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Formulation Of Wine From *Setaria italica* and *Sorghum bicolor* (Foxtail millet and *Sorghum millet)*

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ABSTRACT

Wine is a popular alcoholic beverage that has been consumed for thousands of years. While typically made from grapes, wine can also be made from other fruits and grains. In this paper, we describe the process of extracting wine from sorghum and foxtail millets. The fermentation process of the sorghum and foxtail millets started after 24 hours, with a slightly sour smell indicating active yeast. The fermentation continued for several days, and the resulting wine had a smooth, sweet taste. The pH was around 3.5, and the alcohol content was around 8%. This alternative source of wine could be beneficial to individuals who are allergic or intolerant to grapes. Further research and experimentation are necessary to improve the quality and taste of the wine.

Overall, this study demonstrates the feasibility of producing wine from sorghum and foxtail millets, showcasing their potential as alternative sources for winemaking. The findings contribute to the expansion of the wine industry by diversifying the range of raw materials available for wine production. Further research on optimizing fermentation conditions, refining sensory attributes, and investigating potential health benefits will be valuable for commercializing millet wines and meeting consumer demands for innovative and sustainable beverages.

Keywords: Wine, millets, fermentation, alcohol content

INTRODUCTION

Wine is a popular alcoholic beverage made from fermented grapes. However, grapes are not the only source of wine. Wine can also be made from other fruits, such as apples, pears, and berries. In recent years, there has been growing interest in the production of wine from non-grape sources, such as sorghum and foxtail millets. These grains are widely grown in many parts of the world and are known for their high starch content. Starch is a complex carbohydrate that can be broken down into simple sugars, which are then fermented by yeast to produce alcohol.

Millets are cereals that belong to the Poaceae grass family. They are small-seeded grasses, many of which are adapted to tropical and desert regions, and they are distinguished by their capacity to flourish in less fertile soil.Based on the size of their grains, millets are divided into three categories :- Major Millets, Minor Millets and Pseudo Millets.

Sorghum bicolor

Sorghum bicolor, sometimes referred to as big millet and a member of the Poaceae family, is an African-born plant. Major cereal crop is sorghum in the world's semi-arid zone. Despite being a major producer of sorghum, the USA only consumes a very little amount of the grain for human consumption. In contrast, enormous populations in the semi-arid tropics of India and Africa use sorghum as their main source of food.Because phenolic chemicals like flavonoids are present in sorghum grains, they serve a crucial role in preventing the growth of tumors.

In compared to other cereals, the starches and sugars in sorghum release at a slower rate, which may be advantageous for diabetic people.Sorghum is a wholesome and nutritious grain that, when included in a diet that is balanced, can offer a number of health advantages.

Setaria italica

Foxtail millet originated in China and is currently grown in 26 nations, where it ranks second in the world's millet production. Foxtail has a high production capacity. It is the second-largest millet crop in the world and is grown for food in India, China, Africa, the United States, Russia, and some regions of Europe. Foxtail millet contains inclusive health benefiting components such starch, dietary fibers, proteins, fat, minerals and vitamins.

Foxtail millet is a good source of nutrients like protein, dietary fiber, B vitamins, and minerals such as iron, magnesium, and phosphorus.A diet including Foxtail Millet may improve glycemic control and reduce insulin, cholesterol and fasting glucose in Type-2 diabetes patients.

MATERIALS USED

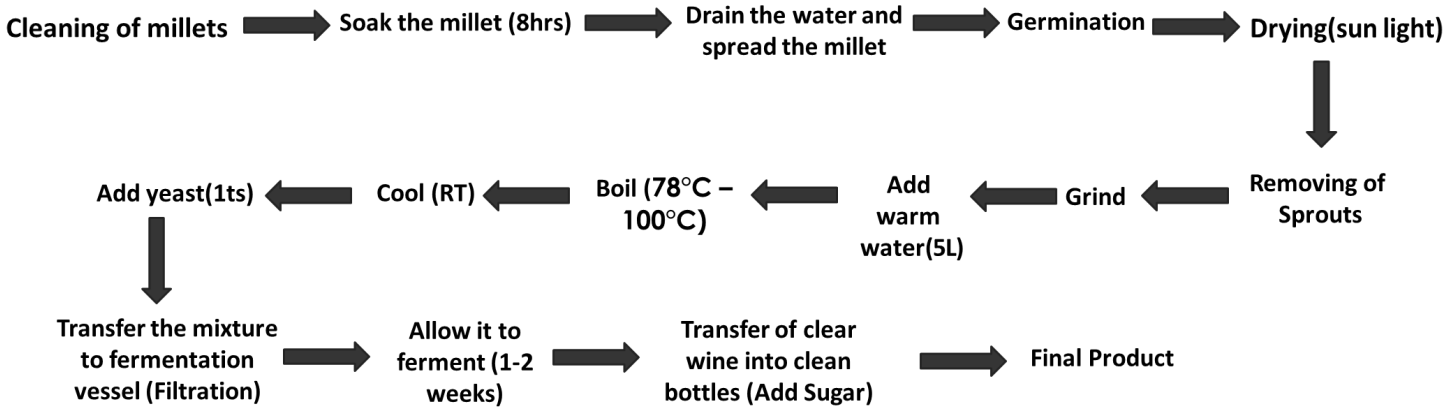
Among the grains that can be utilized to manufacture wine are sorghum and foxtail millets. These grains are used to make wine, which is made up of numerous phases including mashing, fermentation, distillation, and malting. Some of the ingredients that can be used to make wine from sorghum and foxtail millets include the following:

- **Yeast:** Utilizing yeast, alcohol is created by fermenting the carbohydrates in grains. Depending on the desired flavor and aroma of the wine, various yeast strains can be utilized.
- **Water:** Water is used to dilute the fermented mash to the required alcohol level and to moisten the grains during the malting process.
- **Acid:** Acid can be added to the mash to change the pH level, which impacts the wine's flavor and fermentation process.
- **Sugar:** To raise the wine's alcohol concentration, sugar can be added to the mash. It also acts as a sweetening agent.
- **Flavorings:** To improve the wine's flavor and aroma, flavorings like fruits, herbs, and spices can be added.
- **Equipment for distillation/filtration:** Equipment for distillation is used to remove the alcohol from the fermented mash, resulting in a product with a greater alcohol concentration.

Cleaning is done to remove any impurities or foreign matter. This can be done by winnowing, and other various methods.

In order to make millet grains safe for food, any contaminants or foreign objects must be removed from the millet grains. The steps involved in cleaning millets are as follows:

FLOW CHART



- **Sorting:** The millets are first sorted to get rid of any foreign objects that might be mixed in with the grains, like stones, dirt, or debris. This can be carried out manually or with a machine's assistance.

Fig.1.1

- **Washing:** To remove any possible dirt or dust, the millets are then properly rinsed in clean water.
- **Soaking:** Millets can be soaked in water for several hours or even overnight to eliminate any remaining contaminants

Fig.1.2

- **Draining:** The millets are drained and given a second clean water rinse after soaking.

Germination:

Germination of millets is a process of sprouting the millet grains to activate enzymes and increase their nutritional value.

The soaked millet grains are equally distributed on a damp surface or on a sprouting tray, and they are allowed to sprout for 24 to 48 hours. During this time, the grains are kept moist but not waterlogged and are covered with a cloth to prevent them from drying out.

Proper understanding and management of the germination process are critical for producing high-quality millet wine with desirable flavor, aroma, and alcohol content.Germinated millets are known to have increased levels of certain vitamins, minerals, and amino acids, which can contribute to the overall health benefits of consuming millet-based wines.

Fig.1.3

Drying:

Drying of millets refers to the process of reducing the moisture content of the millet grains to make them suitable for further process.The millet grains are spread out in a thin layer on a clean, dry surface in direct sunlight. They are turned over regularly to ensure that they dry evenly. Sun drying usually takes 3-5 days depending on the weather conditions.Proper drying of millets is important to prevent spoilage and ensure their quality.

Grind:

Grinding millets can help to release their natural sugars, which can then be fermented into alcohol.Millets can be ground using a variety of methods, including a mortar and pestle, a grain mill, or a food processor. The goal is to grind the millets into a fine powder.

Fig 1.4

Add Warm Water:

The warm water helps to activate the enzymes in the millet mash that are responsible for breaking down the starches into simpler sugars such as glucose and fructose, which can then be fermented by yeast. This process is known as saccharification. The water is added to the millets in a certain ratio 1:5.

Boil:

Boiling millets is an important step in wine making because it helps to sterilize the millets and make them more suitable for fermentation. Boiling the millets kills any unwanted microorganisms that may be present on the millets, which could otherwise interfere with the fermentation process or lead to spoilage of the wine. Here the millet was boiled at 70℃ - 90℃.

Fig. 1.5

Add Yeast:

Once the millets are prepared,yeast can be added in order to start the fermentation process.After adding the yeast, mix the millets well to ensure that the yeast is evenly distributed.About 1 tsp of yeast was added to the mixture.

Filtering:

Sorghum and foxtail millet contain a significant amount of solids, such as husks and grit, that can affect the clarity and flavor of the wine. Filtering helps to remove these solids, resulting in a clearer and better-tasting wine. Filtering was done with the help of Polypropylene filter cloth.

Fig. 1.6

Fermentation:

Fermentation is a critical step in the wine-making process from millets as it enables the conversion of sugars, development of flavor and aroma, clarification, and preservation of the wine.As fermentation progresses, the alcohol content of the wine increases and the carbon dioxide is released into the atmosphere or captured and used for carbonation. The fermentation process can take anywhere

from a few days to several weeks. Once fermentation is complete, the wine is typically aged in barrels or bottles to allow the flavors to develop further before it is bottled and sold.

Bottling And Add Sugar:

Adding sugars before the process of bottling is known as "back-sweetening", and it can be done to balance the flavors or increase the sweetness of the wine.

Bottling is the final step in the wine-making process, and it involves transferring the finished wine from the fermentation vessel to bottles. Insert the cork into the bottle, making sure it is securely in place. It is also important to use the right size and type of cork to ensure a tight seal.

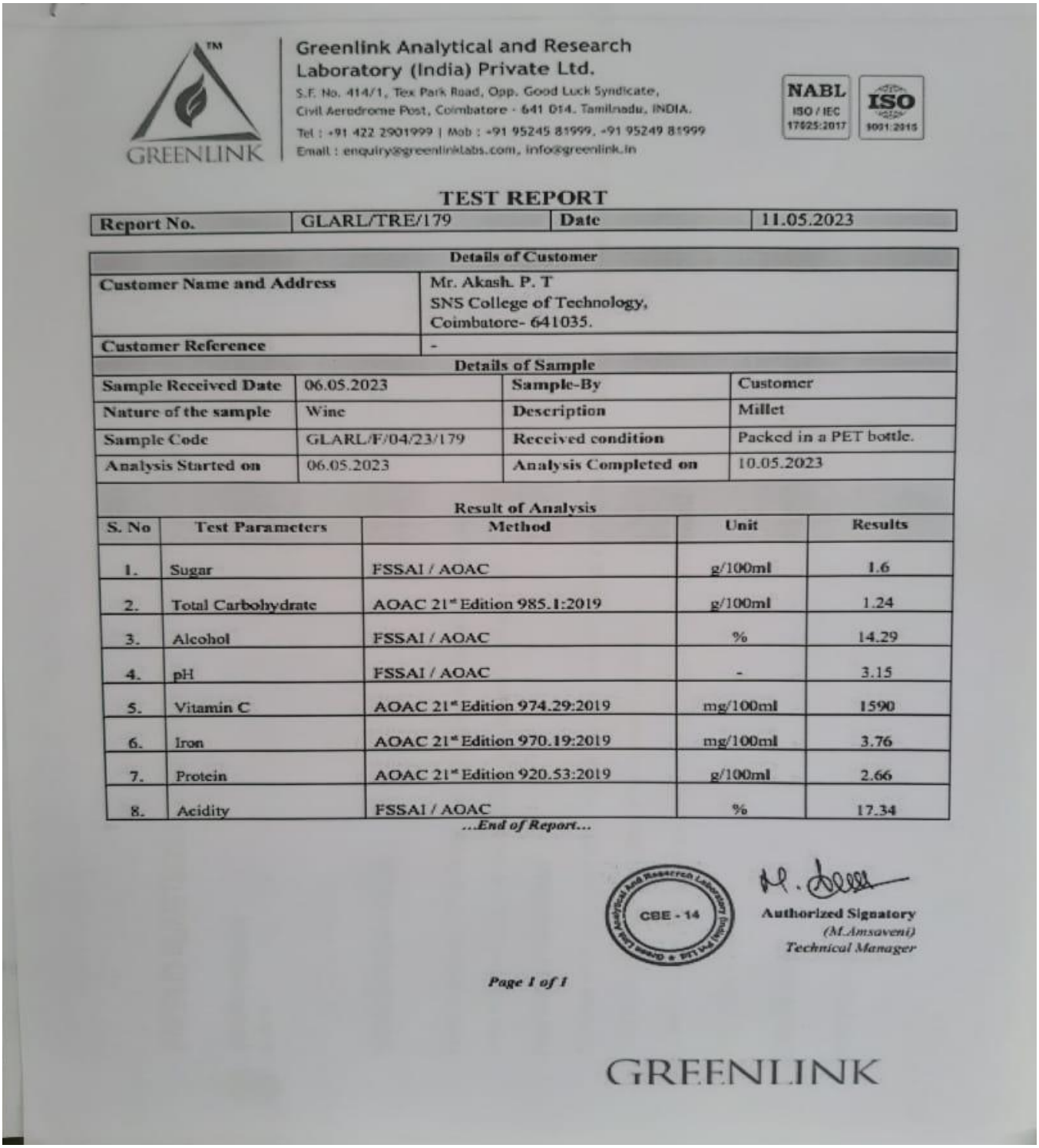
Fig. 1.7

HEALTH BENEFITS

Wine made from sorghum and foxtail can offer several potential health benefits when consumed in moderation as part of a balanced diet.Some of the potential health benefits include

- **Antioxidants:** Wine made from sorghum and foxtail contains polyphenols, which are powerful antioxidants that may help to protect the body against damage from harmful free radicals.
- **Blood sugar control:** It may also help to improve blood sugar control, as the polyphenols can help to improve insulin sensitivity and reduce insulin resistance.
- **Digestive health:** It contains probiotics that can help to promote the growth of healthy gut bacteria, improving digestion and overall gut health.
- **Immune system support:** Studies have also shown that the polyphenols in wine can help to boost the immune system, potentially reducing the risk of certain diseases.

TEST REPORT



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TEST REPORT

Report No.	GLARL/TRE/179	Date	11.05.2023

Details of Customer	
Customer Name and Address	Mr. Akash. P. T SNS College of Technology, Coimbatore- 641035.
Customer Reference	-

Details of Sample			
Sample Received Date	06.05.2023	Sample-By	Customer
Nature of the sample	Wine	Description	Millet
Sample Code	GLARL/F/04/23/179	Received condition	Packed in a PET bottle.
Analysis Started on	06.05.2023	Analysis Completed on	10.05.2023

Result of Analysis

S. No	Test Parameters	Method	Unit	Results
1.	Sugar	FSSAI / AOAC	g/100ml	1.6
2.	Total Carbohydrate	AOAC 21st Edition 985.1:2019	g/100ml	1.24
3.	Alcohol	FSSAI / AOAC	%	14.29
4.	pH	FSSAI / AOAC	-	3.15
5.	Vitamin C	AOAC 21st Edition 974.29:2019	mg/100ml	1590
6.	Iron	AOAC 21st Edition 970.19:2019	mg/100ml	3.76
7.	Protein	AOAC 21st Edition 920.53:2019	g/100ml	2.66
8.	Acidity	FSSAI / AOAC	%	17.34

...End of Report...

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Page 1 of 1

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RESULT

Name	Sorghum Wine (100 gms)	Foxtail Wine (100 gms)	Millet Wine (g/100ml)	Unit
Sugar	1.2	1.3	1.6	g/100ml
Total Carbohydrates (in gms)	2	3	1.24	g/100ml
Alcohol	1.2	4	14.29	%
pH	5.4	2.8	3.15	-
Vitamin C	329	351	1590	mg/100ml
Iron	2	6.7	3.76	mg/100ml
Protein	8 -12	8 -12	2.66	g/100ml
Acidity	-	-	17.34	%

Table 1 Nutritive Value Analysis

The primary purpose of extracting wine from sorghum and foxtail millets is the production of an alcoholic beverage rather than a significant source of essential nutrients. The nutritive value of millet wine should be considered in the context of moderate consumption and balanced dietary choices.

Overall, wine made from sorghum and foxtail millets can be a nutritious and delicious alternative to grape wine, and can provide a range of beneficial nutrients. However, as with any alcoholic beverage, it should be consumed in moderation.

CONCLUSION

As the demand for gluten-free and plant-based products continues to increase, the production of wine from sorghum and foxtail millets presents an opportunity for the wine industry to offer an alternative to traditional grape-based wine. Further research is needed to explore the potential benefits and limitations of wine made from sorghum and foxtail millets and to develop best practices for its production, storage, and distribution. Overall, wine making from sorghum and foxtail millets is a valuable and sustainable practice that has the potential to offer unique flavors and health benefits to consumers.

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