The Production of Non Alcoholic Wine and Subsequent Syrups using Generative AI

Devansh Agarwal[1], Naren J[2]

[1]Student, School of CS and IT, JAIN (Deemed-to-be University), Bengaluru, India
[2]Asst. Professor, Alliance University, Bengaluru, India

Abstract

Non-alcoholic wine has gained increasing popularity in recent years due to the rising awareness of the health risks associated with excessive alcohol consumption. In this research paper, we explore the production of non-alcoholic wine using Generative AI, through Reinforcement Learning in text GPT models like ChatGPT. Using an experimental analysis with the help of iterative algorithms, we investigate the production process of non-alcoholic wine. Our results indicate that the production process of non-alcoholic wine involves the removal of alcohol from wine using various methods, such as vacuum distillation and reverse osmosis. These methods affect the sensory characteristics of non-alcoholic wine by altering its aroma and flavour. We also found that the grape variety, fermentation conditions, and aging process can significantly affect the sensory properties of non-alcoholic wine. Based on our findings, we recommend that producers of non-alcoholic wine pay close attention to the production and grape selection in order to achieve desirable sensory characteristics. Furthermore, we develop syrup from this wine which has many uses, such as taste enhancers, wine substitutes, emulsifiers and reconstituted drinks.

Problem: Despite the growing trend of health consciousness and the increasing demand for non-alcoholic beverages, there is a lack of research on the production and market potential of non-alcoholic wine.
Objective: This study aims to fill this gap by exploring the production of non-alcoholic wine syrups for the health-conscious consumers in the beverage industry.
Significance: The findings of this research will provide valuable insights for beverage companies, marketers, and industry stakeholders to better understand the consumer preferences and expectations for non-alcoholic wine syrups. Additionally, it will contribute to the growth of the non-alcoholic beverage market.

Keywords: Generative AI, Reinforcement Learning, Iterative Algorithms, GPT Models.

1. Literature Review

In order to come up with insights on Wine, Wine Making and process of Distillation and De-Alcoholisation, many universally acclaimed texts and articles were reviewed. Some of them are:

- National Institute on Alcohol Abuse and Alcoholism. (2021). Alcohol facts and statistics.
- World Health Organization. (2021). Global status report on alcohol and health 2020.
- "Handbook of Enology: The Microbiology of Wine and Vinifications" by Pascal Ribéreau-Gayon, Denis Dubourdieu, B. Donèche, and A. Lonvaud.
- "Winemaking: From Grape Growing to Marketplace" by Richard P. Vine, Ellen M. Harkness, and Theresa Browning.
- "The Oxford Companion to Wine" edited by Jancis Robinson.
- "Wine Science: Principles and Applications" by Ronald S. Jackson.

These texts were referred to and fed into the GPT Model in order to prepare the dataset for reinforced learning. These were used to prepare the information applied in the complete process that this paper will discuss.

2. Introduction

Wine has been consumed for centuries as a popular beverage worldwide. It is typically made from fermented grapes, with alcohol content ranging from 5% to 14% [1]. However, with the rise in health consciousness and restrictions on alcohol consumption, there has been an increasing demand for non-alcoholic wine. This study aims to investigate the production of non-alcoholic wine and its syrups using ChatGPT. Before which, there is a need to understand the composition, health benefits and market trends (viability) of this wine.

Composition: Non-alcoholic wine is made from grapes, just like regular wine. The difference lies in the production process, where the alcohol is removed from the wine. This can be done through various methods, including reverse osmosis or distillation. The composition of non-alcoholic wine includes water, sugar, acids, tannins, and other components found in regular wine [2]. However, the alcohol content is significantly lower, ranging from 0.05% to 0.1%.

Health Benefits: Compared to alcoholic wine, non-alcoholic wine offers several health benefits. It contains antioxidants, which are known to reduce risk of heart diseases and various types of cancer. Non-alcoholic wine also contains lower levels of sugar, making it a better option for people with diabetes. Additionally, it does not have the adverse effects associated with alcohol consumption, such as liver damage and impaired judgment.

Market Trends: The market for non-alcoholic wine has grown significantly in recent years, with more and more people opting for a healthier alternative to traditional alcoholic wine. According to a recent report by the Beverage Marketing Corporation [3], the global non-alcoholic wine market is expected to reach $4.4 billion by 2023. This growth can be attributed to the increasing health consciousness among consumers and the availability of a wider range of non-alcoholic wine options. [2]Wine segment is anticipated to witness significant gains over 7% p.a. from 2019 to 2025.

3. Algorithm

In order to begin the production of non alcoholic wine and its syrup, we form an Iterative Algorithm for Reinforced Learning of the GPT Model.

Step 1: The dataset [4-9] prepared during literature review is fed into the GPT Model agent.

Step 2: The prompt to formulate a methodology for production of wine is fed in next for action.

Step 3: The resultant methodology is executed in order to produce the wine.

Step 4: The resultant wine is sent for quality assessment and the alcohol content of final product is checked.

Step 5: If the alcohol content is less than 0.1% then the environment is rewarded and wine is accepted for use.

Step 6: If the parameters are not met then feedback is sent to the environment and the action is reiterated.

Step 7: Steps 2-6 are reiterated until wine preparation is successful and all quality tests are passed.

This algorithm is based on reinforcement learning as every time the action is performed, the environment gains more insights and the user feedback informs it of the status of the result. Since the algorithm is iterated upon indefinitely until success, hence it is an iterative reinforcement learning based algorithm which makes use of the given dataset and the GPT model as the environment for the action performed, i.e. the wine in this case.
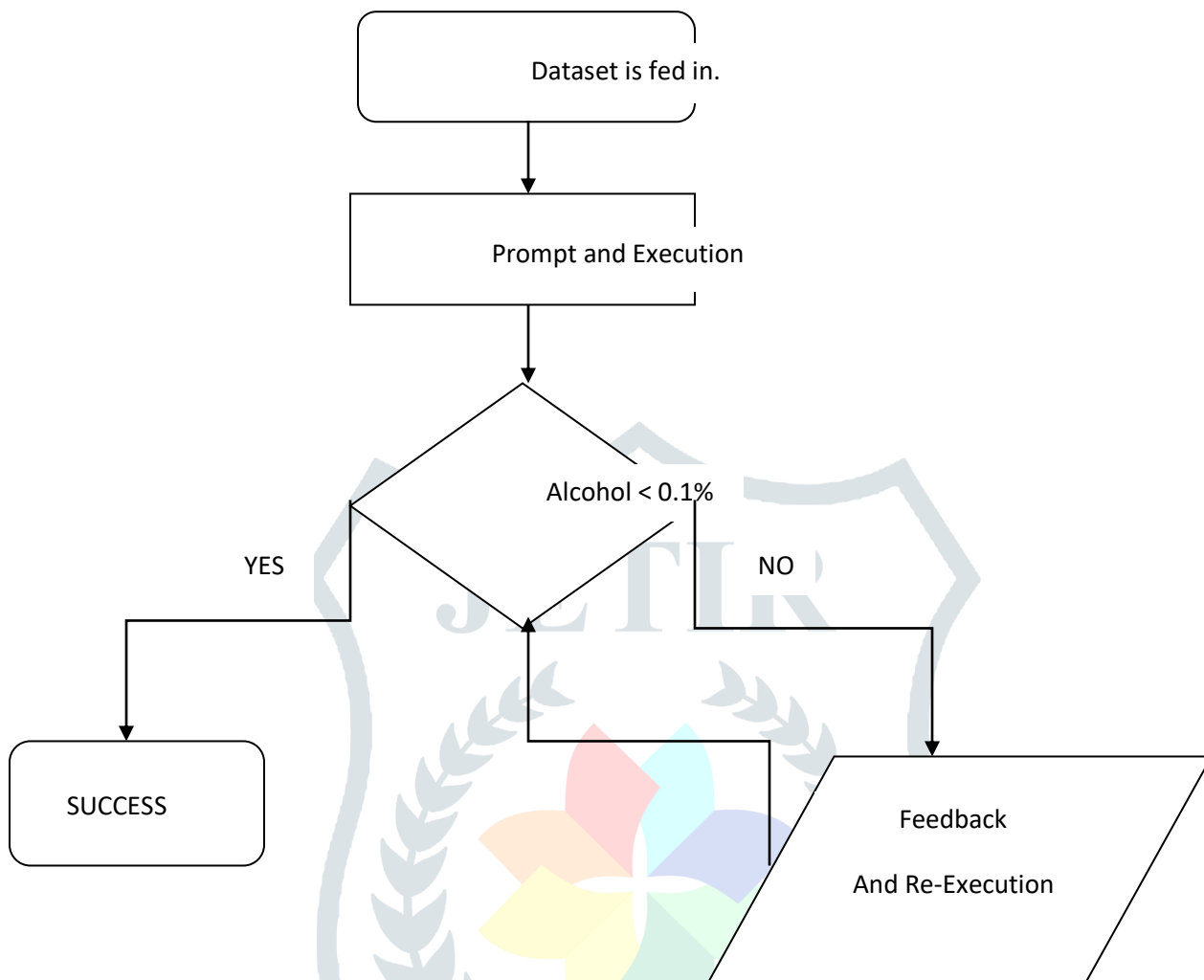
Figure 3.1: The Flowchart

4. Methodology

This methodology is the result of the Algorithm given previously.

    A) Production of Wine[6][7]

Ingredients:

     I.   8 lbs[approx. 3.63kg] of ripe grapes or fruit juice (red or white grape juice)
    II.   3 lbs[approx. 1.36kg] of sugar
  III.   1 packet of wine yeast
  IV.   5 quarts[approx. 4.75litres] of water

Equipment:

     I.   Large pot
    II.   Fermentation vessel (such as a glass carboy or plastic food-grade bucket)
  III.   Airlock
  IV.   Racking cane and hose
   V.   Hydrometer
  VI.   Sterilizing solution (such as sodium metabisulfite)

Instructions:

I. Sterilize all equipment with a sterilizing solution. This will prevent unwanted bacteria and yeast from contaminating the wine.
II. In a large pot, heat 4 quarts of water and add 3 lbs of sugar. Stir until the sugar dissolves completely.
III. Crush the grapes or pour the fruit juice into the pot and stir.
IV. If using grapes, press them to extract the juice.
V. Let the juice cool to room temperature and transfer it to the fermentation vessel.
VI. Add the yeast to the juice and stir gently.
VII. Cover the fermentation vessel with a cloth or lid and secure the airlock in place.
VIII. Allow the juice to ferment for 5 to 7 days. The airlock will bubble as the yeast converts the sugar into carbon dioxide and water.
IX. After 5 to 7 days, use a hydrometer to measure the gravity of the juice. When the gravity stabilizes, the fermentation is complete.
X. Transfer the wine to a clean, sterilized vessel using a racking cane and hose, leaving the sediment behind.
XI. Seal the new vessel with an airlock and let the wine age for 2 to 3 months.
XII. After the 3 month period, wine is aged and ready.

[Note: After aging, the wine can be bottled and served but we shall proceed further to conversion into syrup.]

This process produces least amount of alcohol in the wine and the remaining alcohol is removed using the dealcoholisation process of osmotic distillation, which is a very common industrial practice in the beverage industry.
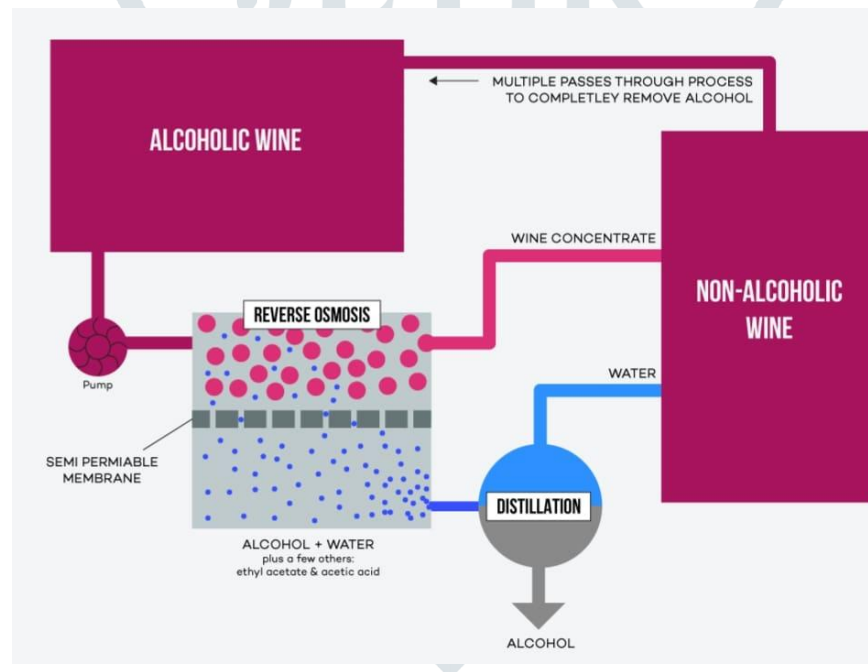

Figure 4.1: Osmotic Distillation

B) Conversion of Wine into Syrup

Ingredients:

I. 1 bottle of non-alcoholic wine
II. 1 cup of sugar
III. 1 cinnamon stick (optional)
IV. 1 vanilla bean (optional)
V. 1 lemon or orange peel (optional)

Equipment:

I. Saucepan
II. Measuring cup

III. Wooden spoon
IV. Funnel
V. Glass jars or bottles with airtight lids

Instructions:

I. In a saucepan, combine the non-alcoholic wine, sugar, and any optional ingredients (such as cinnamon stick, vanilla bean, or lemon/orange peel).
II. Stir the ingredients together until the sugar dissolves completely.
III. Place the saucepan over medium heat and bring the mixture to a boil.
IV. Reduce the heat to low and simmer the mixture for about 30 to 40 minutes, or until it has reduced to about half its original volume.
V. Stir the mixture frequently to prevent burning.
VI. When the mixture has thickened and reached the desired consistency, remove it from heat and let it cool to room temperature.
VII. Strain the mixture through a fine-mesh strainer to remove any solids.
VIII. Using a funnel, transfer the concentrated syrup to glass jars or bottles with airtight lids.
IX. Store the syrup in the refrigerator for up to 1 month.
X. This stored syrup can be mixed with water and other beverages in order to reconstitute the wine.

[Note: This concentrated syrup can also be used as a sweetener in a variety of dishes and drinks. It can be further flavoured with a variety of spices and herbs in order to achieve a specific taste profile too.]

5. Conclusion

Non-alcoholic wine is a healthy alternative to traditional alcoholic wine, offering several health benefits and lower alcohol content.

The production of non-alcoholic wine is a complex process. Non-alcoholic wine can be made from a variety of grape varieties, and the fermentation conditions and aging process can greatly affect the sensory properties of the final product. Producers of non-alcoholic wine must pay close attention to the selection of grape varieties, fermentation conditions, and aging process in order to achieve desirable sensory characteristics. Non-alcoholic wine has become increasingly popular due to its lower health risks and wider availability to people who prefer not to consume alcohol. There is a growing interest in the potential health benefits of non-alcoholic wine, as well as the factors that influence consumer acceptance of this product.

The conversion of non-alcoholic wine into concentrated syrup is a simple and effective way to create a versatile ingredient for various recipes. The process involves removing the alcohol from non-alcoholic wine, boiling it down to concentrated syrup, and then adding sweeteners and flavours as desired. The resulting non-alcoholic wine syrup can be used in a variety of recipes, from cocktails and mocktails to desserts and marinades. It provides a rich, complex flavour that is similar to traditional wine, without the alcohol content. When making non-alcoholic wine syrup, the selection of sweeteners and flavours can also greatly impact the final product, and should be chosen carefully to complement the wine's natural characteristics. Overall, the production of non-alcoholic wine syrup is a great way to incorporate the complex flavours of wine into recipes without the alcohol content. It is a versatile ingredient that can add depth and richness to a variety of dishes, and is well worth the effort of production.

The market for non-alcoholic wine is growing rapidly, with increasing demand from health-conscious consumers. The syrup prepared in this research paper is a novel idea and there is no market competition. Hence, there is a high market scope for this product.

This research limits the alcohol content of non alcoholic wine to approximately below 0.1%. Further research is needed to reduce this content and fully understand the composition of non-alcoholic wine and its impact on health.

Acknowledgment

References

[1] Gary J. Pickering (2000) Low- and Reduced-alcohol Wine: A Review, Journal of Wine Research, 11:2, 129-144, DOI: 10.1080/09571260020001575

[2] Non-Alcoholic Wine and Beer Market Size By Product (Beer {By Material (Grapes, Berries/ Apples, Malted Grains, Hops, Yeast, Enzymes), By Type (Alcohol Free [0.0% ABV], Lower Alcohol [0.0% - 1.5% ABV], Lower Alcohol [1.5% - 3.5% ABV], By Technology (Restricted Fermentation, Dealcoholization [Reverse Osmosis, Heat Treatment, Vacuum Distillation]), By Sales Stores (Liquor Stores, Convenience Stores, Supermarkets, Online Stores, Restaurants & Bar)}, Wine { By Material (Grapes, Berries/ Apples, Malted Grains, Hops, Yeast, Enzymes), By Type (Alcohol Free [0.0% ABV], Lower Alcohol [0.0% - 8% ABV], Lower Alcohol [8% - 12% ABV], By Technology (Restricted Fermentation, Dealcoholization [Reverse Osmosis, Heat Treatment, Vacuum Distillation]), By Sales Stores (Liquor Stores, Convenience Stores, Supermarkets, Online Stores, Restaurants & Bar)}), Industry Analysis Report, Regional Outlook, Growth Potential, Price Trends, Competitive Market Share & Forecast, 2019 – 2025. Report ID: GMI2776

[3] Beverage Marketing Corporation. (2022). The global non-alcoholic wine market size, share & trends analysis report by product type, by distribution channel, by region and segment forecasts, 2022-2027.

[4] National Institute on Alcohol Abuse and Alcoholism. (2021). Alcohol facts and statistics.

[5] World Health Organization. (2021). Global status report on alcohol and health 2020.

[6] "Handbook of Enology: The Microbiology of Wine and Vinifications" by Pascal Ribéreau-Gayon, Denis Dubourdieu, B. Donèche, and A. Lonvaud.

[7] "Winemaking: From Grape Growing to Marketplace" by Richard P. Vine, Ellen M. Harkness, and Theresa Browning.

[8] "The Oxford Companion to Wine" edited by Jancis Robinson.

[9] "Wine Science: Principles and Applications" by Ronald S. Jackson.