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PRODUCTION OF RED AND WHITE WINE WITH ESTIMATION OF ALCOHOL CONTENT AND ANALYSIS OF TEMPERATURE INFLUENCE ON YEAST GROWTH

G. Vinay* and Dr. Madan Mohan Gunda Department of Microbiology, Government Degree and PG college (A), Siddipet, Telangana, India.

ABSTRACT :

The article presents review on potential of wine production from white and black grapes, classification of wines and current status of industry.Various wine classes such as white grape wine, black grape wine have been discussed in this paper. The present study was carried out to evaluate wine production from grapes along with determination of alcohol percentage and to investigate the effect of temperature on yeast growth during fermentation. Fresh black and white grapes were used for wine preparation through standard pre-fermentation, fermentation, and post fermentation processes. Sucrose was added to enhance sugar content, and activated yeast was inoculated under sterile conditions to initiate fermentation. The fermented samples were filtered and stored for physico-chemical analysis. Alcohol estimation revealed that white wine showed a higher alcohol content compared to red wine, indicating variation in fermentation efficiency between the two samples. In addition, the influence of temperature on yeast growth was studied at 16°C, 20°C, and 27°C. Yeast growth was slow at 16°C, reaching maximum population (1.0×10^8 cfu/ml) on the sixth day, whereas at 20°C and 27°C, rapid growth was observed with maximum population achieved by the second day. The results indicate that moderate temperatures (20–27°C) enhance yeast activity and fermentation rate, while lower temperature slows down fermentation. Overall, the study highlights that temperature plays a crucial role in regulating yeast growth and fermentation efficiency, thereby influencing wine production quality and alcohol yield.

KEY WORDS: Fermentation , Yeast Growth, Alcohol Estimation, Physico-Chemical Analysis, Fermentation Efficiency.

INTRODUCTION:

India is one of the largest producers of fruits in the world. Fruits are among the most important foods of mankind as they are not only nutritive but are also indispensable for the maintenance of health. Fruits, both in fresh as well as processed forms, not only improve the quality of our diet but also provide essential nutrients such as vitamins, minerals, carbohydrates, and dietary fiber (Joshi and Attri, 2006). Postharvest loss of fresh fruits is one of the serious problems of tropical countries like India. Due to improper postharvest handling and inadequate processing facilities, nearly 35–40% of horticultural production goes to waste (Battcock and Azam-Ali, 1998). India incurs postharvest fruit and vegetable losses worth over Rs. 2 lakh crore annually, largely owing to the absence of food processing units, modern cold storage facilities, and inadequate preservation technologies. The fruit and vegetable preservation industry in India utilizes less than 2% of the total production of fruits and vegetables for conversion into value added products, compared to 40–50% in developed countries (Swami et al., 2014).

Fermentation is a viable technique in the development of new products with modified physicochemical and sensory qualities, especially flavor and nutritional components (Caplice and Fitzgerald, 1999). Alcoholic, acetic acid, and lactic acid fermentations are important processes in food production and preservation. Among these, alcoholic fermentation is widely employed for the preparation of beverages in which alcohol is the major constituent (Steinkraus, 1995). Fermented beverages have been known to mankind since ancient times and continue to play an important role in food culture and industry (Jackson, 2008).

An alcoholic beverage is a drink that contains ethanol. These beverages are generally divided into three classes for taxation and regulatory purposes: beers, wines, and distilled spirits such as whisky, rum, gin, and vodka (Frazier and Westhoff, 2007). Beer is produced through the fermentation of starch-rich cereals such as barley, corn, rye, or wheat, usually flavored with hops. It typically contains 4–8% alcohol and provides 28–73 kcal per 100 mL (Prescott et al., 2008). Distilled alcoholic beverages are obtained by distillation of fermented materials derived from grains, fruits, vegetables, sugarcane juice, molasses, cereals, potatoes, and malted barley or rye. The alcohol content of distilled beverages generally ranges between 40 and 60% (Amerine and Cruess, 1960).

Fruit wines are undistilled alcoholic beverages produced by the fermentation of fruits such as grapes, mangoes, apples, guavas, berries, and several tropical fruits. The sugars naturally present in fruits are converted into ethanol by the action of yeasts, predominantly *Saccharomyces cerevisiae* (Fleet, 2008). Fruit wines have gained considerable attention due to their nutritional value, unique flavor profiles, and potential to utilize surplus fruits that would otherwise be wasted (Jagtap and Bapat, 2015). The production of fruit wine not only enhances the shelf life of fruits but also contributes to value addition and reduction of postharvest losses (Reddy and Reddy, 2005).

MATERIAL AND METHODS :

Wine production and determination of alcohol percentage


Fig 1 : Crushed grapes with mortar pestle Fig 2 : Extracted the grape juices

Wine production mainly involves three important stages , namely pre-fermentation , fermentation, and post-fermentation processes. In the present study , fresh black and white grapes were collected from the local market and washed thoroughly with distilled water to remove dust and other external contaminants before processing. Approximately 500g of grapes were weighed and manually crushed using o mortar and pestle to obtain grape must .The extracted juice along with the pulp was transferred aseptically into sterile conical flasks .

Pre -fermentation involved preparation of the grape must by adding 30g of sucrose to enhance the sugar concentration required for alcohol production. A yeast suspension was prepared separately by dissolving 5g of yeast in 80ml of lukewarm distilled water to activate the Yeast cells before inoculation. The prepared yeast solution was then added to the grape must under sterile conditions and mixed uniformly.

Fermentation is a biochemical process in which yeast converts fermentable sugars into alcohol and carbon dioxide under anaerobic conditions. The fermentation flasks were properly covered and incubated at room temperature for several days. During this period, changes such as gas evolution, aroma development, colour changes ,and sediment formation were observed. Fermentation was allowed to continue until the desired stage was achieved.
Post -fermentation processing involved filtration of the Fermented samples to remove suspended particles grapes residues, and Yeast sediments. The clarified wine samples were then stored under refrigerated conditions for further physico-chemical analysis and determination of alcohol percentage. The methodology adopted in the present study was based on stranded wine-making technology involving pre-fermentation, and post-fermentation processing, which are standard procedures followed in grape wine production.

Fig 3 : Fermentation of wine

Effect of Temperature on Yeast Growth

The growth of yeast was influenced by different fermentation temperatures. At 16°C, yeast growth occurred at a slower rate, showing a prolonged exponential growth phase. The yeast population required more time to reach its maximum level (1.0×10^8 cfu/ml) and achieved peak growth around the sixth day of fermentation. In contrast, fermentations carried out at 20°C and 27°C showed faster yeast multiplication, reaching the maximum population by the second day and maintaining a stable growth phase for the remaining fermentation period. The stationary phase was more prolonged at higher temperatures, whereas at 16°C it appeared only near the end of fermentation.

The findings indicate that increasing temperature enhances yeast activity and fermentation efficiency. Moderate temperatures, especially between 20°C and 25°C, promote rapid yeast growth and shorten fermentation duration. However, lower temperatures delay microbial activity and extend the overall fermentation process.
Furthermore, no clear lag phase was observed in any of the fermentations. This may be due to the use of active dry yeast, which is already adapted to fermentation conditions and can begin growth immediately after inoculation without requiring an extended adaptation period.

RESULTS :

Fig 4 : Estimation of alcohol percentage

Table 1 : Alcohol % Of Wine

	Red wine	White wine
Alcohol %	0.62	1.3

1.4 1.2 1
0.8 0.6 0.4 0.2 0
Alcohol percentage of wine Red wine White wine

Fig 5: Alcohol Percentage Of Wine

Table 2 : Effect of Temperature on Yeast Growth

Temperature (°C)	Growth Rate	Day of Maximum Population	Maximum Population (cfu/ml)	Stationary Phase
16°C	Slow	6th Day	1.0×10^8	Reached near the end of fermentation
20°C	Fast	2nd Day	1.0×10^8	Prolonged until end of fermentation
27°C	Fast	2nd Day	1.0×10^8	Prolonged until end of fermentation

DISCUSSION

The results showed that white wine (1.3%) had a higher alcohol content than red wine (0.62%), indicating more efficient fermentation in white wine. This difference may be attributed to better sugar utilization by yeast and favorable fermentation conditions, which enhance ethanol production (Boulton et al., 1996). Similar observations have been reported where the composition of the fermentation medium significantly influenced alcohol yield and wine quality (Ribéreau
Gayon et al., 2006).

Temperature had a marked effect on yeast growth during fermentation. At 16°C, yeast growth was relatively slow, reaching its maximum population on the sixth day. This delay may be due to reduced enzymatic activity and slower metabolic processes at lower temperatures (Fleet, 2008). In contrast, at 20°C and 27°C, yeast exhibited rapid growth and attained maximum population by the second day, indicating that these temperatures are more suitable for active fermentation (Pretorius, 2000).

The maximum yeast population remained constant at 1.0 × 10^8 cfu/ml under all temperature conditions, suggesting that temperature primarily affected the rate of growth rather than the final biomass produced. Similar findings have been reported by Bisson (1999), who noted that temperature influences fermentation kinetics without necessarily affecting the final yeast cell density. Furthermore, the stationary phase was prolonged at higher temperatures, indicating sustained yeast viability and continued metabolic activity throughout the fermentation period (Kunkee, 1984).

Overall, moderate temperatures ranging from 20°C to 27°C were found to be more favorable for rapid yeast growth and efficient fermentation. Lower temperatures significantly delayed fermentation by reducing yeast metabolic activity. These findings are consistent with previous studies demonstrating that temperature is one of the most important factors influencing yeast performance, fermentation efficiency, and wine quality (Jackson, 2008; Rankine, 2004). Therefore, maintaining optimal temperature conditions is essential for improving wine production and achieving efficient alcoholic fermentation.

CONCLUSION

The present study successfully demonstrated the preparation of red and white wine using standard fermentation techniques and evaluated the alcohol content along with the effect of temperature on yeast growth. The results indicated that white wine showed a higher alcohol percentage (1.3%) compared to red wine (0.62%), suggesting better fermentation efficiency under the conditions used. The study of yeast growth at different temperatures revealed that lower temperature (16°C) slowed down yeast activity and delayed maximum growth, while moderate to higher temperatures (20°C and 27°C) supported rapid growth and early attainment of maximum population (1.0 × 10^8 cfu/ml). However, the final biomass remained constant across all temperatures, indicating that temperature mainly influences the rate of fermentation rather than total yield. Overall, the findings confirm that moderate temperatures (20–27°C) are most suitable for efficient yeast activity and faster fermentation, thereby improving wine production quality and consistency.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES :

1. Joshi VK, Attri D. Fruits and Vegetable Fermentation Technology. Narosa Publishing House, New Delhi, 2006; 211-245.
2. Battcock M, Azam-Ali S. Fermented Fruits and Vegetables: A Global Perspective. FAO Agricultural Services Bulletin, Rome, 1998; 55-72.
3. Swami SB, Thakor NJ, Divate AD. Fruit wine production: A review. Journal of Food Research and Technology. 2014; 2: 93-100.
4. Caplice E, Fitzgerald GF. Food fermentations: role of microorganisms in food production and preservation. International Journal of Food Microbiology. 1999; 50: 131-149. 5. Steinkraus KH. Handbook of Indigenous Fermented Foods. 2nd edition. Marcel Dekker Inc., New York, 1995; 411-432.
6. Jackson RS. Wine Science: Principles and Applications. 3rd edition. Academic Press, San Diego, 2008; 1-25.
7. Frazier WC, Westhoff DC. Food Microbiology. 4th edition. Tata McGraw Hill, New Delhi, 2007; 487-510.
8. Prescott LM, Harley JP, Klein DA. Microbiology. 7th edition. McGraw Hill, New York, 2008; 842-860.
9. Amerine MA, Cruess WV. The Technology of Wine Making. AVI Publishing Co., Connecticut, 1960; 112-140.
10. Fleet GH. Wine yeasts for the future. FEMS Yeast Research. 2008; 8: 979-995. 11. Jagtap UB, Bapat VA. Wines from fruits other than grapes: current status and future prospectus. Food Bioscience. 2015; 9: 80-96.
12. Reddy LVA, Reddy OVS. Production and characterization of wine from mango fruit. World Journal of Microbiology and Biotechnology. 2005; 21: 1345-1350. 13. Boulton R, Singleton VL, Bisson LF, Kunkee RE. Principles and Practices of Winemaking. Springer, New York, 1996; 220-275.
14. Ribéreau-Gayon P, Dubourdieu D, Donèche B, Lonvaud A. Handbook of Enology, Volume 1: The Microbiology of Wine and Vinifications. Wiley, New York, 2006; 17-45. 15. Pretorius IS. Tailoring wine yeast for the new millennium. Journal of Industrial Microbiology and Biotechnology. 2000; 24: 139-145.
16. Bisson LF. Stuck and sluggish fermentations. American Journal of Enology and Viticulture. 1999; 50: 107-119.
17. Kunkee RE. Yeast genetics and wine fermentation. Advances in Applied Microbiology. 1984; 30: 201-230.
18. Rankine BC. Making Good Wine. Pan Macmillan Publishers, London, 2004; 52-89. 19. Pambianchi D. Techniques in Home Winemaking. Vehicule Press, Canada, 2008; 78- 118.
20. Reddy YN, Joshi VK, Sharma S. Development of wine from fruits. Beverage and Food World. 2007; 34: 55-58.
21. Rossi J, Singleton VL. Wine processing and fermentation technology. Food Technology. 1966; 20: 40-45.
22. Ough CS. Winemaking Basics. Haworth Press, New York, 1992; 96-132.