

Fermenting fruit juices: Exploring new possibilities beyond wine

There is a paradigm shift happening in the fermentation technology of fruit juices to accommodate growing demand on alcohol reduction, enhancement of organoleptic qualities, shelf life and functional attributes. Low alcoholic wines, probiotic fruit juices, fortification with parabiotics etc. are technologies to develop the above attributes. Indian public sector research organisations have come out with promising technologies suitable for up scaling by the industry.

TRADITIONALLY, the term ‘fermented fruit juices’ is synonymous with their respective wines. Although wines are unarguably proven as a healthy beverage, their alcoholic nature has raised concerns on their acceptance as a daily drink, and threat on alcohol related health issues. Most of the fruit wines are characterised by 7-15% ethanol. Drinking in moderation to consume not more than 2-4 units of ‘standard drink’ (14 g ethyl alcohol) is the recommendation by several health agencies, considering the toxic effects of ethanol. There are several alternative foods developed through research to reap the fermentation derived benefits, but with little harmful microbial metabolites in them.

Low alcoholic and zero alcoholic wines

The World Health Organisation’s global alcohol strategy called on the alcohol industry to contribute to reducing the harmful use of alcohol by addressing the composition of the products. This approach could be supported by production and marketing of low alcoholic and zero alcoholic wines.

Several strategies are followed by wine makers to reduce the alcohol content in wines. In the pre-fermentation stage, this may be achieved partly through reduction of fermentable sugars in the grapes by early harvest or removal of sugars through membrane filtration and enzyme treatments. During fermentation process, the type of yeast is the decisive factor for ethyl alcohol levels. In general, *non-saccharomyces* yeasts produce low amount of alcohol than the universally employed starter culture *Saccharomyces cerevisiae* in wine industry.

Most of the commercially available low and zero alcoholic wines reduce the alcohol content in the final product through adopting an additional dealcoholisation process after the completion of fermentation steps. The membrane filtration technologies and reverse osmosis have been used in the removal of alcohol from wines. Thermal distillation represents the most common and widely used commercial techniques in the production of

dealcoholized beverages. However, the postfermentation alcohol removal poses the challenges such potential loss of antioxidants, sensory qualities as well as self-preservation properties inherently present in wines by virtue of ethyl alcohol present in wines.

Apart from fruit juices, the byproducts with low sugar content, but rich in phytochemicals, are also investigated for their utility in production of low alcoholic wines. Indian patent has been granted to ICAR for a process for preparation of alcoholic beverage with nutraceutical properties from kinnow peels in 2020; while another patent on mutant yeast strain for producing low-alcoholic debittered beverage was granted to PAU, Ludhiana in 2023.

Fruit juice fermentation by probiotic yeasts

Probiotics are the microorganisms which impart beneficial health effect upon consumption. These benefits include improved gut health, micronutrient supplementation, improved immune function besides several strain specific beneficial effects. Complex mixture of metabolic products secreted by probiotics such as enzymes, secreted proteins, short chain fatty acids, vitamins, biosurfactants, amino acids, peptides etc., also confer health benefits to the host. It has been established that bacterial metabolism improves the antioxidant content of fruit juices, increase the quantity and enhances the bioavailability of micronutrients through the *de novo* synthesis and biotransformations.

Several species and strains of yeasts have been recognized as excellent probiotics. Though consumed mainly as dietary supplement in present times, their incorporation to food is also actively researched by food industry. *Saccharomyces boulardii* is one such probiotic yeast species with beneficial health effects that has been studied regarding its potential for use in the development of innovative functional beverages. Other probiotic yeasts include certain strains of *Pichia pastoris* and *Kluveromyces marxianus*.



Probiotic beverages developed at ICAR-IIHR

Quality parameters of fruit beverages is rapidly evolving due to the better understanding of gut health and prebiotic roles of dietary fibres present in fruits. During earlier days, clarification was almost an essential step practised in fruit juice industry. The recent trend is to retain the fibre content and pulpiness of the fruits in the final beverage. Prebiotics are substrates that are selectively used by gut microorganisms to produce a health benefit. Fruit-derived carbohydrate compounds called oligosaccharides as well as resistant starch are the main source of prebiotics that have been identified. Specifically, fructans and galactans are two oligosaccharide sources which have been found to stimulate the activity and growth of beneficial bacterial colonies in the gut. Fructans are a category of carbohydrate consisting of fructooligosaccharides (FOS) and inulins, while galactans consist of galactooligosaccharides. Other dietary fibers, such as pectin, beta-glucans and xylooligosaccharides also fit the definition of prebiotics. The richness in prebiotic components and fermentable sugar makes the fruit juices as an ideal medium for the growth of probiotic microorganisms. Probiotic fruit juices have great market potential across the globe due to vegan food styles, lactose intolerance, cholesterol free nature etc. offered by them. Probiotic fruit juices are commercially available using the strain *Lactobacillus plantarum* 299V.

ICAR-IIHR, a premier horticultural research institute of the country, have identified certain probiotic strains suitable for fruit juice fermentation, and has come out with

processes for different probiotic fruit juices with acceptable organoleptic properties. These products include probiotic juices from mango, pineapple, pomegranate, carrot, aonla, guava, kiwifruit, jamun etc. A few of such processes for probiotic beverages production have been already identified as licensable technologies. These beverages have shelf life ranging from two to three months at low temperature storage, and have more than one billion probiotic cells during the recommended shelf life as per FSSAI standards.

SUMMARY

Food fermentation is practised since time immemorial; and fruit juices are ideal substrates for fermentation. There is a paradigm shift happening in the fermentation technology of fruit juices to accommodate growing demand on alcohol reduction, enhancement of organoleptic qualities, shelf life and functional attributes. Low alcoholic wines, probiotic fruit juices, etc. are technologies to develop the above attributes; and the public funded research organisations have come out with promising technologies suitable for up scaling up by industry.

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