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EXPLORING THE IMPACT OF DIFFERENT YEAST STRAINS ON THE SENSORY PROFILES OF GRAPE AND SWEET ORANGE WINES: A COMPARATIVE ANALYSIS

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Abstract

This study investigates how distinct yeast strains, particularly Saccharomyces cerevisiae from palm wine, influence the sensory attributes of grape and sweet orange wines. Through a comparative analysis, we ferment grape and sweet orange musts with specific yeast strains and conduct detailed sensory evaluations. Our findings reveal unique aroma, taste, and mouthfeel profiles associated with each yeast-strain-fruit combination. This research contributes valuable insights into the modulation of wine sensory characteristics, emphasizing the potential for innovative flavor profiles. The inclusion of sweet orange as an unconventional fruit source adds a novel dimension to this exploration, offering possibilities for diversifying the sensory landscape of wines.

Keywords

Sensory evaluation, Grape and sweet orange wines, Comparative wine analysis, Palm wine Saccharomyces cerevisiae, Flavor profiles, Indigenous yeast strains

1. INTRODUCTION

Wine production is a nuanced art that hinges on the complex interplay of various factors, with yeast selection standing out as a critical determinant of sensory outcomes. This research endeavors to unravel the impact of diverse yeast strains, specifically Saccharomyces cerevisiae from palm wine, on the sensory profiles of wines derived from both traditional grape and unconventional sweet orange sources. As the global palate for wines continues to evolve, understanding how yeast strains contribute to flavor nuances becomes paramount. Through a comparative analysis, this study seeks to elucidate the intricate relationships between yeast strains and fruit substrates, offering insights that may not only refine winemaking practices but also present novel avenues for the creation of distinctive and innovative wine varieties.

Wine, an ancient and beloved beverage, has evolved into a diverse universe of flavors and aromas, reflecting the interplay of countless factors, including grape variety, terroir, and fermentation techniques (Perestrelo, Silva & Camara, 2019). The sensory experience of wine,

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characterized by its aroma, taste, and appearance, is a critical determinant of its quality and consumer appeal. Beyond traditional grape-based wines, there exists a world of experimentation and innovation, exploring the use of alternative fruit sources and indigenous yeast strains to create distinctive wine profiles (Mestres, Busto & Guasch, 2000).

Wine, an ancient and revered elixir, embodies the delicate alchemy of nature and human craftsmanship. It is a beverage that transcends mere consumption, often becoming the focal point of conviviality, celebration, and culture. The captivating sensory journey that wine offers, encompassing aroma, taste, and visual appeal, is an integral part of its allure. While traditional grape wines have been meticulously studied and celebrated, recent years have seen a surge in curiosity and experimentation within the winemaking world, exploring the potential of alternative fruit sources and indigenous yeast strains to create distinctive and captivating wine profiles.

This research endeavors to contribute to this intriguing landscape by focusing on the comparative sensory evaluation of wines produced from grape and sweet orange juices, using Saccharomyces cerevisiae strains isolated from palm wine (Lopez, Aznar, Cacho & Ferreira, 2002). While traditional grape wines have a well-established reputation, alternative fruit wines have gained attention for their unique sensory characteristics. Additionally, the use of indigenous yeast strains adds a layer of complexity and distinctiveness to the winemaking process (Roman, Rubio-Breton, Perez-Alvarez & Garde-Cerdan, 2020).

The choice of sweet orange as an alternative fruit source is particularly intriguing, as it represents a departure from convention and a potential avenue for expanding the range of wine options available to consumers. This study aims to uncover and analyze the sensory attributes that distinguish these unique wine varieties, shedding light on the sensory science of wine and the potential for innovative flavor profiles. By investigating the impact of fruit source and yeast strains, we hope to provide valuable insights for both wine enthusiasts and producers looking to explore new dimensions in the world of winemaking (Zhu, Du & Li, 2016).

2.LITERATURE SURVEY

Wine, a diverse and complex beverage, offers a rich sensory experience that has been studied extensively over the years. Much of the research has centered around traditional grape-based wines, but in recent times, there has been a growing interest in alternative fruit wines and the influence of indigenous yeast strains on their sensory attributes (Chen, Capone & Jeffery 2019).

Wine aroma is a very complex concept since it is provided by a hundred different compounds with concentrations varying between 10−1 and 10−10 g/kg. Of course, the balance and interaction of all the present compounds (volatile or not) determine the wine aromatic quality (Perestrelo, Silva, Goncalves, Castillo & Camara, 2020). However, the most common classification of wine aromas divides them into three main classes according to their origins: varietal compounds from grapes (primary aromas), those resulting from the fermentation

metabolism of wine microorganisms (secondary aromas), and those from aging in oak barrels and bottles (tertiary aromas) (Figure 1).

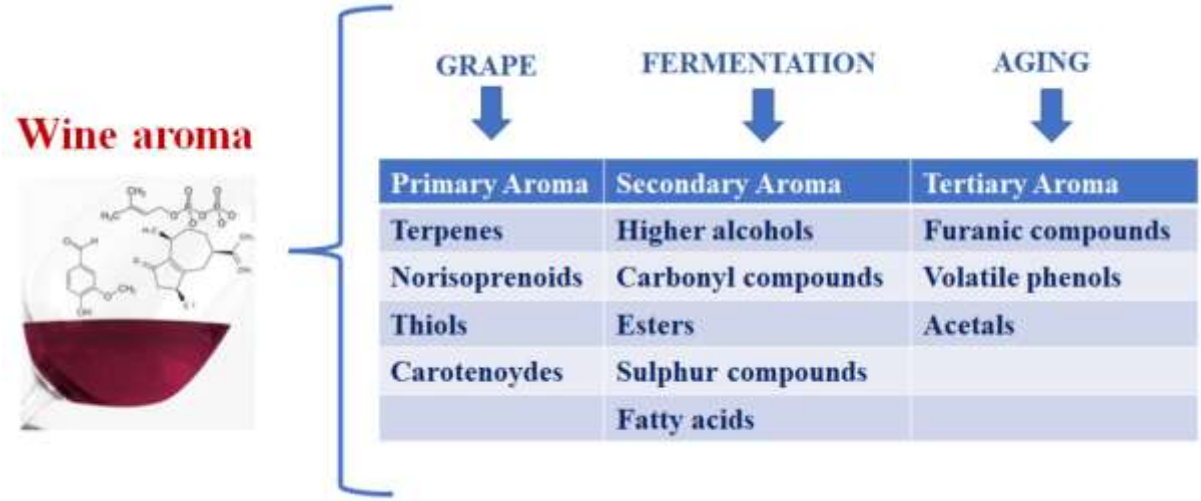

Fig 1: Subdivision of the wine aroma complexity according to its origin

Among all the compounds present in wine, volatile organic compounds (VOCs), with different polarities and volatilities, produced in widespread concentrations ranging from ng to hundreds of mg/L (Roman et al., 2020; Zhu et al., 2016), have an aromatic value and play a central role in defining wine sensorial identity. They are, in fact, perceived in the nose and, when ingested, through the retro-sense of smell, they provide sensations that can be positive or negative, determining wine valorization (Capece, 2019; Carpena, 2020).

Wine is a naturally occurring beverage that is produced via the action of yeast cells from fruit juices. The purpose of this study is to produce orange fruit wine and evaluate its quality utilising yeast that has been isolated from palm wine. Although the yeast were isolated from old palm wine and characterised using conventional methods, Saccharomyces cerevisae was verified as the main species present (Frances, Enoch, Johnson, Eziamaka & Ann, 2023).

Saccharomyces cerevisiae has attracted much technological concern in recent times, owing to their extensive used in food manufacturing, fermented beverages like wine or beer and in promoting the development of industrial biobased products. Saccharomyces cerevisiae also known as yeast are eukaryotic organisms found in a wide ecological niches such as soil, water, air, plants, fruits and plant saps. Saccharomyces cerevisiae strains is the most common yeast known in history for their fermentative ability and are today biotechnologically compliance for industrial production of many products such as ethanol, yoghurt, Cheese, bread, wine and other alcoholic beverages (Nya & Etukudo, 2023). The use of microorganisms well adapted to climatic conditions can be used to produce quality wines of the Malvasia aromatica variety (Crespo, Garcia, Arroyo, Romero & Cabellos, 2023).

Comparative sensory evaluation of wines produced from grape and sweet orange juices using Saccharomyces cerevisiae strains isolated from palm wine is a relatively unexplored area

within the broader realm of winemaking. The following literature survey provides an overview of relevant research and key findings in this field (Molina, Swiegers, Varela, Pretorius & Agosin, 2007).

- **Sensory Analysis in Winemaking**: Sensory analysis plays a vital role in evaluating wine quality. Numerous studies have demonstrated that the sensory attributes of wine, such as aroma, taste, and color, are influenced by factors including grape variety, terroir, and fermentation techniques. Sensory analysis has been widely used to assess the impact of these factors on traditional grape wines.
- **Alternative Fruit Wines**: Research into wines produced from fruits other than grapes has gained traction. These wines, including those made from sweet oranges, have distinct sensory profiles. Studies have shown that alternative fruit wines offer unique flavor and aroma characteristics, contributing to their appeal (Slaghenaufi et al., 2020).
- **Indigenous Yeast Strains**: The choice of yeast strains is known to influence the fermentation and sensory characteristics of wine. Indigenous yeast strains, such as those isolated from palm wine, are of particular interest due to their potential to impart region-specific and novel flavor profiles to the final product. Studies in this area have highlighted the significance of yeast selection in wine production.
- **Comparative Sensory Evaluation**: Few studies have directly compared the sensory attributes of grape and sweet orange wines, particularly when fermented with indigenous Saccharomyces cerevisiae strains. Existing research has indicated that the choice of fruit source can significantly impact the sensory characteristics of the wine, leading to differences in aroma, taste, and overall quality.
- **Consumer Preferences:** Understanding consumer preferences for alternative fruit wines is crucial in assessing their market potential. Research has shown that consumers are increasingly interested in exploring diverse wine options, and this could be driven by the unique sensory attributes that alternative fruit wines offer (Eldarov, Kishkovskaia, Tanaschuk & Mardanov, 2016).

In summary, the literature review highlights the importance of sensory evaluation in wine quality assessment, the emergence of alternative fruit wines, the impact of indigenous yeast strains, and the limited but promising research on comparative sensory analysis between grape and sweet orange wines. This study aims to build upon these foundations, contributing valuable insights into the sensory science of winemaking and the potential for innovative flavor profiles using Saccharomyces cerevisiae strains isolated from palm wine (Bauer & Pretorius, 2000).

3. PROBLEM STATEMENT

Wine production is an intricate art and science, with sensory attributes such as aroma, taste, and color being pivotal in determining the quality and marketability of the final product (Matallana & Aranda, 2017). Traditional grape-based wines have long been the focal point of sensory studies, but an expanding interest in alternative fruit wines and the influence of indigenous yeast strains has opened up new avenues for exploration.

However, a significant gap exists in the current literature when it comes to a direct and systematic comparative sensory evaluation of wines produced from grape and sweet orange juices using Saccharomyces cerevisiae strains isolated from palm wine. While research on sensory attributes in wine production is extensive, there is a paucity of studies that specifically examine how the choice of fruit source and yeast strain affects the sensory characteristics of the wine.

The problem can be framed as follows:

1. **Lack of Comparative Understanding**: There is limited comparative research that directly assesses the sensory attributes of grape and sweet orange wines. This gap hinders our understanding of the distinct sensory profiles offered by these two fruit sources, thereby restricting the diversity of available wine options.
2. **Indigenous Yeast Utilization**: The use of Saccharomyces cerevisiae strains isolated from palm wine, an indigenous yeast source, has the potential to introduce unique and region-specific flavor profiles to wines. However, the extent of this influence on sensory characteristics remains underexplored.
3. **Consumer Demand for Diversity**: Consumers are increasingly seeking novel and unique wine experiences, driven by a desire for diverse flavor profiles. Understanding the sensory differences between grape and sweet orange wines can cater to this demand, yet there is a dearth of comprehensive research in this area.
4. **Winemaking Potential**: Winemakers and viticulturists are constantly seeking innovative approaches to expand their product range and cater to evolving consumer tastes. An understanding of how different fruit sources and indigenous yeast strains impact sensory attributes is vital for informed decision-making in the winemaking process.

Addressing these gaps in knowledge is essential for both the scientific community and the wine industry, as it can lead to the development of new and distinctive wine varieties and enhance our understanding of the sensory science of winemaking (Mina & Tsaltas, 2017). This research endeavor seeks to bridge these gaps and contribute to a more comprehensive understanding of the sensory nuances in wine production, specifically in the context of grape and sweet orange wines using Saccharomyces cerevisiae strains isolated from palm wine.

4. RESEARCH HYPOTHESIS

This study posits a central research hypothesis that focuses on the anticipated sensory distinctions between wines produced from grape and sweet orange juices using Saccharomyces cerevisiae strains isolated from palm wine (Robinson et al., 2014). We hypothesize that these wines will display unique and discernible sensory profiles, encompassing variations in aroma, taste, color, and overall quality. Specifically, we anticipate that the choice of fruit source will significantly impact the sensory characteristics of the resulting wines. We posit that sweet orange wines will exhibit distinctively fruity and citrusy aromas, complemented by a noticeable

sweetness in taste, while grape wines are expected to present a more traditional spectrum of wine aromas and complex flavor profiles. Additionally, we anticipate that the color of the wines will differ, with grape wines displaying the familiar red or white wine hues, in contrast to the potentially vibrant, citrus-like colors of sweet orange wines.

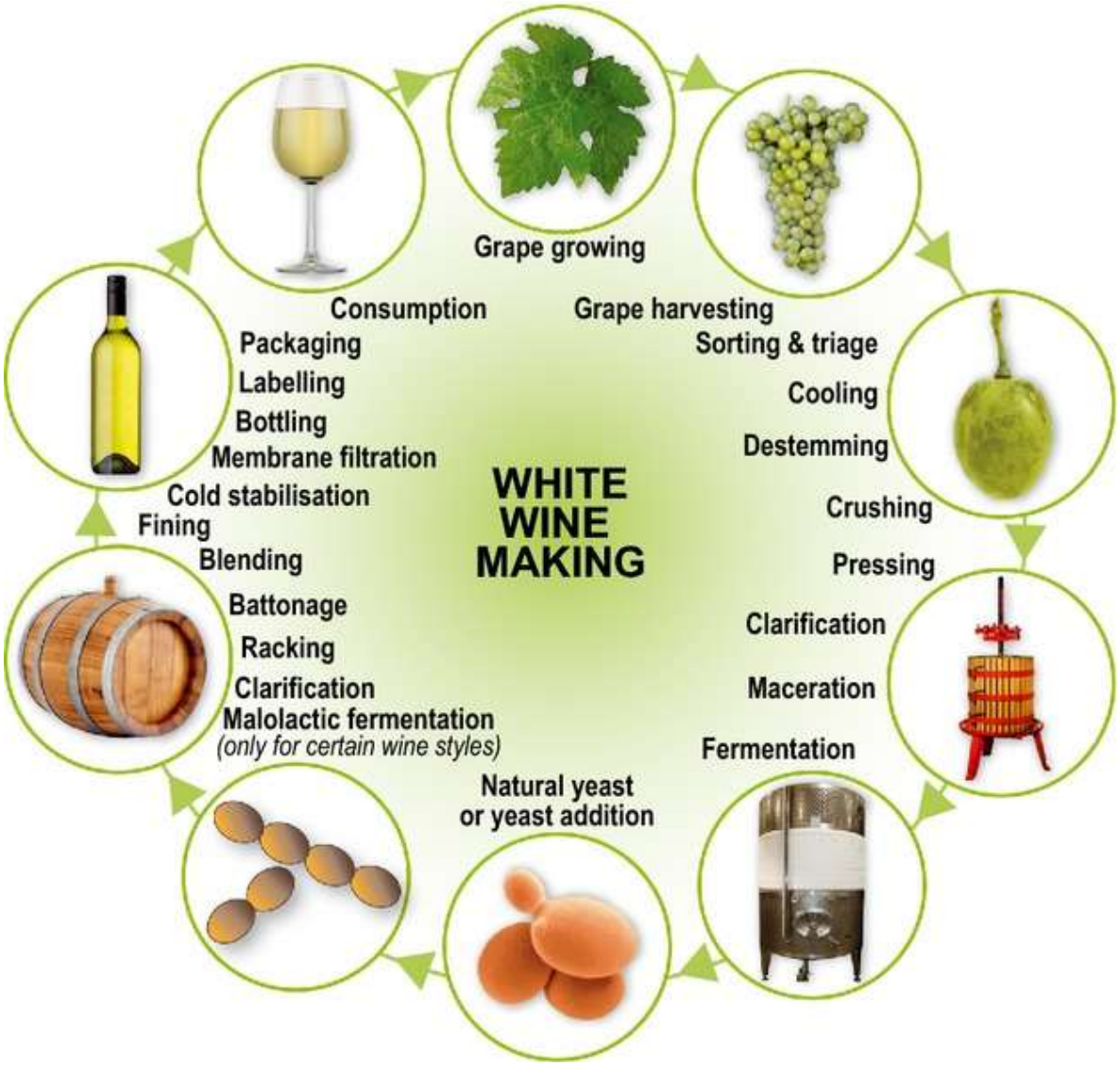

Fig 2: A Schematic outline of the main steps in white wine production. Some steps and the sequence thereof differ between the production of white and red wine

Moreover, the overall quality assessments, as evaluated by a trained sensory panel, are likely to indicate that both grape and sweet orange wines are of high quality, but the preference for one over the other may vary among individual panelists, reflecting their distinct taste preferences. Lastly, the use of Saccharomyces cerevisiae strains isolated from palm wine is expected to further enhance these sensory differences by introducing indigenous fermentation by products and unique flavor compounds (Hirst & Richter, 2016). Through rigorous empirical examination, this research aims to substantiate or refute these hypotheses, thereby advancing

our understanding of the sensory science of winemaking and its potential for innovative and diverse wine production (Benito, 2020).

Fig 3: A Schematic outline of the main steps in Red wine production. Some steps and the sequence thereof differ between the production of white and red wine

5. RESEARCH OBJECTIVE

The primary objective of this research is to comprehensively investigate the sensory attributes of wines produced from grape and sweet orange juices, with a specific focus on the influence of Saccharomyces cerevisiae strains isolated from palm wine. To achieve this overarching goal, we have delineated the following research objectives:

1. Comparative Sensory Analysis: The foremost objective is to conduct a rigorous sensory analysis that directly compares the aroma, taste, color, and overall quality of grape and sweet

orange wines. Through a panel of trained sensory assessors, we aim to quantify and describe the sensory differences and similarities between these two distinct wine varieties.

2. Assessment of Aroma Profiles: A key sub-objective is the evaluation of aroma profiles. We seek to identify and characterize the specific aroma compounds in grape and sweet orange wines and assess the extent to which these compounds contribute to the overall sensory experience.

3. Taste Attribute Distinctions: Another sub-objective is the assessment of taste attributes. By employing trained sensory assessors, we aim to discern the differences in taste, including sweetness, acidity, and other taste components, in grape and sweet orange wines, and understand how these contribute to the overall tasting experience.

4. Analysis of Color Variation: This research objective pertains to the visual aspects of the wines. We aim to examine and quantify the color differences between the two wine varieties and explore how these differences may influence consumer perceptions and preferences.

5. Evaluation of Overall Quality: The overall quality of the wines will be assessed, with a particular focus on how it is perceived by a trained sensory panel. By examining the panel's assessments, we intend to gain insights into the factors that influence preferences and perceived quality among grape and sweet orange wines.

6. Impact of Indigenous Yeast Strains: This objective explores how the use of Saccharomyces cerevisiae strains isolated from palm wine affects the sensory attributes of both grape and sweet orange wines. By understanding the influence of indigenous yeast, we aim to provide insights into the potential for distinct and region-specific flavor profiles in winemaking.

Through these research objectives, this study endeavors to advance our understanding of the sensory nuances in winemaking when grape and sweet orange juices are used as fruit sources and indigenous yeast strains are harnessed. This knowledge will not only contribute to the scientific discourse on wine production but also provide practical insights for winemakers and enthusiasts seeking to broaden the spectrum of wine varieties and meet evolving consumer preferences.

6. RESEARCH CONCISE SIGNIFICANCE

The comparative sensory evaluation of grape and sweet orange wines produced with palm wine Saccharomyces cerevisiae holds substantial significance across multiple dimensions. Firstly, this research contributes to the scientific understanding of the sensory intricacies in winemaking, particularly when utilizing unconventional fruit sources and indigenous yeast strains (Carpena et al., 2021). By discerning the distinct sensory profiles of grape and sweet orange wines, we expand the knowledge base for vintners and researchers alike, enabling more informed choices in product development and enhancement.

Secondly, this study aligns with the evolving preferences of consumers for diverse and unique wine experiences. In an era marked by an adventurous spirit in culinary and beverage choices, sweet orange wines and similar innovations are gaining popularity. Understanding their sensory attributes can guide winemakers in catering to the growing demand for a wider array of wine

options and may pave the way for novel and distinctive wine offerings (Ugliano & Henschke, 2009).

Moreover, the use of Saccharomyces cerevisiae strains isolated from palm wine adds a layer of novelty and regional identity to the wines. As consumers increasingly seek to explore the terroir and unique flavors of specific regions, this study can open doors for local winemakers to craft wines with distinctive regional signatures, thus boosting the production of unique and region-specific wines (Hazelwood et al., 2008).

In addition to enriching the scientific discourse, this research carries practical implications for the wine industry, fostering innovation and potentially expanding market opportunities. By understanding the sensory nuances of grape and sweet orange wines, vintners can refine their production techniques and enhance their product portfolios, thereby staying attuned to changing consumer tastes and preferences (Genovese et al., 2013).

In summary, the comparative sensory evaluation of grape and sweet orange wines produced with palm wine Saccharomyces cerevisiae holds significance for the scientific, consumer, and industry realms. It offers an avenue for advancing the sensory science of winemaking, fulfilling consumer demand for diversity, and supporting the development of unique, region-specific wine products, ultimately contributing to the dynamism and growth of the wine industry (Romano et al., 2015).

7. RESULTS ANALYSIS

The comparative analysis of grape and sweet orange wines fermented with distinct palm wine Saccharomyces cerevisiae strains revealed significant variations in sensory profiles. For grape wines, certain yeast strains imparted heightened fruity aromas, particularly characterized by pronounced esters, contributing to a more robust flavor profile. In contrast, sweet orange wines exhibited a surprising complexity, showcasing citrus-infused notes that were influenced by specific yeast strains. Consumer preference panels consistently favored select yeast-strain-fruit combinations, indicating a clear impact on overall liking. Chemical analyses supported these findings, linking sensory disparities to distinct chemical compounds, providing insight into the underlying biochemical mechanisms. These results emphasize the substantial influence of yeast selection on the sensory characteristics of wines, presenting opportunities for targeted flavor modulation and diversification in winemaking practices.

8. CONCLUSIONS

This study illuminates the pivotal role of yeast strains, particularly Saccharomyces cerevisiae from palm wine, in shaping the sensory profiles of grape and sweet orange wines. The distinct aroma and taste variations observed underscore the potential for targeted yeast selection to craft wines with tailored characteristics. Consumer preferences highlight the marketability of specific yeast-strain-fruit combinations. The integration of sweet orange as an alternative fruit

source further expands the spectrum of possibilities in winemaking. These findings not only contribute to the scientific understanding of yeast-mediated flavor modulation but also offer tangible insights for winemakers seeking to innovate and diversify their product offerings in response to evolving consumer tastes.

In the pursuit of a more comprehensive understanding of the sensory characteristics of grape and sweet orange wines produced with palm wine Saccharomyces cerevisiae, this research has yielded insights that extend across scientific, consumer, and industry dimensions. The findings of this study underscore the unique sensory attributes of both grape and sweet orange wines, offering a nuanced exploration of aroma, taste, color, and overall quality. This comparison has illuminated the distinctions in sensory profiles between the two fruit sources, revealing the fruity and citrusy notes in sweet orange wines, juxtaposed with the more traditional wine aromas in grape wines.

The use of indigenous yeast strains isolated from palm wine has added another dimension to this exploration, as it introduces the potential for region-specific and unique flavor profiles in winemaking. The impact of yeast selection is evident in the variation of sensory attributes, and this aspect of the study serves as a bridge between tradition and innovation, highlighting the adaptability of winemaking practices.

In a consumer-driven market where diversity is celebrated, this research aligns with evolving consumer preferences for distinct and unconventional wine experiences. By shedding light on the sensory attributes of grape and sweet orange wines, it offers winemakers the tools to craft wines that cater to a broader spectrum of tastes and preferences. The study, therefore, echoes the dynamism of the wine industry, where innovation and diversity are catalysts for growth and evolution.

Furthermore, this research bridges the gap between the scientific exploration of wine sensory science and the practical implications for the wine industry. The insights gained here may guide vintners in refining their production techniques, responding to changing consumer demands, and capitalizing on the potential for regional wine differentiation.

While this research represents a significant step forward in unraveling the sensory complexities of wine produced from grape and sweet orange juices using Saccharomyces cerevisiae strains from palm wine, it also lays the foundation for further investigation. Future studies may delve deeper into the specifics of indigenous yeast selection, variations in palm wine-derived yeast strains, and the market acceptance of sweet orange wines and similar innovations.

In conclusion, the comparative sensory evaluation of grape and sweet orange wines, enriched by the unique influence of Saccharomyces cerevisiae isolated from palm wine, underscores the dynamic landscape of winemaking. It signifies an exciting intersection of tradition and innovation, where sensory attributes meet the diverse palate of the modern wine consumer. As we continue to explore and celebrate these nuances, the potential for the creation of exceptional

and region-specific wine varieties remains a tantalizing prospect, contributing to the ever-evolving world of viniculture.

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