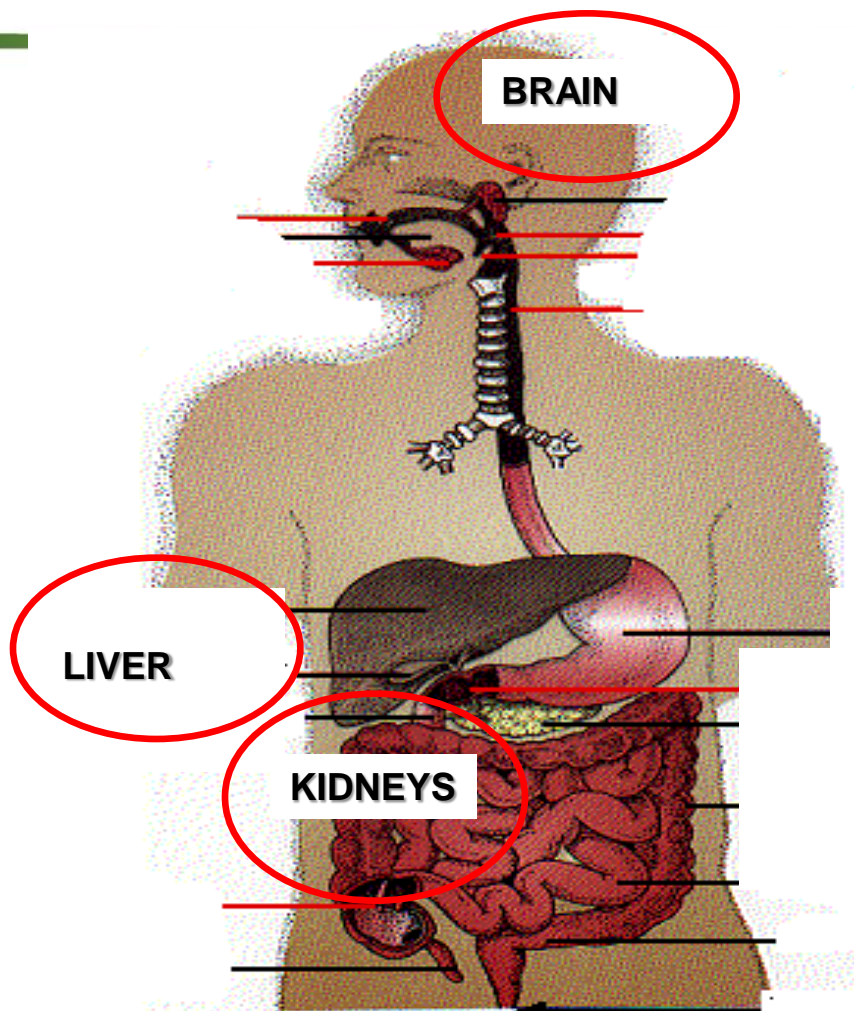
- Correlation with total polyphenol concentration: $R^2=0.872$.
- In 2012 USDA has withdrawn ORAC test, since no correlation between test results and biological activity could be found; stating that no physiological proof *in vivo* existed in support of the free-radical theory.

Bioavailability of wine hydroxycinnamates

- Rats were anaesthetized;
- Their ligated stomach was filled with caftaric acid;
- After 10 min blood, liver kidneys and brain were collected;
- Tissue samples were analyzed by HPLC-DAD-MS.



10 minutes after administration, caftaric acid was found intact in mammalian organs



Caftaric acid - bioactive compound in wine and in *Echinacea* - known to improve the human immune system.

VANZO, Andreja, CECOTTI, Roberto, VRHOVŠEK, Urška, TORRES, Adriana M., MATTIVI, Fulvio, PASSAMONTI, Sabina. The fate of trans-Caftaric acid administered into the rat stomach. *Journal of agricultural and food chemistry* 200755,1604-1611.

White wine polyphenols showed promising effect on Alzheimer disease cell recovery

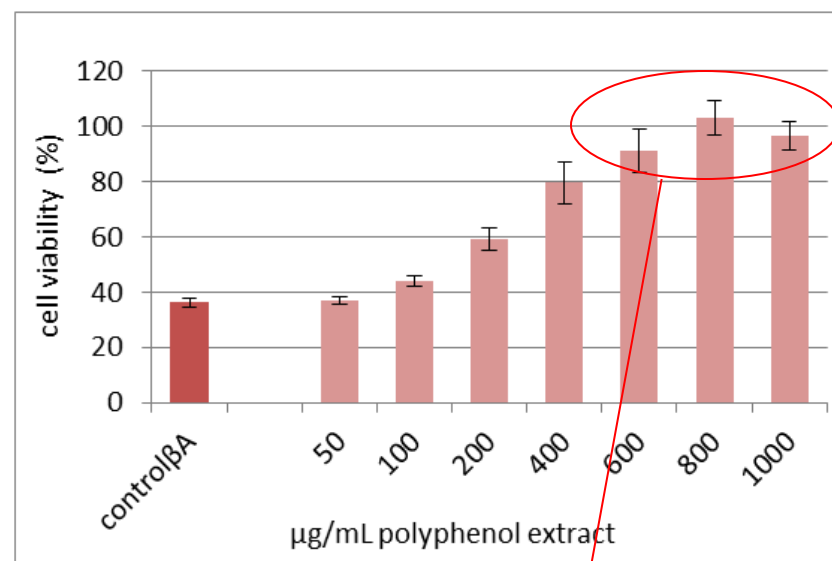
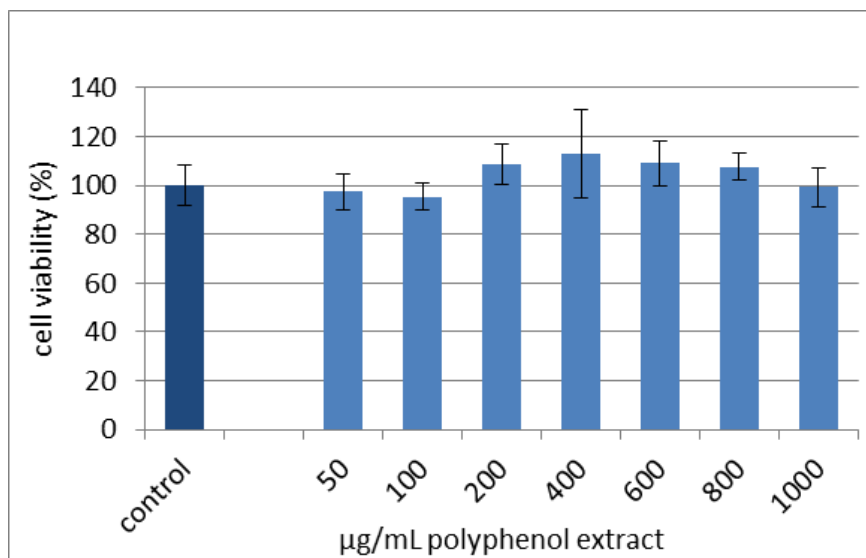
- White wine polyphenol extract (0.25% v/v) was tested on neuronal cells with β -amyloid (a peptide which induces Alzheimer disease).
- After 24h cell viability was compared to control (healthy cells).



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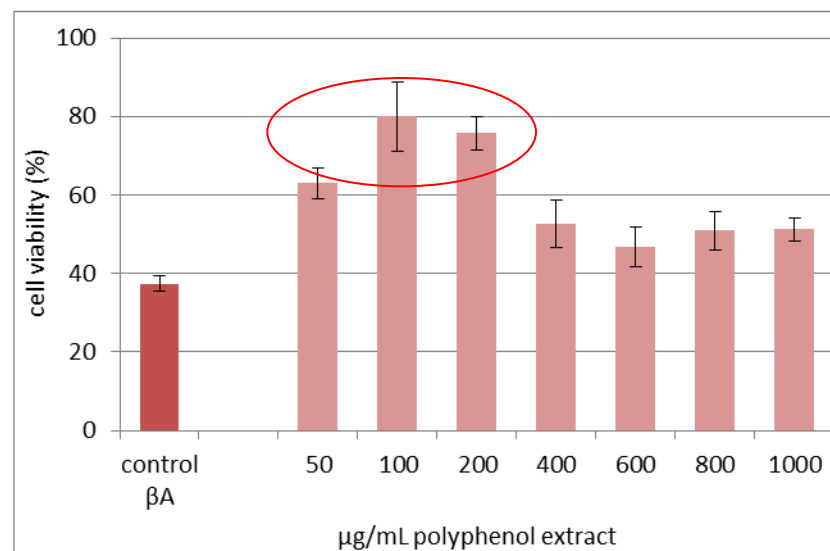
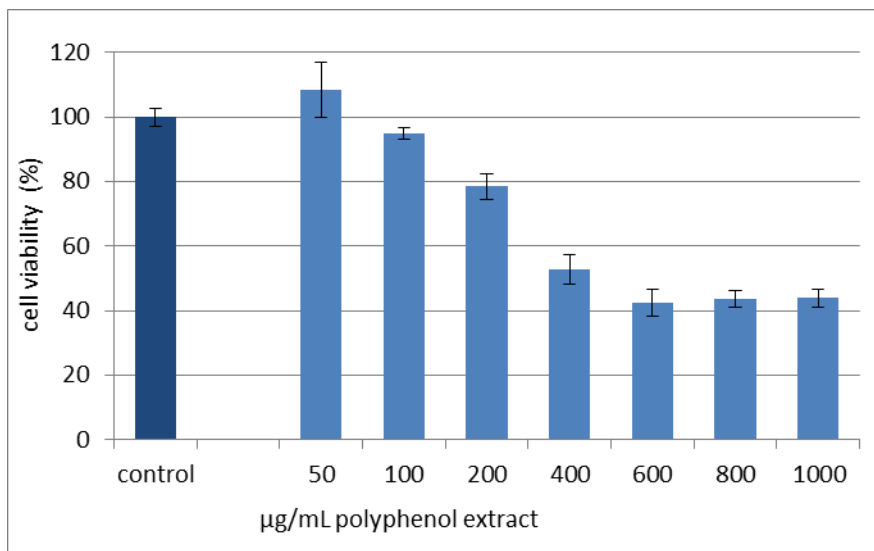
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Fresh white wine polyphenol extract – influence on cell viability



With addition of polyphenol extract – improved viability of cells has been observed

,Skin contact' white wine polyphenol extract – influence on cell viability



In conclusion....

- Hydroxycinnamates are most abundant phenolics in white wines.
- Temjanika is extremely rich in hydroxycinnamates.
- Both, hydroxycinnamates and glutathione could be rapidly oxidized and lost during grape processing.
- Oxygen management (eg. hyperreductive pressing, grape cooling) is important to preserve antioxidants.
- Hydroxycinnamates were found in mammalian organs, including brain.
- Neural mammalian cells incubated with white wine polyphenols showed better viability in comparison to control – it might be compliant with finding that grape hydroxycinnamates can reach the brain.

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Thank you for your attention

andreja.vanzo@kis.si



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