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Valorisation of Grape Pomace: Transforming Winemaking Waste in to Nutritional and Economic Opportunities

Ramya C. S.*, Parvathy Nayana N., Prajwal R. and Sripriyanka S. Nalla
Ph.D. Scholar, Division of Agricultural Engineering, ICAR-IARI, New Delhi
*Corresponding Author: ramyacs8369@gmail.com

Grape (Vitis spp.) is one of the most valued conventional fruits in the world. It can be consumed raw or used in the formulation of products such as wine, jam, juice, jelly, raisins, vinegar, and seed oil. In India, grapes grow in an area of 162.34 hectares with a production of 3.4 metric tonnes and a productivity of 21.50 MT per hectare (indiasta.com). Considering the entire grape production, approximately 75% is utilized for wine-making (Zhu et al., 2015). During wine processing, a significant amount of non-edible residues, known as grape pomace waste (including seeds, skins, leaves, and stems), is produced by the wine industry. This waste leads to environmental pollution, management challenges, and economic loss. After pressing and fermentation, approximately 20 to 25% of grape pomace is generated during winemaking. For every 6 liters of wine produced, around 1 kg of grape pomace is generated. This pomace comprises approximately 10 to 12% grape skins and pulp, 3 to 6% grape seeds, and 5 to 7% stem (Favre et al., 2019), contributing to roughly 62% of the organic waste. Furthermore, High useful components such as phytochemicals like phenolic acids, flavonoids, anthocyanins, and lipids, and structural polymers like cellulose and hemicellulose have been found in winery wastes.

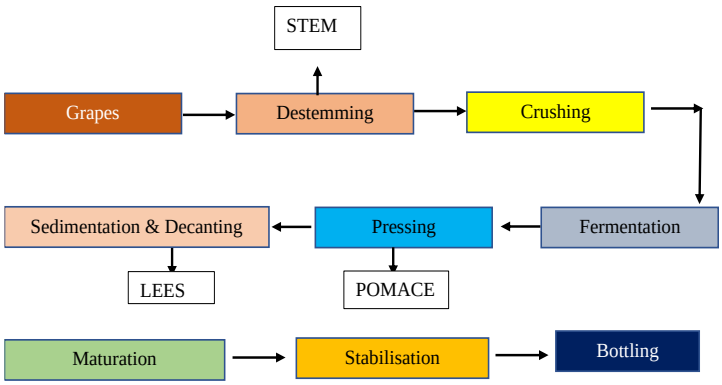

Fig 1: Grape pomace derived from the wine making process (Red grapes)

Grape pomace

Grape pomace, the primary solid organic waste produced by the winery industry during pressing and fermentation processes, is generated in large quantities worldwide. It is recognized as a rich source for extracting a wide range of polyphenols, which exhibit various bioactivities such as antioxidant, anti-inflammatory, and anti-cancer properties. These polyphenols are also beneficial in alleviating metabolic syndrome and regulating intestinal flora. The health effects are largely attributed to polyphenol metabolites, which are formed from grape pomace phenolics through complex metabolic processes in vivo. On the other hand, it has been used as fertilizer or as animal feed.

Grape pomace mainly consists of two fractions: (i) seedless pomace, which includes skins, residual pulp, and stems, and (ii) the seeds themselves. The main components of these fractions are dietary fiber and oil, respectively. Moreover, both fractions are rich in various bioactive compounds. Notably, anthocyanins, which are phenolic compounds found in the skins, and flavanols, which are concentrated in the seeds, are of significant importance.

Table 1: Average chemical composition values related to grape pomace (FM, fresh matter; DM, dry matter) (Bordiga et al., 2019)

Component	Pomace
Dry matter (g/kg FM)	329–490
Ash (g/kg FM)	18–24
Organic matter (g/kg DM)	827-959
Total sugars (g/kg FM)	150-330
Neutral detergent fibre (g/kg DM)	569-626
Acid detergent fibre (g/kg DM)	480-543
Acid detergent lignin (g/kg DM)	320-388
Total dietary fibre (g/kg FM)	190-380
Total nitrogen (g/kg DM)	10-17
Lipids (g/kg FM)	4-10
Condensed tannins (g/kg DM)	
Free	16–38
Fibre-bound	19–34
Protein-bound	56–131
Total	91-203

1.1 Phenolic compounds from grape pomace and its application

The phenolic compounds like Hydroxycinnamic acid (*P*- coumaric acid, caffeic acid, ferulic acid, sinapic acid), Hydroxybenzoic acids (protocatechuic acid, gallic acid, syringic acid, gentisic acid), Flavonoids (Fkaempferol, quercetin, myricetin, catechin, epigallocatechin, gallocatechin,

anthocyanins), Stilbenes and tannins are extracted from grape pomace (Beres et al., 2017).

Applications

Grape pomace extracts can be utilized in various industries, including food, pharmaceuticals, and cosmetics, in forms such as liquid extracts, concentrates, or powders. These extracts are particularly valuable in food preservation due to their antioxidant properties, which help prevent lipid oxidation in fish-based products. While the dietary fibre is provided as supplement; used in biscuits and snacks to improve alternative source of antioxidants. On the other hand, it is also using in biodegradable packaging and bio-methane production etc. Whereas phenolic compounds play important role in extending the shelf life of meat, acrylamide formation reduction, reduction of cholesterol level, fining agent for reducing the level of tannins and animal feed.

The grape seed oil was found many applications in cosmetic formulation, active packaging, to modify the meat products formulations, energy production, biodiesel, skin moisturiser gel and in the animal feed.

Grape pomace powder as a fortifying agent

The procedure for production of pomace powder is as follows (Baldan et al., 2021)

Pomace of red grape

↓

The grape pomace samples were conventionally dried to specific temperature and duration

↓

Then all samples were ground with a hammer mill till the particle size reached

↓

The completely floured samples, were vacuumed in packages with a barrier property.

Grape pomace powders (GPP) were produced and incorporated into a gluten-free premix designed for culinary use. It is incorporating as fortifying agent which replace the little amount of whole wheat flour (upto 25%). For example, addition GPP (15% and 25%) into the muffins enhanced their nutritional composition, particularly by increasing protein and crude fiber content. These muffins also received a good level of acceptability from consumers. Considering that grape pomace is a by-product discarded by wineries, it has potential added value and can be feasibly used as an ingredient in gluten-free muffins (Baldan et al., 2021). Furthermore, GPP increases the polyphenolic content and textural stability of cookies during storage time. Moreover, in case of bread, the GPP shows negative effect on colour and texture of product. GPP also decreases the lipid oxidation and inhibits the microbial growth in the pork burger, pork loin marinade, and pork sausage.

Animal Feed

Adding grape pomace to cow feed increases the concentration of polyunsaturated fatty acids (PUFA) in milk and alters the composition of the rumen bacterial community, thereby enhancing cow health. Increasing grape pomace in broiler diets boosts the immune response and antioxidant levels in broiler chickens while reducing feed cost per kilogram of live weight. However, no effects on chicken performance were observed.

Conclusion

Grape pomace, a significant by-product of winemaking, presents environmental challenges and economic losses due to its disposal. However, it is a rich source of bioactive compounds, such as polyphenols, which have numerous health benefits and industrial applications. These compounds can be extracted for use in food preservation, pharmaceuticals, and cosmetics. Additionally, grape pomace can be used as a fortifying agent in gluten-free products and as animal feed, enhancing the nutritional profile and health benefits of these products. By converting this waste into valuable products, the wine industry can mitigate environmental impacts and create economic opportunities.

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