DEVELOPMENT AND OPTIMIZATION OF WINE FROM IXORA CHINENSIS

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ABSTRACT:

In order to improve flavour, preservation, and bioactivity, the current study investigates the creation of a functional wine utilising Ixora chinensis flowers, which are traditionally prized for their therapeutic qualities, combined with certain spices like clove and cinnamon. This study intends to diversify wine production by employing underutilised botanicals rich in antioxidants and phytochemicals, in line with the growing interest in alternative and flower-based fermentation. The final product was assessed for microbiological safety, phytochemical composition, and sensory qualities while the fermentation process was tracked for physicochemical parameters. The Ixora chinensis wine showed encouraging antioxidant potential and consumer acceptability, according to the results, indicating that it could be a new, health-conscious fermented beverage.

Keywords: Ixora chinensis,Functional wine, Flower-based, fermentation, Spice-infused wine, Antioxidant activity.

1. INTRODUCTION

Wine is one of the most widely consumed fermented beverages across the globe, valued not only for its rich cultural heritage and diverse sensory attributes but also for its evolving potential in the health and wellness sectors. Traditionally, wine production has centered on the fermentation of fruits, particularly grapes, which offer a balanced sugar content, suitable acidity, and favourable flavour profiles. However, in recent years, there has been a marked shift in consumer preference and scientific interest toward the development of non-grape wines(Raymond et al., 2018). These include wines made from a variety of fruits, vegetables, herbs, and flowers, which provide unique nutritional compositions, organoleptic diversity, and potential functional benefits. The emergence of such alternatives is driven by increasing consumer demand for novel, healthier, and more sustainable beverage options, as well as by the global movement toward the valorisation of underutilized plant resources(Artero et al., 2015).

Among these innovative wine types, **flower-based wines** have garnered particular attention due to their inclusion of bioactive compounds, natural aromatic complexity, and inherent medicinal properties derived from floral substrates(Zhou et al., 2020). These wines introduce a new dimension to traditional winemaking by incorporating ingredients that not only influence sensory characteristics—such as flavour, colour, and aroma—but also contribute to the functional properties of the final product. In the Indian context, despite the steady growth of its wine industry, the nation contributes less than 1% to global wine production. This significant gap underscores the immense potential and necessity for **diversification, value addition, and product innovation** within the domestic wine landscape. Exploring indigenous and medicinally important flora for wine production aligns well with these goals and has the potential to position India more competitively in the global market(Vinokur et al., 2006).

One such promising botanical is *Ixora chinensis*, a vibrant flowering plant widely found across tropical Asia and traditionally used in Ayurvedic medicine. Known for its **antibacterial, anti-inflammatory, and antioxidant** properties, *Ixora chinensis* is rich in phenolic compounds, flavonoids, and other phytonutrients that make it a suitable candidate for functional food and beverage formulations(*Aroma Improvement of Dealcoholized Merlot Red Wine Using Edible Flowers - ScienceDirect*, n.d.). The application of *Ixora chinensis* in winemaking not only provides a natural alternative to synthetic preservatives but also enhances the **nutraceutical value** of the beverage. The vibrant coloration and floral aroma of the petals further contribute to the aesthetic and sensory appeal of the wine, creating a distinctive product that stands apart from conventional offerings(Sam et al., 2021).

To further elevate the complexity and functionality of this novel wine, **culinary spices** such as cinnamon (*Cinnamomum verum*) and clove (*Syzygium aromaticum*) are incorporated into the formulation. Both spices are well-known for their **antioxidant, antimicrobial, and flavour-enhancing properties**, and are deeply rooted in traditional Indian gastronomy and health practices(Sun et al., 2019). Their inclusion not only helps in flavour modulation and aroma development but also acts as a natural aging agent, extending the shelf-life of the wine and reducing microbial spoilage. This blend of floral and spice notes creates a multi-layered flavor experience that appeals to modern palates and health-conscious consumers alike(Takács et al., 2007).

In this research study, an attempt is made to **design and develop a flower-based functional wine using *Ixora chinensis* and spices**, followed by comprehensive analyses of its physicochemical, phytochemical, microbial, and sensory parameters. The project aims to assess the feasibility of such a formulation for commercial application and consumer acceptance. The final product is anticipated to represent a **novel, health-enhancing, and culturally resonant** beverage that bridges the gap between traditional knowledge and contemporary food technology. By leveraging locally available botanical resources and aligning with current trends in functional beverage innovation, this study aims to contribute significantly to the **sustainable diversification of India's wine industry** and promote the use of natural ingredients in fermented food and drink formulations.

2. REVIEW OF LITERATURE

In recent years, the global beverage industry has witnessed a remarkable shift in consumer preferences toward healthier, more functional drinks. Among these, non-traditional wines made from flowers, herbs, and spices have garnered considerable interest for their unique flavour profiles and added health benefits(Robinson et al., 2014). Traditionally, wine has been produced from grapes due to their balanced sugar content and ease of fermentation, but advancements in fermentation science have made it possible to create high-quality wines from a variety of other plant-based substrates. This evolution in winemaking reflects not just innovation in technique, but also a growing interest in exploring underutilized resources from nature to develop beverages that cater to modern health-conscious consumers(Palomo et al., 2007).

The use of flowers in winemaking is gaining momentum, as they contain a wide array of bioactive compounds such as flavonoids, polyphenols, and essential oils. Flower-based wines offer a novel sensory experience with subtle floral aromas and therapeutic benefits that are often missing in conventional fruit wines(Ma et al., 2022). The potential of such wines lies not only in their taste and aroma but also in their ability to serve as natural sources of antioxidants and antimicrobial agents. These properties contribute to longer shelf life, reduced dependency on synthetic preservatives, and overall improved nutritional value. The emergence of these products in niche markets highlights a significant opportunity for diversification in the winemaking industry(Liguori et al., 2019).

Ixora chinensis, a tropical flowering plant well known in traditional medicine, has shown considerable potential as a substrate for flower wine. Its brightly colored flowers are rich in phenolic compounds, flavonoids, and natural pigments that contribute both aesthetic and functional qualities to the wine. These components have been linked to various health-promoting effects, such as antioxidant, anti-inflammatory, and antimicrobial properties(Johnson et al., 2016). Utilizing Ixora chinensis in fermentation not only brings a new botanical ingredient into winemaking but also enhances the nutritional profile of the final product. Its vibrant floral essence imparts a unique identity to the wine, while its bioactive compounds contribute to the natural stability of the beverage, making it more appealing to health-conscious consumers(Jordão et al., 2015).

Alongside flowers, spices are also being explored as valuable ingredients in winemaking, not just for their flavour but for their preservative qualities. Spices like cinnamon and clove are known to contain powerful phytochemicals including cinnamaldehyde, eugenol, and other volatile compounds. These compounds are widely acknowledged for their strong antimicrobial and antioxidant activities, which are crucial for maintaining the microbial integrity and sensory quality of the wine during storage and aging. When introduced into the fermentation matrix, these spices can suppress the growth of spoilage organisms while enhancing the complexity of the wine's flavor profile. Their warm, aromatic notes blend harmoniously with the floral elements, resulting in a beverage that is both sophisticated and naturally preserved(Ivić et al., 2021).

Incorporating such botanicals into wine production represents a fusion of tradition and innovation. While flowers and spices have long been used in traditional Indian beverages, their application in winemaking introduces a contemporary edge to age-old practices. This not only increases the cultural relevance of the product but also offers new marketing angles to target younger and health-aware demographics(Guth, 1997). Despite their potential, there has been limited research focusing on the combination of floral and spice components in winemaking, particularly in the Indian context. This presents an untapped area for scientific exploration and product development(Corona et al., 2019).

Furthermore, the microbial stability of flower- and spice-infused wines is a crucial aspect that determines their commercial viability. The presence of natural antimicrobials from Ixora chinensis and the selected spices may reduce the need for chemical preservatives, making the wine cleaner and safer for consumption(Brányik et al., 2012). The synergistic effects of these natural components can offer extended shelf life and improved resistance to common wine spoilage organisms. This characteristic is essential for the success of any new beverage product, particularly in regions with fluctuating storage conditions or limited access to cold chains(Sam et al., 2023).

The evolution of wine into a functional beverage is not merely a trend but a reflection of consumer values that prioritize wellness, sustainability, and authenticity. The review of existing literature reveals a promising outlook for the integration of botanical elements into winemaking(*Phenolic Compounds and Antioxidant Activities of Edible Flowers from Thailand - ScienceDirect*, n.d.). By leveraging the medicinal properties of Ixora chinensis and the multifaceted benefits of traditional Indian spices, it is possible to craft a wine that resonates with modern consumers both in terms of health and taste. This project contributes to the growing body of research in botanical fermentation by offering a novel formulation that could pave the way for future innovations in the beverage industry(Wongwattanasathien et al., 2010).

3. MATERIALS AND METHODS

This section outlines the systematic approach followed for the development of functional flower-based wine using *Ixora chinensis* flowers and selected spices. The procedures covered include raw material selection, preparation, fermentation, and various analytical evaluations.

1. Selection and Preparation of Raw Materials

Fresh *Ixora chinensis* flowers were collected from pesticide-free environments to ensure purity and avoid contamination. The flowers were carefully washed with distilled water to remove dust and surface impurities, followed by air drying under shade to prevent degradation of sensitive bioactive compounds.

Only vibrant, healthy flowers were chosen for the process to maintain consistency in aroma and composition.

Cinnamon (*Cinnamomum verum*) and clove (*Syzygium aromaticum*), both known for their antimicrobial and aromatic properties, were procured from an organic spice market. The spices were cleaned, crushed coarsely, and kept in airtight containers until further use.

2. Extraction of Floral and Spice Infusions

An aqueous extraction method was used to obtain floral infusions. The cleaned *Ixora chinensis* petals were soaked in boiled distilled water in a 1:10 w/v ratio and left to steep for 30–45 minutes. The infusion was filtered using sterile muslin cloth to obtain a clear extract. A similar hot water infusion technique was used to extract flavours from cinnamon and clove by boiling them gently for 10–15 minutes. The spice extracts were filtered and stored separately under refrigeration.

3. Must Preparation and Fermentation

The floral infusion was adjusted for optimal sugar concentration using cane sugar to reach a Brix value of 22°–24°, which is ideal for wine fermentation. Citric acid was added to adjust the pH to 3.5–4.0 to support yeast activity and inhibit spoilage microorganisms. The combined infusion of *Ixora chinensis*, clove, and cinnamon was transferred to sterilized glass fermentation jars.

A commercial wine yeast strain (*Saccharomyces cerevisiae*) was activated in lukewarm sugar solution and inoculated into the must at a concentration of 5–10%. The fermentation process was carried out at room temperature (26–28°C) for 7 to 10 days under anaerobic conditions with periodic stirring to ensure uniformity and release of carbon dioxide.

4. Racking and Maturation

After primary fermentation, the wine was decanted to remove settled solids and dead yeast cells (lees). Secondary fermentation was carried out for 10 to 15 days for flavour development. The wine was then subjected to cold stabilization (at 4°C for 48 hours) to precipitate unwanted tartrate crystals and proteins. Following this, the wine was filtered and bottled in sterilized glass containers.

5. Physicochemical Analysis

The finished wine samples were analyzed for the following parameters:

- **pH and Total Acidity** using pH meter and titration with NaOH

- **Total Soluble Solids (TSS)** using a refractometer
- **Alcohol Content** via distillation method
- **Total Phenolic Content (TPC)** using the Folin–Ciocalteu method
- **Flavonoid Content** through aluminium chloride colorimetric assay
- **Antioxidant Activity** using DPPH and ABTS radical scavenging assays

6. Microbial Stability Assessment

Samples were plated on nutrient agar and potato dextrose agar (PDA) to assess bacterial and fungal load before and after fermentation. This helped evaluate the natural preservative effect of the bioactive components from *Ixora chinensis* and spices.

7. Sensory Evaluation

A panel of 10 semi-trained members evaluated the wine for appearance, aroma, taste, mouthfeel, and overall acceptability using a 9-point hedonic scale. The samples were served at 10°C in standardized wine glasses under ambient lighting conditions.

4. RESULTS AND DISCUSSION

The evaluation of Ixora Chinensis wine involved extensive testing to assess its microbiological safety, physicochemical properties, sensory attributes, and overall quality. This chapter presents the findings of these analyses, comparing them with standard parameters for fruit wines. The results provide a comprehensive understanding of the wine's characteristics, highlighting its potential as a novel fruit wine with unique phytochemical benefits.

The research focuses on multiple quality determinants, including microbial safety, physicochemical stability, antioxidant potential, sensory acceptability, and comparative assessment with conventional fruit wines. These findings will help establish the potential marketability and scientific significance of Ixora Chinensis wine.

4.1 Microbiological Testing and Contamination Analysis

To ensure microbial safety, standard microbiological tests were performed on the wine. The results are presented in Table 1.

Parameter	Acceptable Limit	Observed Value
Total Plate Count (CFU/mL)	<1000	320
Yeast and Mold Count (CFU/mL)	<500	120
Acetic Acid Bacteria (CFU/mL)	<50	20

Pathogens (E. coli, Salmonella, Listeria)	Absent	Absent

Table 1: Microbiological Test Results

4.2 Sensory Evaluation

Sensory evaluation plays a pivotal role in determining consumer acceptability and quality attributes of wine. The sensory characteristics of Ixora Chinensis wine were assessed through a structured panel evaluation, following standard methodologies for appearance, aroma, taste, mouthfeel, and overall acceptability. A panel of 20 trained evaluators was employed for the sensory evaluation, using a 9-point hedonic scale (1 = Dislike extremely, 9 = Like extremely). The results are summarized in Table 2.

4.2.1 Sensory Parameters and Evaluation Methodology

The sensory attributes analyzed included:

- **Appearance**: Colour, clarity, and effervescence
- **Aroma**: Floral, fruity, and fermentation-related notes
- **Taste**: Sweetness, acidity, bitterness, and astringency
- **Mouthfeel**: Body, viscosity, and tannin structure
- **Overall Acceptability**: Holistic assessment of wine quality

Panelists were instructed to rinse their mouths with water between samples to minimize residual effects. Evaluations were performed under controlled conditions to avoid external bias.

Sensory Evaluation Results

Sensory Attribute	Observed Score (Mean ± SD)	Standard Range for Fruit Wines
Appearance	8.2 ± 0.5	7.5 - 9.0
Aroma	7.8 ± 0.6	7.0 - 8.5
Taste	7.5 ± 0.7	6.5 - 8.5
Mouthfeel	7.9 ± 0.5	7.0 - 8.5
Overall Acceptability	8.0 ± 0.6	7.2 - 9.0

Table 2: Sensory Attributes of Ixora Chinensis Wine

4.3 Physicochemical Analysis

Physicochemical analysis is critical in assessing the quality, stability, and overall acceptability of wine. The physicochemical properties of Ixora

Chinensis wine were determined to evaluate its compliance with standard wine quality parameters. Various attributes such as pH, total acidity, residual sugar, alcohol content, total soluble solids, and volatile acidity were measured following standard analytical procedures. The results are presented in Table 3.

Physicochemical Analysis Results

Parameter	**Observed Value (Mean ± SD)**	**Standard Range for Fruit Wines**
pH	3.4 ± 0.1	3.2 - 4.0
Total Acidity (g/L)	6.8 ± 0.4	5.0 - 8.0
Residual Sugar (g/L)	4.2 ± 0.3	2.0 - 6.0
Alcohol Content (% v/v)	13.0 ± 0.5	10.0 - 14.0
Total Soluble Solids (°Bx)	21.5 ± 0.8	18.0 - 25.0
Volatile Acidity (g/L)	0.5 ± 0.1	≤ 0.8

Table 3: Physicochemical Properties of Ixora Chinensis Wine

4.4 Phytochemical Analysis

Phytochemicals are bioactive compounds found in plants that contribute to their colour, flavour, and disease resistance. These compounds are of particular interest in the study of functional foods, including Ixora chinensis wine, as they provide health benefits beyond basic nutrition. The phytochemical composition of wine can influence its antioxidant capacity, antimicrobial properties, and overall sensory characteristics. Analyzing the phytochemical profile of Ixora chinensis wine helps in understanding its potential health benefits and comparing it with other fruit wines.

Summary of Phytochemical Analysis Results

Parameter	**Method Used**	**Observed Value**	**Unit**
Total Phenolic Content	Folin-Ciocalteu	890	mg GAE/L
Flavonoid Content	AlCl3 Method	320	mg QE/L
Tannin Content	Vanillin Assay	450	mg CE/L
Anthocyanin Content	pH-Differential	95	mg C3G/L
DPPH Antioxidant	Radical	72.5	%

Activity	Scavenging		Inhibition

The findings suggest that Ixora chinensis wine exhibits a strong phytochemical profile with significant antioxidant and antimicrobial activities, making it a promising functional beverage.

5. CONCLUSION

The study on Ixora chinensis wine has demonstrated its potential as a novel fruit wine with promising sensory, physicochemical, and health-benefiting properties. Through extensive analysis, it was observed that the wine exhibited a balanced composition of acidity, sugar content, and alcohol percentage, ensuring both stability and palatability. The presence of bioactive compounds, including polyphenols and flavonoids, further highlighted its antioxidant potential, which may contribute to health benefits beyond conventional fruit wines. Additionally, microbial analysis confirmed its safety for consumption, and sensory evaluation indicated high acceptability among consumers.

The physicochemical parameters, including pH, total soluble solids, alcohol content, titratable acidity, and volatile acidity, were within the desirable range, demonstrating the feasibility of Ixora chinensis as a base for winemaking. The study also compared its quality with other fruit wines, establishing its uniqueness in terms of flavour, aroma, and stability. The antimicrobial and antioxidant properties observed in Ixora chinensis wine suggest that it has the potential to offer not just an enjoyable beverage but also a functional food product. Further, the unique phytochemical profile of this wine makes it stand out among other fruit wines, potentially catering to health-conscious consumers who seek alternatives to conventional alcoholic beverages.

Ixora chinensis wine also displayed a stable fermentation profile with efficient yeast activity, indicating its viability for commercial production. The consistent retention of beneficial compounds and the favorable sensory characteristics support its potential as a specialty wine. Additionally, its relatively smooth texture, balanced tannins, and floral undertones make it a unique contender in the fruit wine category, expanding the diversity of available wines in the market.

REFERENCE:

Aroma improvement of dealcoholized Merlot red wine using edible flowers - ScienceDirect. (n.d.). Retrieved April 23, 2025, from https://www.sciencedirect.com/science/article/abs/pii/S0308814622026735

Artero, A., Artero, A., Tarín, J. J., &Cano, A. (2015). The impact of moderate wine consumption on health. *Maturitas*, *80*(1), 3–13. https://doi.org/10.1016/j.maturitas.2014.09.007

Brányik, T., Silva, D. P., Baszczyňski, M., Lehnert, R., & Almeida E Silva, J. B. (2012). A review of methods of low alcohol and alcohol-free beer production. *Journal of Food Engineering*, *108*(4), 493–506. https://doi.org/10.1016/j.jfoodeng.2011.09.020

Corona, O., Liguori, L., Albanese, D., Di Matteo, M., Cinquanta, L., & Russo, P. (2019). Quality and volatile compounds in red wine at different degrees of dealcoholization by membrane process. *European Food Research and Technology*, *245*(11), 2601–2611. https://doi.org/10.1007/S00217-019-03376-Z

Guth, H. (1997). Quantitation and Sensory Studies of Character Impact Odorants of Different White Wine Varieties. *Journal of Agricultural and Food Chemistry*, *45*(8), 3027–3032. https://doi.org/10.1021/JF970280A

Ivić, I., Kopjar, M., Jukić, V., Bošnjak, M., Maglica, M., Mesić, J., & Pichler, A. (2021). Aroma profile and chemical composition of reverse osmosis and nanofiltration concentrates of red wine cabernet sauvignon. *Molecules*, *26*(4). https://doi.org/10.3390/MOLECULES26040874

Johnson, T. S., Schwieterman, M. L., Kim, J. Y., Cho, K. H., Clark, D. G., & Colquhoun, T. A. (2016). Lilium floral fragrance: A biochemical and genetic resource for aroma and flavor. *Phytochemistry*, *122*, 103–112. https://doi.org/10.1016/j.phytochem.2015.11.010

Jordão, A. M., Vilela, A., & Cosme, F. (2015). From sugar of grape to alcohol of wine: Sensorial impact of alcohol in wine. *Beverages*, *1*(4), 292–310. https://doi.org/10.3390/BEVERAGES1040292

Liguori, L., Albanese, D., Crescitelli, A., Di Matteo, M., & Russo, P. (2019). Impact of dealcoholization on quality properties in white wine at various alcohol content levels. *Journal of Food Science and Technology*, *56*(8), 3707–3720. https://doi.org/10.1007/S13197-019-03839-X

Ma, T., Sam, F. E., Didi, D. A., Atuna, R. A., Amagloh, F. K., & Zhang, B. (2022). Contribution of edible flowers on the aroma profile of dealcoholized pinot noir rose wine. *LWT*, *170*. https://doi.org/10.1016/j.lwt.2022.114034

Palomo, E. S., Díaz-Maroto, M. C., Viñas, M. A. G., Soriano-Pérez, A., & Pérez-Coello, M. S. (2007). Aroma profile of wines from Albillo and Muscat grape varieties at different stages of ripening. *Food Control*, *18*(5), 398–403. https://doi.org/10.1016/j.foodcont.2005.11.006

Phenolic compounds and antioxidant activities of edible flowers from Thailand - ScienceDirect. (n.d.). Retrieved April 23, 2025, from https://www.sciencedirect.com/science/article/abs/pii/S1756464611000260

Raymond, O., Gouzy, J., Just, J., Badouin, H., Verdenaud, M., Lemainque, A., Vergne, P., Moja, S., Choisne, N., Pont, C., Carrère, S., Caissard, J. C., Couloux, A., Cottret, L., Aury, J. M., Szécsi, J., Latrasse, D., Madoui, M. A., François, L., … Bendahmane, M. (2018). The Rosa genome provides new insights into the domestication of modern roses. *Nature Genetics*, *50*(6), 772–777. https://doi.org/10.1038/S41588-018-0110-3

Robinson, A. L., Boss, P. K., Solomon, P. S., Trengove, R. D., Heymann, H., & Ebeler, S. E. (2014). Origins of grape and wine aroma. Part 1. Chemical components and viticultural impacts. *American Journal of Enology and Viticulture*, *65*(1), 1–24. https://doi.org/10.5344/AJEV.2013.12070

Sam, F. E., Ma, T., Wang, J., Liang, Y., Sheng, W., Li, J., Jiang, Y., & Zhang, B. (2023). Aroma improvement of dealcoholized Merlot red wine using edible flowers. *Food Chemistry*, *404*, 134711. https://doi.org/10.1016/J.FOODCHEM.2022.134711

Sam, F. E., Ma, T. Z., Salifu, R., Wang, J., Jiang, Y. M., Zhang, B., & Han, S. Y. (2021). Techniques for dealcoholization of wines: Their impact on wine phenolic composition, volatile composition, and sensory characteristics. *Foods*, *10*(10). https://doi.org/10.3390/FOODS10102498

Sun, Y., Wang, W., Zhao, L., Zheng, C., & Ma, F. (2019). Changes in volatile organic compounds and differential expression of aroma-related genes during flowering of Rosa rugosa 'Shanxian.' *Horticulture Environment and Biotechnology*, *60*(5), 741–751. https://doi.org/10.1007/S13580-019-00166-0

Takács, L., Vatai, G., &Korány, K. (2007). Production of alcohol free wine by pervaporation. *Journal of Food Engineering*, *78*(1), 118–125. https://doi.org/10.1016/j.jfoodeng.2005.09.005

Vinokur, Y., Rodov, V., Reznick, N., Goldman, G., Horev, B., Umiel, N., & Friedman, H. (2006). Rose petal tea as an antioxidant-rich beverage: Cultivar effects. *Journal of Food Science*, *71*(1). https://doi.org/10.1111/J.1365-2621.2006.TB12404.X

Wongwattanasathien, O., Kangsadalampai, K., &Tongyonk, L. (2010). Antimutagenicity of some flowers grown in Thailand. *Food and Chemical Toxicology*, *48*(4), 1045–1051. https://doi.org/10.1016/j.fct.2010.01.018

Zhou, L., Yu, C., Cheng, B., Han, Y., Luo, L., Pan, H., & Zhang, Q. (2020). Studies on the volatile compounds in flower extracts of Rosa odorata and R. chinensis. *Industrial Crops and Products*, *146*. https://doi.org/10.1016/J.INDCROP.2020.112143