

Conceptual Editorial

Wine has a rich history of preparation and consumption dating back thousands of years, with its earliest traces so far discovered in 6000 BC in Georgia as revealed by the ancient scriptures like the Rigveda and the New Testament, and the literary writings. Not only this, it is regarded as a gift from God, describing as a divine fluid in Indian mythology. Admittedly, except for water and milk, no other beverage has earned such universal acceptance and esteem throughout the ages as wine. It has been a part of the human diet ever since his settlement in the Tigris–Euphrates Basin. The Codex Alimentarius Commission has defined the wine as a food : which means any substance, whether processed, semi-processed, or raw, which is intended for human consumption, and this includes drink. Preparation of wine though accidently, is an important method of preservation and preparation of perishables and to make a product with appealing qualities, even today.

Wine is a completely or partially fermented juice of grape, but fruits other than grapes, like apple, plum, peach, pear, berries, strawberries, cherries, currants, apricots, etc., have also been converted into fruit wines. The process of wine-making is unique in the sense that nearly all the physical, chemical, and biological sciences, especially microbiology and biochemistry, contribute to its production though in the beginning the man was not aware of any science involved in its preparation. Now, it is established that the yeast *Saccharomyces cerevisiae* var. *ellipsoideus* is the microorganism on whose activity the production of wine or any other alcoholic beverage depends upon. The fruits used in wine-making are fermented using this yeast and aged in wooden barrels to improve the taste and flavor quality.

Similar to the wines made from grapes, there are different types of fruit wines depending upon the method of preparation; the raw material (type of fruits) used, the vinification practices and the intended product. Most of the fruit wines are still wines, as they retain no carbon dioxide produced during the fermentation, in contrast to sparkling wines which have substantial quantity of carbon dioxide. Similarly, most of the fruit wines are sweet in taste and are generally grouped into the category of dessert wine. The wines from non-grapes have been accepted people from various countries. Globally, cider is popular throughout the Europe, *apfelwein* in Germany and Switzerland, while plum wine is quite popular in Germany and Pacific Coastal states, Japan, Korea, and China.

From grapes, various types of wines such as vermouth, sparkling wine, and sherry are prepared, but the research on non-grape fruits is scanty. Can such types of wines be prepared from stone fruits also? Considering the quantity of fruit production, especially of the non-grape fruits, there seems to be a considerable scope for wine production. It could lead to a diversify--cation of the products available to the consumers. It can be an important tool for reducing the post-harvest losses in the developing countries, which usually range from 20% to 30%. In these countries, production of wine could soak excessive production of fruits. It is undisputable that wine is the most important tool for value addition to horticultural produce like the sand pear, which as such commands a small market, but its wine (vermouth) fetches many times higher price. Thus, unless the processing industry is linked with the horticultural industry, it is unlikely to achieve any worthwhile results either for the farmers or for the consumers. Setting up of fruit wineries, in addition to industrialization of the fruit

growing belts, could result in economic upliftment of the people, generating employment opportunities and providing better returns to the orchardists for their produce. The availability of raw materials and technology is the most important factor determining production, although production technology for different types of wines, research and development support for troubleshooting, state policies including tax structure, industrial prioritization, prohibition, advertisement, consumer response, market behavior, and export potential, cost and type of product are other significant considerations in popularizing the product.

The suitability of various fruits other than grapes for preparation of wines of various types needs to be carried out. Most fruits have several varieties with a large range of color, flavors and nutritive values besides the antioxidant content that gives an excited opportunity for production of wine from non-grape fruits. However, whatever evaluation is carried out is too meager and the findings are scattered here and there rather than being carried out in systematic manner as is the case of wines from grapes. Another important element is the proper quality of raw materials and for this the proper knowledge of harvesting date of the fruits is a must. Fruits of proper maturity are important as fine-quality wine can be made from fruits with a proper sugar–acid balance. Even the best varieties of fruits give inferior quality of wine if not harvested at proper maturity. It is known that the aroma of wine depends largely on the variety of fruit but yeast strains used for fermentation also modify the sensory qualities by forming flavouring components especially esters and higher alcohols at various concentrations. Yeasts are also capable of producing hydrogen sulfide, which is undesirable as it imparts a undesirable flavor to the wine, here it is equally important to have a yeast strain with desirable properties to make wine. It is a hot area of future research.

Several developments in the wine production from grapes have been demonstrated, like the use of enzymes in juice extraction, flavor improvements, and continuous fermentation using bioreactor technology. There has been a considerable interest in the use of enzymes, notably glucosidases, to release flavor compounds bound in the fruit and in the use of cell and enzyme immobilization in wine production in batches as well as in continuous fermentation systems. However, their possible applications in wine production from non-grape fruits need serious consideration, though some efforts in this direction have been made. In the past few decades, significant advances have also been made in the standardization of wine quality and safety by introducing new techniques for the analysis of the various types of phenolics and aromatics that affect the characteristics of wine and the increased understanding of the factors influenced by vineyard practice and wine aging. There is also an increasing awareness of the disadvantages of overly protecting the juice from the minimal oxidation that occurs during crushing, racking, and other wine-making practices. This is particularly reflected in the reduced use of sulfur dioxide before and after fermentation. In addition, there is growing interest in the use of several yeast strains to induce fermentation, to produce some of the perceived benefits of spontaneous fermentation while retaining the safety of induced fermentation. Inoculation with one or more strains of lactic acid bacteria is also becoming a common practice to induce malo-lactic fermentation. Some of the fruits used in wine-making are highly acidic and the use of biological de-acidification (using malo-lactic bacteria or de-acidifying yeasts like *Schizo pombe*) is another approach that has given encouraging possibilities in plum fruit.

Several developments in the production of wines from pome fruits, such as the use of *S. cerevisiae* along with malo-lactic bacteria in immobilized form in a bioreactor to produce cider of improved flavor, and the wines

from other pome fruits have been made. But despite the efforts made and described here, there are a large number of research gaps which could be a potential area for the future research. Similarly, preparation and evaluation of different types of wines, such as vermouth, sparkling wine, sherry, etc. from non-grape wines could be carried out to diversify the products from these fruits. The relationship between the flavour attributes and chemical constituents changes during vermouth production and maturation need to be explored. Production of sparkling wines has a significant potential from some non-grape fruits, especially plum and apple and the foaming properties are significant parameters in the quality of sparkling wine.

A crisp overview of the research work carried out on stone fruit wines would also reveal clearly that quite good base has been on wine production from these fruits but similar to pome fruits there are still a large number of research gaps, which need more elaboration in the future. Application of yeasts other than *Saccharomyces* in the production of wines as such or in combination could be another area of future research. The use of enzymes in juice extraction, flavor improvements, continuous fermentation using bioreactor technology, and their possible applications in stone fruits wine production are some of the areas that need serious consideration. The future could also see the usage of biological de-acidification using malo-lactic bacteria or de-acidifying yeasts like *Schizo. pombe*.

Tropical fruits around the globe, are especially favorable for wine production. Their unique flavor, attractive fragrance, and color make them highly desirable. In the future it will be necessary to conduct more studies on more varieties available in India regarding the physic-chemical composition, volatile composition, and especially health beneficial effects of wines from such tropical fruits.

Citrus fruits especially orange and mandarin fruits hold promise to make wine, being a good source of flavor, color, vitamin C, carotenoids, and flavonoids, and the wines made from such fruit could become a good source of such components, being associated with healthful properties. The brief overview of the research revealed only scattered work on orange and kinnow. So there is a great need to carry out in-depth and systematic studies on various aspects of the wine-making process especially effect of different yeast strains, de-bittering treatment, maturation with wood or otherwise, antioxidant activity etc.

Being rich in medicinal properties, non-grape fruit-based wines and vermouths have a wide scope in the field of enology. Systematic research at both academic and industrial level is required to be strengthened for the commercial productivity of vermouths produced from different fruits. In addition, through the incorporation of healthy compounds, the image of the alcoholic beverages can be improved.

A typical wine contains ethyl alcohol, sugar, acids, higher alcohols, tannins, aldehydes, esters, amino acids, minerals, vitamins, anthocyanins, and flavoring compounds. Being fruit based, fermented, and un-distilled, wines retain most of the nutrients present in the original fruit juice. Efforts have been directed in the past to find out ways and means to improve the useful components in wine from grapes and eliminate those that are toxic to human health. Similar efforts for non-grape wines are also need to be made in the future. An appraisal of methods of vinification and other factors in wine making have been made, but how these practices influence the composition and nutritive value of wines has not been evaluated so far, and is an interesting and useful aspect of research in the near future.

It has been used as a medicinal or therapeutic agent and served as an important adjunct to the human diet by increasing satisfaction. Wine contains some minerals, vitamins, sugars, acids, phenols, and small quantities of the B vitamins but is devoid of vitamins A, D, and K. In the past, the addition of spices and herbs to wine was a common practice, both for flavor and for medicinal or aphrodisiacal properties and it was also used in wound dressing, served as a nutritious dietary beverage, as a cooling agent for fevers, as a purgative, and as a diuretic as documented by Hippocrates of Cos (460–370 BC). Thus, moderate alcohol and/or wine consumption protects against the incidence of many diseases of modern society like cardiovascular diseases, dietary cancers, ischemic stroke, peripheral vascular disease, diabetes, hypertension, peptic ulcers, kidney stones, and macular degeneration, in addition to stimulating resistance to infection and retention of bone density. The healthful benefits of wine are due to the antimicrobial activities of ethanol and antioxidant properties of phenolics and flavonoids. Glucose tolerance factor (GTF), a chromium-containing compound that is synthesized by yeast and considered beneficial in the cure of diabetes, is also found in wine.

The wine-making process releases many of the bioactive components into the aqueous ethanolic solution, thus making them more biologically available for absorption during consumption. Wines from grape have been associated with antimicrobial and antioxidant activities. With regard to the fruit wines, however, there is large scarcity of such type of information though there are some reports including that from stone fruits, and the wines from apple, cherry, citrus on the antioxidant activity and antimicrobial activities of wines. Most of the antimicrobial effects of wine have been attributed to phenolic compounds such as *p*-coumaric acid, particularly active against Gram-positive bacteria, whereas other phenols inhibit Gram-negative bacteria. Even efforts are being made to make wine with that medicinal values such as that from *Amla* or that from apple with additional extract from plants having medicinal value, wine is a particularly rich dietary source of flavonoid phenolics, including resveratrol that could reduce coronary heart disease (CHD) mortality (by its ability to inhibit platelet aggregation, eicosanoid synthesis, oxidation of human low-density lipoproteins reduce serum lipid levels) and can prevent or inhibit cellular events associated with tumor initiation, promotion, and progression. Detailed determination of medicinal, therapeutic, nutritional values of fruit wines could certainly be a fruitful area of research, especially in those countries and regions where cultivation of non-grape fruits is practiced commercially.

Alcoholic beverages derived from fruits present a wide research field, combining tradition with innovation, either using fruit not considered before or using traditional fruit in different ways. Better characterization and increased knowledge of so-called exotic fruit has already allowed the generation of aromatically appealing new products. Even though of the most exotic-fruit alcoholic beverages are consumed in the countries they are produced, globalization could boost their international trade.

Like in other food industries, the waste from wine and brandy is highly polluting, but rich in several useful constituents, which are recoverable. Solid wastes such as fruit skin, seed, pulp, peels, and stems often emerge as a considerable disposal problem for the beverage industry and characterized by the heterogeneity of their sources, variations in their chemical composition, and microbial instability. Rich in antioxidants, pectin, fibers, carbohydrates, organic acids, mineral salts, food flavors, and colorants, these compounds can be utilized as substrates for secondary processes or as ingredients for novel products. The most popular products derived from the waste are animal feed, bio-fuels, biopolymers, fertilizers, and ingredients for novel foodstuffs.

Development of effective recycling techniques requires effective tapping of the maximum potential of the unavoidable fruit wine waste components including effective large-scale processing technologies such as engineering of large-scale extraction techniques facilitating recovery of the desired materials like bioactive compounds. Integrated aerobic and anaerobic processing has been successfully used in brewery waste treatment. Yeast biomass, which is the main component of lees, has long been used in food and flavor industries in dried form. Although different applications include the recovery of ethanol, production of polyphenolic compounds, fertilizer, l-lactic acid production, and biogas, the waste lees appear as an undervalued by-product so far. Finally, the biorefinery approach for valorization of wine lees has been proposed with production of poly-hydroxy-alkanoates at the final stage. However, many of these products and their methods of production are at lab scale and need to be scale up.

To monitor and ensure the quality of wine, new techniques have emerged, including the use of molecular biology techniques like polymerase chain reaction. In future, these techniques are likely to be used more frequently, such as in direct profiling of yeast dynamics in wine fermentation especially the use of molecular techniques.

Many times, it is argued that there may be few consumers of non-grape wines, but the variety of apple wine, cider, kiwi wine, and plum wine clearly spells out a big market for non-grape wines, provided these are of proper quality and priced within an acceptable range for the consumers. The explosion in information technology and introduction of satellite communications via the Internet and television have already eliminated the boundaries between countries and regions and have resulted in the globalization of wine.

In an overview, it is apparent that the fruit wines production has great potential and a bright future.

Prof V.K. Joshi

Adjt Professor, Shoolini University, Solan
Consultant CSIR, Palampur
Prof and Head (Rtd),
Dept. FST, Dr Y.S.P UHF, Nauri, Solan (HP), India