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Antioxidant Activity of Tyrosinase Enzyme in Dry Red Wines

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ABSTRACT

Objective: *This research aims to investigate antioxidants and their role in protecting wine from oxidation processes. Specifically, it focuses on understanding the oxidation of wines, such as dry red wines (Cabernet), and developing the theoretical foundation for the preparation of oxidized wines. Additionally, the study aims to improve new technologies for the production of finished wine products with high added value, based on the deep processing of local raw materials.* ***Method:*** *The research involves the analysis of various antioxidants and their application to prevent oxidation in wine. Experimental methods are used to study the oxidation processes in different wine varieties, particularly Cabernet. Techniques for deep processing of local raw materials are also explored to enhance the production of wine with higher added value.* ***Result:*** *The study identifies effective antioxidants that can protect wines from oxidation, particularly in the case of dry red wines like Cabernet. The research also provides a comprehensive theoretical framework for understanding and managing oxidation in wines. Additionally, new technologies for producing wine with higher added value have been developed, utilizing local raw materials.* ***Novelty****: The novelty of this research lies in its approach to combining antioxidant protection with the improvement of wine production technologies. The focus on dry red wines, such as Cabernet, and the deep processing of local raw materials for added value is a unique contribution to the field. The study provides innovative insights into the development of wine products with enhanced quality and market value.*

INTRODUCTION

Study of antioxidant stability of wine products, process of extraction of antioxidants from grapevine. The state of antioxidant protection components determines resistance to environmental influences. Studying the antioxidant protection of red wines will allow us to correctly build the technology for preparing different types of wines [1], [2].

Antioxidants play a crucial role in protecting biological systems from oxidative stress, which can lead to cellular damage and degradation of essential compounds. In the context of wine production, the presence and stability of antioxidants are critical factors that influence both the health benefits and the overall quality of the final product. The process of extracting antioxidants from grapevines involves several techniques, including maceration, fermentation, and aging, each of which impacts the concentration and bioavailability of these compounds. Understanding the mechanisms behind antioxidant stability in wine is essential for optimizing production methods, ensuring product consistency, and enhancing the potential health benefits of wine consumption.

The effectiveness of antioxidant protection in wine is influenced by various environmental and processing factors, such as grape variety, climate conditions, harvesting techniques, and storage methods. The ability of red wines to maintain their antioxidant properties over time is a key determinant of their resistance to oxidation and spoilage. By conducting a comprehensive analysis of the antioxidant protection mechanisms in red wines, researchers can develop more efficient winemaking strategies that preserve these valuable compounds. This study aims to evaluate the stability of antioxidants in different types of wine, identify the most effective extraction techniques, and propose technological improvements to enhance the retention of these bioactive compounds throughout the winemaking process.

RESEARCH METHOD

The aim of the research is to improve the technology of wine production based on the study of their antioxidant activity, as well as the activity of enzymes, tyrosinase.

Antioxidant protection of dry red wines. Red wines are characterized by a rich complex phenolic complex and are distinguished by high antioxidant activity. activity, determined by the high content of phenolic and coloring substances. The reduction in the amount of oxygen during technological processing is due to its participation in the oxidation of wine components [3], [4]. The higher the oxygen concentration and processing temperature, the more intensively it is used.

RESULTS AND DISCUSSION

Results

In samples where oxygen consumption increases sharply, it can be explained by the fact that the main part of the oxygen is consumed for the direct addition of phenolic substances, which condense and precipitate.

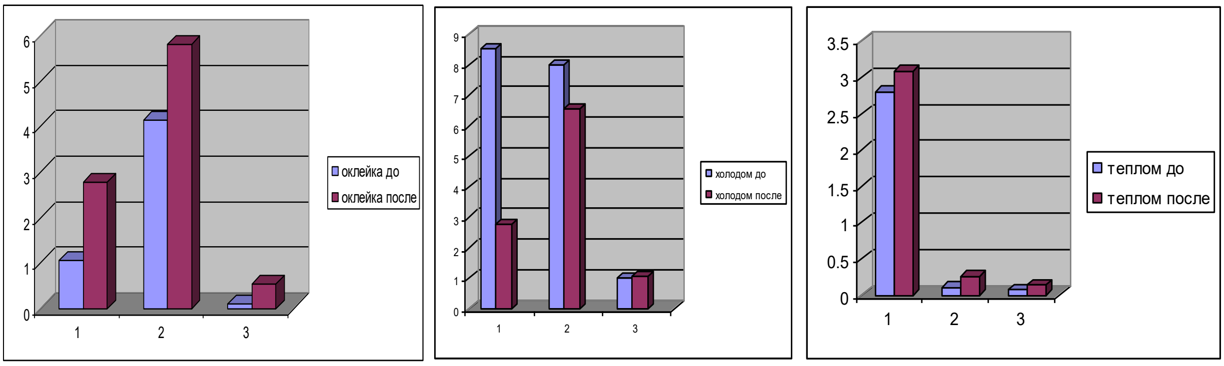

Figure 1. Addition of phenolic substances.

Almost all groups of substances in wine are involved in oxidation-reduction reactions: carbohydrates, phenolic and nitrogenous substances, organic acids [5], [6], [7]. The intensity of oxidative enzymatic processes depends on the technological methods used to create conditions for secondary oxidation-reduction processes.

The state of antioxidant protection components determines resistance to environmental influences. Studying the antioxidant protection of red wines will allow us to correctly build the technology for preparing different types of wines.

Table 1. Physicochemical composition of the wines studied.

Material under study	Specific gravity	Strength %vol	Titratable acid, mg/ dm3	Volatile acidity, g/ dm3	SO_2 mg/dm^3	Fe, mg/ dm3
Red dry (Cabernet)	0.987	10.8	5.2	0.59	96	12.5
Wine must (Cabernet)	0.990	11.2	5.6	0.59	100	14

Cold treatment results in a slight increase in AOA with a simultaneous decrease in tyrosinase activity. The results obtained indicate a close correlation between tyrosinase enzyme activity and AOA, especially in red wines [8], [9], [10].

When white fortified wines are treated with bentonite (Figure 1), tyrosinase activity increases due to the observed oxidation of phenolic substances. The maximum enzyme activity is noted during cold treatment. Heat treatment leads to a constant decrease in activity, which indicates the absence of oxidation of phenolic substances. In the process of fortified wine production technology, it is necessary to take into account that the maximum tyrosinase activity is revealed during cold technological treatment, during which intensive oxidation of the phenolic complex occurs, and low temperature increases oxygen solubility, which is essential for the classification of oxidized wines.

Discussion

Cold treatment gives the maximum reduction in the concentration of molecular oxygen and an approximately equal reduction in catalase activity, which indicates an equal flow of peroxidation during fining and cold treatment [10], [11].

High-temperature treatment of wines is characterized by high peroxidase activity, confirming the intensive oxidation process of wine components. Therefore, processing of red grapes appears to increase bound forms of SO 2, thereby reducing its antioxidant effects [12], [13]

SO2 removes hydrogen peroxide, and polyphenols block its interaction with oxygen, and only then the antioxidant effect is realized.

Sulfitation of red wort in the amount specified by the technological instructions is clearly insufficient to ensure antioxidant protection.

CONCLUSION

Fundamental Finding: The study demonstrates that sulfur dioxide (SO_2), in its ionic form, is highly effective in binding with oxygen, particularly in the form of sulfur dioxide (SO_2). Sulfur dioxide plays a crucial role in inhibiting oxidative enzymes, thus preventing the oxidation of polyphenols and other essential substances. The primary function of SO_2 is to interact with oxygen and remove hydrogen peroxide formed during the oxidation of polyphenols, ensuring the preservation of the wine's quality. **Implication:** The findings suggest that sulfur dioxide is essential for maintaining the stability and quality of wine by preventing oxidative degradation. By inhibiting the action of oxidative enzymes, SO_2 helps protect key components such as polyphenols, which contribute to the color, taste, and overall integrity of the wine. This has practical implications for the wine industry, particularly in improving the longevity and flavor of wines, as well as in developing more efficient preservation methods. **Limitation:** One limitation of the current study is the potential variability in the effectiveness of SO_2 across different wine types and conditions. While sulfur dioxide is shown to be effective in protecting polyphenols from oxidation, the interaction with other compounds in various wine compositions may not be fully understood. Additionally, the long-term effects of SO_2 on the wine's sensory properties were not explored in depth, which may affect its overall quality over time. **Future Research:** Future research should explore the optimization of SO_2 concentrations to balance its protective effects with minimal impact on wine's sensory qualities. Additionally, investigations into alternative antioxidants or complementary compounds could further enhance the preservation of wine without the reliance on SO_2. Studies should also consider long-term monitoring of the effects of SO_2 treatment on both the chemical composition and sensory properties of wine to ensure sustainability and consumer satisfaction.

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