



## Towards integral utilization of grape pomace from winemaking process: A review



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### ARTICLE INFO

#### Article history:

Received 23 February 2017

Revised 27 June 2017

Accepted 12 July 2017

Available online 19 July 2017

#### Keywords:

Sustainable winemaking

Grape pomace

Dietary fibre

Grape seed oil

Phenolic compounds

### ABSTRACT

Grape is the main fruit crop in several countries. Although many grape-based food products can be found in the market, studies have shown that around 75% of the world grape production is destined for the wine industry. Grape pomace is an abundant by-product from the wine industry, which consists of the remaining skin, seeds and stalks and represents around 25% of total grape weight used in the winemaking process. In countries such as Italy, France and Spain, where wine production is more relevant, the annual grape pomace generation can reach nearly 1200 tonnes per year. In order to reach a sustainable winemaking process there is a need of a waste reduction policy. Several studies explore this subject using grape pomace as a source of healthy and technological compounds that could be applied in animal feed, pharmaceutical, cosmetic or food industry to improve stability and nutritional characteristics, and in cosmetic industry, where grape seeds oil is widely used. This review aims to approach the recent winemaking scenario and the benefits achieved when a waste management policy is implemented, as well as to compare available extractive technologies and a wide alternative of uses for grape pomace.

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## 1. Introduction

Grape (*Vitis* spp.) is one of the most valued conventional fruits in the world (García-Lomillo and González-SanJosé, 2017). It can be consumed raw or can be used in the formulation of products such as wine, jam, juice, jelly, raisins, vinegar and seed oil. Grape crops are one of the main extended agro economic activities in the world with more than 50 million tons produced every year, of which more than 20 million tons correspond to European producers (FAOSTAT, 2014; Scoma et al., 2014). Taking into consideration the whole grape production, approximately 75% is utilized into wine-making (Zhu et al., 2015), being global wine production around 27 billion litres a year (Amienyo et al., 2014). The three main wine producer in 2014 were France (4,670,100 L), Italy (4,473,900 L) and Spain (3,820,400 L) (FAOSTAT, 2014) (Fig. 1).

The most commonly cultivated species for wine production is *Vitis vinifera* (Devesa-Rey et al., 2011). The wine health benefits were introduced in 1990s due to the theorized “French paradox”, when the high consumption of red wine in France reduced the prevalence of coronary heart diseases even with a traditional consumption of large amounts of saturated fats and sugar. Studies believed that this paradox was due to the phenolic compounds present in wine (Renauld and Lorgeril, 1992).

From then on, wine consumption has increased over the years and, along with that, the concomitant increase in grape pomace production has been drawing attention. Grape pomace is the main solid organic waste from winery industries; resulting from the pressing and/or fermentation processes it is generated in large amounts in many parts of the world (Abarghuei et al., 2010; Christ and Burrit, 2013; Cuccia, 2015). The main components of grape pomace are seeds and skin. Studies have shown the potential of phenolics and antioxidant fibres recovery from skin (Chamorro

et al., 2012; Duba et al., 2015; Beres et al., 2016), as well as oil recovery from the seeds (Bail et al., 2008; Fernandes et al., 2013; Fiori et al., 2014). However, there is still a long way to go until all these residues gains a factual recovery pathway, making the winemaking process a more sustainable activity. In this way, this review presents the main components of grape pomace, together with some extraction pathway and current applications for them, aiming to decrease the negative environmental impact of underutilized grape pomace.

## 2. Winemaking process and pomace generation

### 2.1. Sustainability issues into the winemaking process

A sustainable winemaking process consists of maximizing resources and decrease emissions generated by the production process (Castillo-Vergara et al., 2015; Cuccia, 2015). On a global scale, wine sector is responsible for around 0.3% of annual greenhouse gases (GHG) emission (Amienyo et al., 2014).

Carbon footprint is a worldwide standardized indicator of GHG emissions all over the life cycle phases of any goods, service or activity in accordance with the Kyoto Protocol and Life Cycle Thinking statements. The increase in the consumer interest concerning environmental profile of products, particularly those linked to the food and beverages sector, together with the pressures from local communities and governments, has started a race to propagate environmentally relevant results in order to improve consumer satisfaction. The concern regarding increases in GHGs with the potential to modify regional climate patterns has encouraged many firms to move towards sustainable grape culture and wine production practices (Rugani et al., 2013; Cuccia, 2015; Da Ros et al., 2016).

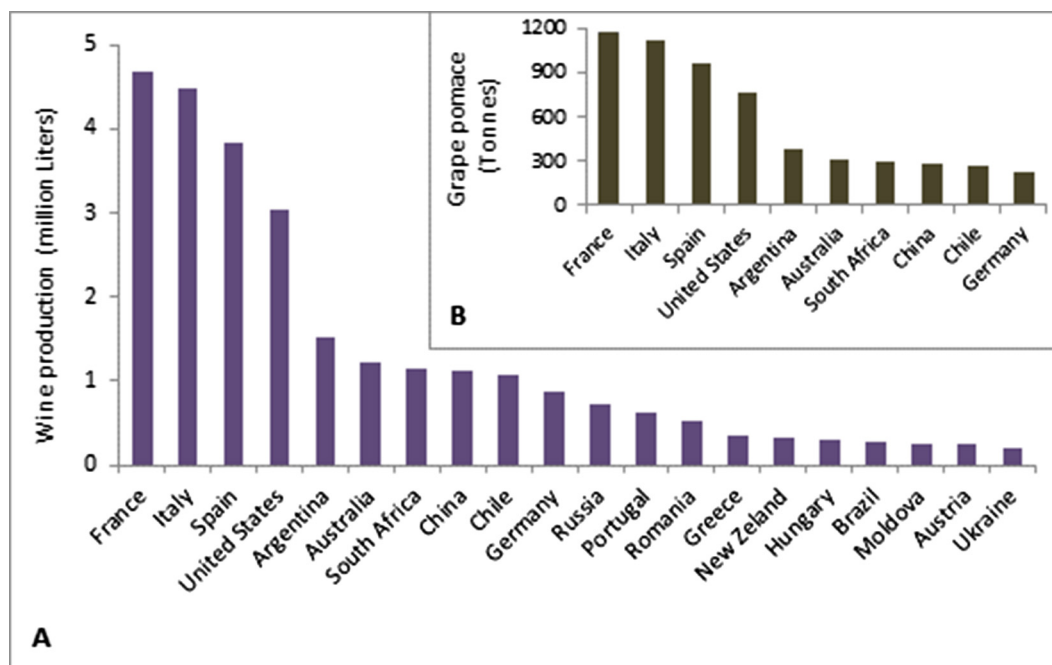


Fig. 1. World wine (A) and grape pomace (B) production by country in 2014, considering that 25% of wine production is pomace (Adapted from <http://www.wineinstitute.org/resources/statistics>) (Wine Institute, 2014).

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