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DEVELOPMENT, OPTIMIZATION, AND QUALITY EVALUATION OF PINEAPPLE-HIBISCUS (ANANAS COMOSUS-HIBISCUS SABDARIFFA) FUNCTIONAL FRUIT WINE

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ABSTRACT

Fermented beverages diversification based on the other substrate sources different from grapes provides a promising strategy for the functional and value-added products. In the present study we show the formulation, optimization and overall characterization of a new pineapple-hibiscus wine derived from *Ananas comosus* and *Hibiscus sabdariffa*. Pineapple juice, which has high levels of fermentable sugars, a moderate level of acidity and an appealing aromatic composition, was selected as a monoculture substrate while hibiscus petals were used as an anthocyanin-, organic acid- and bioactive compound-rich natural additive, to complement the physicochemical and functional properties of the wine.

The fermentation was controlled and was completed with the yeast *Saccharomyces cerevisiae* (optimally sugars and pH and temperature). Sugar utilization by the fermentation process was efficient, resulting in drops in total soluble solids from ~20°Brix to 3.4°Brix, a reduction in pH from 3.7 to 3.1, and a 12.4% (v/v) alcohol yield. The incorporation of hibiscus drastically improved chromatic characteristics, giving a stable red colour, and increased antioxidant capacity due to phenolic and anthocyanin compounds.

Sensory profiling showed excellent organoleptic performances, with very high values for colour, aroma and overall acceptability, implying a balance between sweetness, acidity and floral notes. This synergistic interaction of pineapple and hibiscus contributed to better stability, flavour complexity and consumer acceptance than traditional fruit wines.

Conclusion: This research provides an evidence that a tropical fruit wine with better nutritional values, pleasant features and commercially acceptable can be produced. The results highlight exploring under-utilized fruits and botanicals with known health benefits through fermentation technology to formulate new functional beverage while providing sustainable agro-processing and post-harvest loss management.

KEYWORDS: Pineapple Wine, Hibiscus, Fruit Fermentation, Functional Beverage, Anthocyanins, Sensory Evaluation

INTRODUCTION

The great potential of fruit wines as novel and alternative types of wines that differ from traditional grape wines in sensory profile and nutritional properties has highlighted their suitability for value addition. The rise in interest of functional

and naturally derived beverages has propelled investigation of non-traditional substrates, particularly tropical fruits, for wine production. Pineapple (*Ananas comosus*) has emerged as a prospective raw material due to the characteristics that provide a high fermentable sugar content,

optimal acidity, and a unique aromatic profile, that have favourable considerations for the fermentation process as well as the organoleptic properties.

Hibiscus (*Hibiscus sabdariffa*), also known as roselle, is known as a rich source of anthocyanins, flavonoids, organic acids, and other bioactive compounds. These constituents are also responsible for increased colour intensity, antioxidant activity, and microbial stability in food and beverage systems. The use of hibiscus in fruit wine not only adds value by exhibiting the visual property of natural colouring, since natural pigmentation has the highest consumer acceptance, but also offers flavour complexity and functional properties.

While pineapple and hibiscus are plenty in India, the use of these ingredients for alcoholic drinks is very limited. Many of these agricultural resources never see the light of day because of inefficient processing and preservation methods. Secondary processing into value-added products, such as fruit wines, represent a sustainable strategy for decreasing post-harvest losses that also contributes to local craft beverage industry.

Thus, the objectives of this work were to elaborate and optimize a pineapple–hibiscus fruit wine and to characterize its physicochemical, sensorial and functional properties. The present research is aimed to enhance the fruit wine technology by combining tropical fruit substrates and botanical additives for promoting the innovation, sustainability and economic value addition of local resources.

MATERIALS AND METHODS

Materials

Fresh ripe pineapples (*Ananas comosus*) (12 kg) and hibiscus petals (*Hibiscus sabdariffa*) (25–30 flowers) were the main raw materials. Sugar (1400 g) in granulated form was added to preempt TSS. We used active dry yeast (*Saccharomyces cerevisiae*) for fermentation. Additives which were used include ascorbic acid, diammonium phosphate (DAP) as yeast nutrient, potassium metabisulphite (KMS) as preservative and bentonite as fining agent. All chemicals utilized in this study were all food-grade quality.

METHODOLOGY

Preparation of Must

Pineapple Tasted, washed, peeled and juiced by press The filtered juice was obtained by filtering the sediment of extracted juice. Sugar was added to adjust the total soluble solids (TSS) of must to between 20–22°Brix and sulfuric acid was used to adjust the pH to 3.2–3.5 to provide an optimum environment for yeast activity and fermentation.

Fermentation

The must was inoculated with a *Saccharomyces cerevisiae* prepared for laboratory propagation and fermented under controlled temperature conditions (18–22°C). The duration of fermentation was 7–8 days. The °Brix, pH, and titratable acidity are parameters critical to fermentation; therefore, data was taken daily and used both as indicators of fermentation progress for a specific treatment and markers in order to alternate treatment conditions for enhanced alcohol production.

Hibiscus Incorporation

After fermentation, petals were added to the mixture to increase colour and other functional properties. First, a small portion of the fermented wine was gently heated (to just below boiling temperature) in order to promote extraction of anthocyanin pigments from hibiscus petals. The extract was then filtered, brought back up to room temperature, and added to the main batch of wines to provide its signature garnet colour and floral characteristics.

Post-Fermentation Treatment

After fermentation was finished, racking the wine away from the sediment (lees). Clarification was performed with bentonite to remove the suspended particles. Potassium metabisulphite (KMS) solution was added to stabilize the wine against microbial spoilage and oxidation. After filtering, the wine was kept safe at temperatures that enhanced flavour development prior to bottling for storage.

Analytical Methods

Physicochemical parameters of wine were analyzed according to standard methods. Soluble solids (°Brix) were determined using a hand-held refractometer. A properly calibrated digital pH meter was used to measure pH. Titratable acidity was measured

following classical titration methods. Alcohol (% v/v) was determined using an ebulliometer. The standard process was followed for data analysis.

RESULTS AND DISCUSSION

Fermentation Behaviour

Throughout fermentation, there was a steady and gradual loss of total soluble solids (TSS), as evidenced by the decline in °Brix from 20 to 3.4, suggesting an effective transformation of fermentable sugars to ethanol by *Saccharomyces cerevisiae*. The pH at the same time diminished from 3.7 to 3.1, indicative of the bio-synthesis of organic acids amid fermentation. The reduction of pH also helped to improve microbiological and therefore physical stability and created an environment that was amenable to controlled fermentation, which would reduce spoilage and enhance product safety.

Physicochemical Properties

The final alcohol content (12.4% (v/v)) of developed pineapple–hibiscus wine is typical for fruit wines and indicates successful fermentation performance. To maintain a balanced flavour and better preservation, the total acidity did not exceed desired limits. The physicochemical parameters observed indicated that the optimized fermentation had created a stable, high quality fruit wine.

Sensory Evaluation

The sensory analysis indicated that the wine was highly acceptable overall, being eye-catching (dark crimson in colour), with pleasant fruity–floral aromas, as well as mild sweetness, moderate acidity, and balanced taste. This bonus ingredient not only greatly increased the visual attractiveness from natural anthocyanin colouring but also added depth and complexity to the overall flavours. The bioactive compounds in hibiscus also might have increased the antioxidant ability of the resultant product.

CONCLUSION

The current work has successfully established and optimized a functional fruit wine from pineapple–hibiscus with favourable physicochemical, sensory and functional properties. Not only was the fermentation quick and efficient, but it also achieved a reasonable level of residual alcohol, combined with proper acidity and enhanced stability. ResultsThe

presence of *Hibiscus sabdariffa* had a remarkable effect on the colour, antioxidant capacity and sensory attributes of the wines, resulting in improved organoleptic quality.

Overall, the results point that the combination of substrates (tropical fruits) with other botanical additives can be an interesting way to provide interesting value-added fermented beverages. These high sensory acceptability and quality parameters suggest a strong market potential for this new functional and craft beverage in a growing sector.

Moreover, this study highlights the need to use agriculture resources available locally to minimize the post-harvest losses and promote sustainable practices of production. Pineapple–hibiscus wine is an economically and nutritionally promising novel fruit wine.

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