

Are Wines from Interspecific Hybrid Grape Varieties Safe for Allergic Consumers?

Andrea Curioni, Edward J. Brearley-Smith, and Matteo Marangon*

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The Problem. The sustainable production of grapes has become a major problem for the wine sector, mainly as a result of the enormous quantity of chemicals used to protect the vines from pathogens. Typically, most vineyards are treated 12–15 times per growing season, mostly with fungicides. It is estimated that, in Italy, the majority of all of the pesticides used in agriculture are employed in vineyards, leading to major sustainability issues for the environment, the economy of the wine industry, and the society in general.

PIWI Grape Varieties as a Solution. Recently, several fungus-resistant grape varieties (called PIWI from the German Pilzwiderstandsfähige) have been developed by marker-assisted selection and backcrossing with multiple varieties of *Vitis vinifera*, introducing genes giving different levels of resistance to the most common fungal pathogens, mainly downy and powdery mildews.¹ The resistance genes are mostly sourced from American (such as *Vitis labrusca*) and Asian grape species, as these show high levels of resistance to fungal pathogens.

Pathogenesis-Related Proteins. Although the biochemical mechanisms by which the expression of these genes leading to resistance are not completely known, it is reasonable to assume that they involve the accumulation of phytoalexins, such as stilbenoids, but also proteins, such as peroxidases and pathogenesis-related (PR) proteins, which are known to be key components involved in plant defense.² The main PR proteins found in grapes belong to PR-2 (β -1,3-glucanases), PR-3 (chitinases), PR-5 [thaumatin-like proteins (TLPs)], and PR-

14 [lipid transfer proteins (LTPs)] families. Although the expression of these proteins can be induced by biotic and abiotic stresses, most of them are constitutively expressed in grapevines to be found in healthy grapes.³ Indeed, American grape varieties have been shown to contain higher quantities of PR proteins compared to *V. vinifera*;⁴ therefore, it is conceivable that, at least in some cases, the higher resistance of the American varieties to pathogen attacks is also due to an overexpression of these proteins. PR proteins are also important for winemaking as they survive the vinification process to be found almost unaffected in finished wines, where they represent the main protein components. This results in several winemaking issues, including protein haze formation³ and tannin removal.⁴

PIWI Wines. Our recent findings indicate that six experimental wines made from PIWI grapes (Cabernet Cortis, Cabernet Noir, Cabernet Jura, Cabertin, Regent, and Rondo) grown in West Sussex (U.K.), had an average protein content of 133 mg/L (range of 113–152 mg/L), a value 3–4 times higher than that of red wines produced from *V. vinifera* (unpublished). Taken together, this information indicates that at least part of the resistance of PIWI varieties may be attributable to a higher expression of PR proteins deriving from the resistant non-*V. vinifera* parents and that, if this is the case, a higher quantity of PR proteins can also be expected in the wines produced from these hybrids, as demonstrated for some of them.⁴

PR Proteins Are Allergens. Plant PR proteins are main allergens in plant-based foods and beverages, accounting for about 25% of all plant food allergens and being responsible for extensive immunological cross-reactions between plant-derived foods, pollens, and latex.⁵ These PR proteins have been identified as allergens in a multitude of plant materials, including grapes.⁶ Because grape PR proteins survive vinification,³ they can elicit the allergic reaction also upon drinking the wine. In particular, it has already been shown that the main wine allergens are chitinases and LTPs, while TLPs

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play a minor role.⁶ Indeed, other studies confirmed the involvement of LTPs in wine allergy. As a result, LTPs is the only grape (and wine) allergen listed as Vit v 1 by the International Union of Immunological Societies (IUIS).⁷

From the analysis of red wine proteins by sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS–PAGE) (Figure 1), we consistently found that *V. vinifera* red wines did

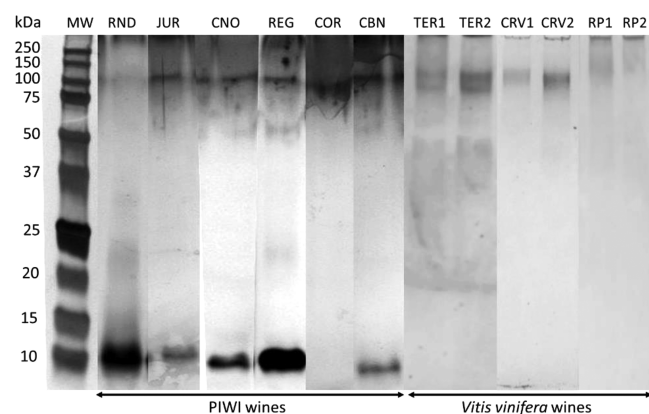


Figure 1. SDS–PAGE analysis of proteins of six PIWI (cv. Rondo, RND; Cabernet Jura, JUR; Cabernet Noir, CNO; Regent, REG; Cabernet Cortis, COR; and Cabertin, CBN) and six *V. vinifera* red wines (cv. Teroldego, TER1 and TER2; Corvina, CRV1 and CRV2; and Raboso Piave, RP1 and RP2).

not display bands with a mobility corresponding to that of LTPs (~9–12 kDa), suggesting their absence, at least in unmodified and free forms, in these wines. In contrast, apart from the COR sample, the protein profiles of PIWI wines were dominated by the presence of a strong band with a mobility of ~10 kDa. Although this band was not identified by mass spectrometry, it is almost certain that it corresponds to the grape LTPs.³

Final Comment. Resistant grape varieties are being increasingly planted worldwide, also in traditional winegrowing areas, but for these to become globally accepted several challenges still need to be faced, including legislative barriers along with wine quality and consumers' acceptance issues.¹ Given that resistant hybrid grape varieties seem to contain more PR proteins, which have been demonstrated to pass into the finished wines, it is possible that drinking these wines would be a problem for consumers allergic to plant foods, particularly those deriving from the Rosaceae family, whose main allergen is in fact a LTP.⁶ Therefore, research is needed to elucidate how the hybridization of *V. vinifera* with resistant species affects the level of PR proteins in wines, because this information will have potential implications not only for wine quality (e.g., protein stability and tannin retention) but also in terms of allergenic potential. Indeed, consumers are currently unaware of this risk. Hence, it should be recommended that, in general, every food product obtained from modifications involving the introduction of defense genes in the plant, also when achieved by the traditional method of crossing, should undergo an in-depth characterization in terms of allergenic potential, as is currently done for novel foods. In the case of PIWI wines, once the presence of higher amounts of allergens compared to traditional *V. vinifera* wines is established, technological intervention for their removal should be regularly adopted by winemakers to safeguard allergic consumers, especially those sensitized to the PR proteins of other plant

foods and, therefore, potentially cross-reacting with those present in wines.

AUTHOR INFORMATION

Corresponding Author

Matteo Marangon – Department of Agronomy, Food, Natural Resources, Animals and Environment (DAFNAE), University of Padova, 35020 Legnaro, Padova, Italy; orcid.org/0000-0001-5358-2428; Email: matteo.marangon@unipd.it

Authors

Andrea Curioni – Department of Agronomy, Food, Natural Resources, Animals and Environment (DAFNAE), University of Padova, 35020 Legnaro, Padova, Italy

Edward J. Brearley-Smith – Department of Agronomy, Food, Natural Resources, Animals and Environment (DAFNAE), University of Padova, 35020 Legnaro, Padova, Italy

Complete contact information is available at:

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Notes

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