

Exploring wine-making by-products: an overview of eight ways of valorisation for grape pomace

Grapes are a fruit commonly produced in Europe. In 2020, there were 2.2 million vineyards holdings for wine in the EU. Grapes are either consumed as fresh fruit, or processed, usually into wine. Europe is one of the most important producers of table grapes and wine, though the production varies enormously from one country to another.

Grape production holds economic value for two main markets: the food industry, and wine industry. In the food industry, grapes can be sold as fresh fruit or as raisins, but they also can be processed to produce juice, vinegar, etc. Both industries generate different types and large quantities of by-products: rotten grapes, for instance, are a by-product of harvesting, while wine production generates stalks, peels, grape seeds, etc.

The R-Resilient partners made the decision to focus their attention on grape pomace, which is one of the major by-products of winemaking (estimated to represent 10-13% of the initial weight of each grape). In addition the partners chose to explore the valorisation of grape pomace in 5 European regions where grape production and processing sector are either important at regional level or the valorisation of grape by-products is now investigated: Sud-Provence-Alpes Côte d'Azur, Auvergne-Rhône-Alpes in France, Emilia-Romagna in Italy, La Rioja in Spain and Central Macedonia in Greece.

Grape pomace (or grape marc) consists of the solid remains of the grape after the juice is extracted. Its major elements are grape skin, seeds and stalks. Grape pomace allows for the recovery of several products such as ethanol, tartrates, citric acid, grape seed oil, hydrocolloids, bioactive compounds, and dietary fibre, which highlights the diverse range of value-added components present in this by-product. However, as indicated by interviews with manufacturers, the mass and composition of these recovered products can vary depending on how grapes are processed.

The partners conducted a market analysis aimed at exploring new business opportunities in the valorisation of grape pomace. The study included a review of scientific literature available, data gathered through Mintel, an international database of product releases as well as interviews with 11 organizations, including different types of companies (SMEs and large companies), three research centres, and one university. This work allowed to identify eight main ways of valorisation of grape pomace in the regions covered by the study: food, pigment industry, feed, bioactive compounds, tartaric acid, energy, biomaterials and agriculture.

Grape pomace, a result of the winemaking process, can be used for various applications, including human consumption. Two valuable compounds extracted from grape pomace

seem to be particularly used in the **food industry**: pectin and grapeseed oil. The former finds applications not only in the food sector (as texture or gelling agent, for instance), but also in nutraceuticals, pharmaceuticals, etc. Similarly, thanks to its rich elements, grapeseed oil is used not only in food, but also in the pharmaceutical and cosmetics sectors. The major limitations of exploitation of both compounds come from the extraction technologies, which are numerous and have different impacts on the physicochemical and organoleptic characteristics of the biomass. The ability to increase the production capacity without incurring disproportionately higher costs or sacrificing quality (i.e., the scalability of the technologies), is also an issue raised by the manufacturers interviewed.

Grapes are rich in anthocyanins, which are responsible for their red and blue colour. Anthocyanins can be extracted, under certain conditions, to obtain **pigments**. The pigment industry is an additional way of valorisation, well explored by the literature and mentioned by industrials. However, this way of valorisation is limited by the fact that anthocyanins can be synthesised in laboratories. This process being more cost-effective, it reduces the motivation of the industrials to invest in technologies for extracting natural pigments from winemaking by-products. Moreover, the extraction of natural anthocyanins may use solvents, with a collateral environmental impact. Finally, extracting natural pigments requires significant investments, which limits the profitability of this activity.

Feed is a new way of valorisation of grape pomace. Grape pomace is a source of nutrients, it improves the digestion of animals, it has antioxidant effects, etc. However, this is considered a low value-added way of valorisation. Another limit lies in the presence of pesticides, which is a major health issue for animals.

The extraction of **bioactive compounds** is also an additional way of valorisation. Grape and its pomace are rich in polyphenol and phenolic acid, which are used in nutraceuticals, cosmetics or pharmaceuticals. However, the high extraction costs associated with isolating polyphenols and phenolic acids from grape pomace can pose a significant barrier to valorisation. Extraction processes often require specialized equipment, solvents, and skilled labour, contributing to the overall cost. In addition, the efficiency of extraction methods can vary depending on factors such as pomace composition, processing techniques, and desired product purity. Furthermore, as the prices of synthetic or non-upcycled molecules are often lower than those extracted from grape pomace, this reduce the economic attractiveness of valorisation efforts for industrials.

Grape pomace is rich in tartaric acid, which is used in several sectors, such as food, cosmetics, nutraceuticals, pharmaceuticals, etc. However, the extraction of tartaric acid from grape pomace also encounters a number of limits. The stabilization of the biomass is one of them. Moreover, some polyphenol or AHAs can be synthesized, limiting the quantity of by-product processed. Finally, end-user markets (cosmetics, nutraceuticals or pharmaceuticals) are niche, accounting for little recovery in terms of quantity (tonnage).

Three ways of valorization are currently emerging and niche: **energy, biomaterials and agriculture**. Grape pomace is rich in sugar, which can be transformed under certain conditions into bioethanol, used therefore as biofuel. The main challenge with using grape pomace for methane production lies nevertheless in its low anaerobic biodegradability, which consequently leads to lower economic yields. Biomaterials are emerging from the scientific literature review and interviews with industrialists. Grapes possesses a number of interesting properties, including the resemblance to animal leather and their potential for use in the fashion industry. Thus, they can be an interesting substitute for animal-based products, though the market remains still very limited. Agriculture is the last way of valorization explored in the report. Grape pomace has beneficial properties for soil health and fertility, when used as an organic soil amendment. Biochar, a residue of pyrolysis of grape pomace, is an interesting way of valorisation, such as illustrated by the Vinichar project, identified in France. The manufacturing of grape biochar is nevertheless limited by the access to raw materials and the costs incurred by farmers.

Would you like to receive more information about apple by-products recovery in the regions targeted by the B-Resilient partners?

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