Vitis 35 (3), 149–150 (1996)

Research Note

Preliminary studies on the effect of *Oidium tuckeri* on the phenolic composition of grapes and wines

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Summary: A study of the influence of *Oidium tuckeri* on anthocyanins and the hydroxycinnamic tartaric esters of grapes and red wines was carried out during the 1993 harvest. After infection the level of anthocyanins in the skins of berries and in wines was lower than in healthy grapes and their wines. It is of particular interest that two bisubstituted anthocyanins reacted less sensitive to the pathogen. Wines from infected grapes contained more hydroxycinnamic tartaric esters.

Key words: Oidium tuckeri, anthocyanins, hydroxycinnamic tartaric esters, grape composition, wine composition.

Introduction: Powdery mildew is the most serious grape disease in European viticulture for more than a century; it can be considered to be present in all viticultural areas with temperate climate causing considerable damage every year.

In comparison to other fungal diseases which attack vines, e.g. *Botrytis cinerea,* there has been no detailed research on the effect of powdery mildew on the metabolism of phenolic compounds.

For this reason, we studied the influence of *Oidium tuckeri* on the composition of phenolic compounds of grapes.

Materials and methods: The tests carried out during the 1993 harvest were made with field-grown Sangiovese in the Chianti classico zone which was severely infected by *Oidium tuckeri.*

100 grape bunches over the entire area (ca. 1 ha) were chosen at random before veraison. The bunches were checked visually at weekly intervals in order to characterize the development of the disease.

At maturation 20 kg of healthy and infected bunches were collected. Limited quantities of wine in 3 replicates were made from both.

Grapes were destalked and 80 mg/l of SO_2 and selected yeasts were added immediately. At the end of fermentation the wine was drawn off, the pomace was pressed and the SO_2 level was raised up to 80 mg/l. After 15 d the wine was decanted and filtered.

Anthocyanins were analyzed using a Knauer liquid chromatograph equipped with an Hypersil 5 ODS (150 x 4.6 mm) column and a UV-VIS detector set at 530 nm. The flow rate was 1 ml/min, the volume injected was 20 µl. Elution was performed with a binary gradient (perchloric acid 0.6% and methyl alcohol) (Arfelli *et al.* 1992).

Grapes with their skins were homogenized in methyl alcohol:water 75:25 v/v and rehomogenized twice with the same solvent. The extract was centrifuged and the supernatant was diluted, filtered (0.45 µm) and injected. The wines were diluted, filtered (0.45 µm) and injected as well.

Caftaric acid, coutaric acid, 2-S-glutathionyl caftaric acid (grape reaction product, GRP) were determined using a Jasco liquid chromatograph equipped with a Spherisorb 5 ODS (250 x 4.6 mm) column and a UV detector set at 313 nm. An isocratic elution with 5 % acetic acid was carried out at a flow rate of 0.85 ml/min, the volume injected was 20 µl.

Further analyses included spectrophotometric determinations of O.D. 420 nm and 520 nm (Sudraud 1963), total polyphenols (Singleton and Rossi 1965) and total anthocyanins (Margheri and Falcieri 1972).

Results and discussion: The level of anthocyanins was lower in grapes with infected skin compared to grapes with healthy skin (Tab. 1). Delphinidin 3-glucoside, petunidin 3-glucoside and malvidin 3-glucoside were more sensitive to the effects of the pathogen. It is suggested that the anthocyanins which were less susceptible to powdery mildew were those with a double substitution at the benzenic B ring. It is interesting to clarify whether the differential sensitivity is due to a direct action of the pathogen on the molecule, or whether it is related to a modification of the biosynthetic processes, especially because the concentration of reducing sugars was lower in infected grapes (178 mg/l) compared to healthy grapes (196 mg/l).

In Tab. 1 skins and wines of infected grapes display a relatively low anthocyanin content compared to healthy grapes.

The relative decrease of anthocyanins during fermentation is not significantly different in the two tests, indicating that the disease does not affect the stability of the anthocyanins during vinification.

Wines made from infected grapes had a higher level of caftaric and coutaric acids than control wines but the same level of GRP (Tab. 2). This could be due to the increased production of phenolic substances produced by the plant as a mechanism of defence against pathogenic attack (Langcake 1981; Pezet and Pont 1988; Jeandet and Bessis 1989; Jeandet *et al.* 1995).

Tab. 2 presents the spectrophotometric indices of the wines produced as an average of 3 runs. Wines made from infected grapes had a lower colour intensity associated with a higher tonality index and a lower concentration of total anthocyanins. Thus, it can be concluded that the pathogenic attack of grapes noticeably influences the results in the successive phases of vinification.

Conclusions: Grapes attacked by powdery mildew demonstrate a significant decrease in the concentration of anthocyanins compared to healthy grapes. The two

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Table 1

Influence of *Oidium tuckeri* on the anthocyanin content of skins and wines

	Skins		Wines*)			
	Healthy mg/kg	Infected mg/kg	Healthy mg/l	C.V. %	Infected mg/l	C.V. %
Delphinidin 3-glucoside	622	182	28	9.5	9	10.6
Cyanidin 3-glucoside	854	382	10	10.6	5	11.4
Petunidin 3-glucoside	659	185	50	9.7	17	9.2
Peonidin 3-glucoside	699	337	23	12.3	14	14.1
Malvidin 3-glucoside	1883	537	210	8.1	87	8.3

*) Average of three runs. C.V. – coefficient of variation.

Table 2

Composition of wines obtained from healthy and infected grapes

		Healthy grapes		Infected grapes	
		*)	C.V. %	*)	C.V. %
O.D. 420 nm		1.039	12.6	0.595	8.1
O.D. 520 nm		2.334	13.2	0.994	10.3
Colour density		3.373	13.0	1.539	9.4
Colour hue		0.445	0.9	0.632	2.2
Total polyphenols	mg/l	768	9.7	695	7.5
Total anthocyanins	mg/l	177	2.7	80	2.9
Caftaric acid	mg/l	18	2.4	25	2.1
Coutaric acid	mg/l	8	4.1	9	4.8
GRP	mg/l	10	1.8	10	2.2

*) Average of three runs. C.V. – coefficient of variation.

bisubstituted anthocyanins (cyanidine 3-glucoside and peonidine 3-glucoside) were less affected.

In particular, colour intensity was lower in wines obtained from infected grapes. Furthermore, these wines had a higher level of caftaric and coutaric acids, probably due to an increased production of phenolic substances by the plant as a reaction to the fungal attack.

Since colour characteristics are correlated with the quality of red wines (SOMERS and EVANS 1974), the lower concentration of anthocyanins and the lower colour intensity of the wines produced from infected grapes will have a negative effect on vinification.

Therefore it appears to be necessary to continue the studies on the relationship between pathogen attack and wine characteristics.

This study was supported by C.N.R. contribution number 932662: Influenza delle ampelopatie sulla composizione delle uve e dei vini.

References

ARFELLI, G.; CHIAVARI, G.; CASTELLARI, M.; AMATI, A; 1992: Influenza della tecnica di vinificazione sul contenuto di sostanze polifenoliche di vini ottenuti da uve di cultivars diverse. Vignevini **6**, 53-58.

JEANDET, P.; BESSIS, R.; 1989: Une réflexion sur les mécanismes morphologiques et biochimiques de l'interaction vigne-Botrytis. Account on morphological and biochemical mechanisms of vine-Botrytis interaction. Bull. O.I.V. **62**, 637-657.

- -; - -; SBAGHI, M.; MEUNIER, P.; 1995: Production of the phytoalexin resveratrol by grapes as a response to *Botrytis* attack under natural conditions. J. Phytopathol. **143**, 135-139.

LANGCAKE, P.; 1981: Disease resistance of *Vitis* spp. and the production of the stress metabolites resveratrol, alpha-viniferin, epsilon-viniferin and pterostilbene. Physiol. Plant Pathol. **18**, 213-226.

MARGHERI, L.; FALCIERI, E.; 1972: Importanza dell'evoluzione delle sostanze fenoliche nei vini rossi di qualità durante l'invecchiamento. Nota II. Vini d'Italia **14**, 501-511.

PEZET, R.; PONT, V.; 1988: Activité antifungique dans les baies de *Vitis vinifera*: effets d'acides organiques et du ptérostilbène. Rev. Suisse Viticult. Arboricult. Horticult. **20**, 303-309.

SINGLETON, V. L.; ROSSI, J. A.; 1965: Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents. Amer. J. Enol. Viticult. **16**, 144-158.

SOMERS, T. C.; EVANS, M. E.; 1974: Wine quality: correlations with colour density and anthocyanin equilibria in a group of young red wines. J. Sci. Food Agricult. **25**, 1369-1379.

SUDRAUD, P.; 1958: Interprétation des courbes d'absorption des vins rouges. Ann. Techn. Agricult. **7**, 203-209.