ORIGINAL RESEARCH

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Comparative Study on Effectiveness of Organic Grape Juice Vinegar Over Commercially Available Vinegar Using Chemical Titration Technique for Chicken Quality Analysis

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Abstract

Aim: In developing nations there is a huge loss in post-harvest process and making vinegar from extra fruit, which may be used to preserve some foods and snacks, is a useful technique for reducing these losses. This research was done to determine the amount and quality of innovative grape vinegar produced (sultanina). The juice from Sultanina grapes was utilized in the making of vinegar. **Materials and Methods:** Two groups are taken with 6 samples per group,G power 80%, Coincidence interval 95%. Grape juice was separated into two batches, with one receiving a 20 percent sugar addition for primary fermentation and the other receiving none. For primary fermentation, we added *Saccharomyces cerevisiae* to the juice in two separate batches. Acetic acid bacteria (acetobacter) were added and left to acetic acid production through aerobic fermentation for 15 days before vinegar was formed. **Results and Discussion**: The pH was found to be 2.36, and the acetic acid content was 7.2%. Our innovative grape juice-based vinegar production procedure increased the content of acetic acid by 2.2 percent (p =0.001) , according to the results **Conclusion:** For the product, researchers looked at color and physical/chemical qualities, and whole chicken preserved in vinegar underwent a sensory examination. When compared to commercial vinegar, grape vinegar has a high acetic acid (7.2%) content. Vinegar with a higher acetic acid concentration can aid to improve the flavour of food.

Keywords

Grape Fruit, Acetobacter, *Saccharomyces cerevisiae,* Fermenter, Innovative grape vinegar

Imprint

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Introduction

Vinegar is a condiment produced by fermenting alcoholic beverages and from sucrose rich fruit juices or from acidic foods. It can be made in a variety of ways and with a wide range of raw materials.Xiang et.al reported producing alcoholic beverages from fruits (Xiang et al. 2019). Various techniques for making vinegar exist, from the traditional use of wood barrels and surface culture to the modern use of submerged fermenters. Shimelis Admassu Emire et.al reported that using modern submerged fermenters (Emire 2012). A variety of substances are commonly used in the vinegar-making process, including red and sherry wine, white wine and rice as well as fruit juices and musts (such as grape, pineapple, apple and sugarcane juices), cider and other alcoholic beverages (such as pure alcohol). Wai Ho et. al reported that a variety of substances used in vinegar production (Ho et al. 2017). Vinegar has long been employed as a preservative in culinary preparations. Plessi et.al reported that preservatives in culinary preparations (Plessi 2003). Because of the presence of acetic acid, it primarily inhibits microbial growth while also enhancing the odor, flavor, and other sensory qualities of a wide range of meals, including chicken. Lucera et.al reported the food applications and antimicrobial properties (Lucera et al. 2012). The acetic acid in vinegar has additional health benefits via modifying liver and gastrointestinal metabolic processes. Johnston and Gass et al reported that they have so many health benefits by using acetic acid in vinegar (Johnston and Gaas 2006).

In the past five years,the total number of articles published by google scholar is 606 articles and science direct contained 402 articles. Amylases convert starch to sugar, ethanol is produced anaerobically by yeast fermentation, acetaldehyde is created, and aldehyde dehydrogenase dehydrates it to acetic acid, resulting

in acetic acid. Parapouli et.al reported the fermentation process in food & beverages (Parapouli et al. 2020). The final two stages are carried out in an aerobic environment using bacteria that produce acetic acid*)*. Gomes et.al reported that in aerobid conditions the acetic acid will be produced. About 30-40% of the acetic acid produced from fermented sugar is lost to volatilization or is transformed into other molecules. Increased aeration rates during production could raise vinegar acidity. Yin et.al reported biotransformation by acetic acid bacteria. After substrate conversion to acetic acid, vinegar can be further processed with clarifying, filtering, distillation, and pasteurization at 74°C before it is bottled, Levonen-Munoz and Cabezudo et.al reported this vinegar production process. Vinegar has a pH of 2.4 in a more acidic range, and a viscosity is around 0.92 cp at 27°C as general qualities. Ameyapoh et.al reported the pH value of the vinegar. Our team has extensive knowledge and research experience that has translate into high quality publications (Chellapa et al. 2020; Lavanya, Kannan, and Arivalagan 2021; Raj R, D, and S 2020; Shilpa-Jain et al. 2021; S, R, and P 2021; Ramadoss, Padmanaban, and Subramanian 2022; Wu et al. 2020; Kalidoss, Umapathy, and Rani Thirunavukkarasu 2021; Kaja et al. 2020; Antink et al. 2020; Paul et al. 2020; Malaikolundhan et al. 2020)

There has never been a study done that uses *Saccharomyces cerevisiae* and *Acetobacter pasteurianus* grains to make grape vinegar. Vinegar making is viewed as a technique to maximize the use of tropical fruits grown in the Philippines in profusion. Pomelo fruit (*Citrus maxima*) is a citrus fruit native to Southeast Asia that is also known as pummelo, shaddock, or Chinese grapefruit. Ripe, it's normally pale green to yellow, with pleasant white flesh (occasionally pink or red) and a thick albedo (skin covering the seeds) (rind pith). The vitamin C, sugar, and organic acid content of grapefruit is well-known. As a result, the objective of this study was to establish if grapefruit juice is an appropriate substrate for the formation of vinegar. There is an emphasis on making vinegar from grape fruit juice and testing the acidity (pH), odor, color, and taste for acceptability.

Materials and methods

The study was carried out in the Saveetha School of Engineering's Microbiology Lab at the Saveetha Institute of Medical and Technical Science in Chennai. Number of groups is 2 (Commercial vinegar and Grape vinegar).

Fruit: This study used the grape fruit (*Citrus paradisi*), a native group variety. Grape fruits weighing between 250 and 500 grams were purchased at the Saveetha fruit stall at Saveetha University in Chennai.

Microbial strain: The Saveetha University Laboratory of Microbiology provided the yeast strain *Saccharomyces cerevisiae* (Baker's yeast) for alcoholic fermentation. The acetic bacterial strain used for alcoholic fermentation was isolated from rice water after being exposed to ambient temperature. In fact, 250 ml of rice water was left out in the open for 72 hours at room temperature. After a 24 hour incubation in an incubator at 30°C, acetic bacteria were extracted from pure single colonies. Biochemical profiles like gram staining, respiratory metabolism, and acid generation from ethanol, as well as catalase and oxidase assays, were used to make the identification. A single drop of hydrogen peroxide (H_2O_2) was used to perform a catalase test on a pure microbial colony. The production of acetic acid from ethanol was achieved by adding ethanol to a mixture of yeast extract and phenol red. The oxidase and catalase tests completed the gender identification process.

Production of grape vinegar: According to the flowchart representation in Fig. 1, the production of innovative grape vinegar from grape fruit was assessed.

Two stages of the procedure were completed in succession. This study utilized two microbial strains: *Saccharomyces cerevisiae* for alcohol fermentation and acetic bacteria from rice water for acetic acid fermentation, both at 30 °C, for a total of 144 hours. To summarize, the dirt was washed out of the grape fruit and mechanical pressure was used to extract grape juice.

The juice was heated to 80°C to avoid microbial contamination and to concentrate sugar until 20°Bx. After cooling at ambient temperature, the juice was packaged in 200 mL sterile bottles. To check for bacterial contamination in the environment, one bottle was used as a control. The rest of the bottles were seeded with 2 mL of 106 CFU (colony forming unit) yeast suspension and fermented at 30°C for 144 hours. One of these seeded bottles was utilized to measure yeast biomass and alcohol concentration at any time during the fermentation process. After 72 hours, 2 ml of 106 CFU acetic bacteria were added to the culture for acetic fermentation. To make innovative grape vinegar, the fermentation was carried out at 30°C for a total of 15 days.

Determination of acetic acid: A titration of a 1 ml sample with sodium hydroxide 0.1 N and phenolphthalein as an indicator was used to measure acetic acid generation every 24 hours. The acidity of vinegar was calculated in degrees of acetic acid using the mass in grams of acetic acid in 100 g pure vinegar.

Statistical analysis

The SPSS software version 26 was used to perform a statistical comparison of the acetic acid concentrations in grape vinegar and commercial vinegar. There are no dependent variables, and the standard deviations and mean differences are independent variables (("Website," n.d.; Ameyapoh et al. 2010)).

RESULTS

The acetic acid concentrations of naturally produced vinegar and commercial vinegar were examined. Table 1 displays the percentage of acetic acid content in vinegar for both grape and commercial vinegar, as well as characteristics features such as pH, temperature, acetic acid concentration, and ethanol concentration (Brewvin vinegar). The average acetic acid concentration difference between grape vinegar (7.2%) and commercial vinegar (5%) is 2.2%. Table 2 compares the acetic acid concentrations in grape vinegar and commercial vinegar. Grape vinegar has a slightly greater acetic acid concentration of roughly 7.2% when compared to commercial vinegar (5% acetic acid concentration); the difference in acetic acid concentration is 2.2%.

In Table 3, compared the mean values, standard deviation and standard mean value for commercial vinegar and grape vinegar. In Table 4, an independent sample test reveals statistical significance (P=0.001) for acetic acid concentration differences between grape vinegar and commercial vinegar (P=0.001).

Table 1

The acetic acid content in vinegar for both grape vinegar and commercial vinegar, as well as pH, temperature, acetic acid concentration, and ethanol concentration (Brewvin vinegar).

S.NO	Vinegar	pH	Temperature	Acetic acid %
1.	Grape vinegar	2.36	30℃	7.2
2.	Commercial vinegar	2.4	30℃	5

Table 2

The acetic acid contents in grape vinegar and commercial vinegar are compared.

S.NO	Vinegar	Acetic acid concentration
1.	Grape vinegar	7.2%
2.	Commercial vinegar	5%

Table 3

The mean value, standard deviation and standard error mean for commercial vinegar and grape vinegar. pH was found to be 2.36, and the acetic acid content was 7.2%. Our innovative grape juice-based vinegar production procedure increased the content of acetic acid by 2.2 percent

	Group	N	MEAN	Std.Deviation	Std.Error Mean
Acetic acid percentage	Commercial vinegar	6	5.0000	0.00000	0.00000
	Grape vinegar	6	7.2667	0.12111	0.04944

Flowchart representation in Fig. 1 shows the production of innovative grape vinegar. Figure 2 shows a bar chart depicting the acetic acid concentrations of grape vinegar and commercial vinegar. They discovered that the concentration of acetic acid in commercial vinegar (5%) is lower than that in grape vinegar (7.2%).

DISCUSSION

For the product, authors looked at color and physical/chemical qualities, and whole chicken preserved

Table 4

An independent sample test reveals statistical significance (P=0.001) for acetic acid concentration differences between grape vinegar and commercial vinegar.

Independent Sample Test										
		Levene's Test for Equality of variances		T-test for Equality of Means						
		F	Sig.	t	df	Sig (2.tailed)	Mean diff	Std. diff error	5%confidence interval of the difference	
									Lower	Upper
Acetic acid percentage	Equal variances assumed	22.500	0.001	-45.846	10	0.000	-2.26667	0.04944	-0.26271	-0.19064
	Equal variances not assumed			-45.846	5.000	0.000	-2.26667	0.04944	-0.28010	-0.20803

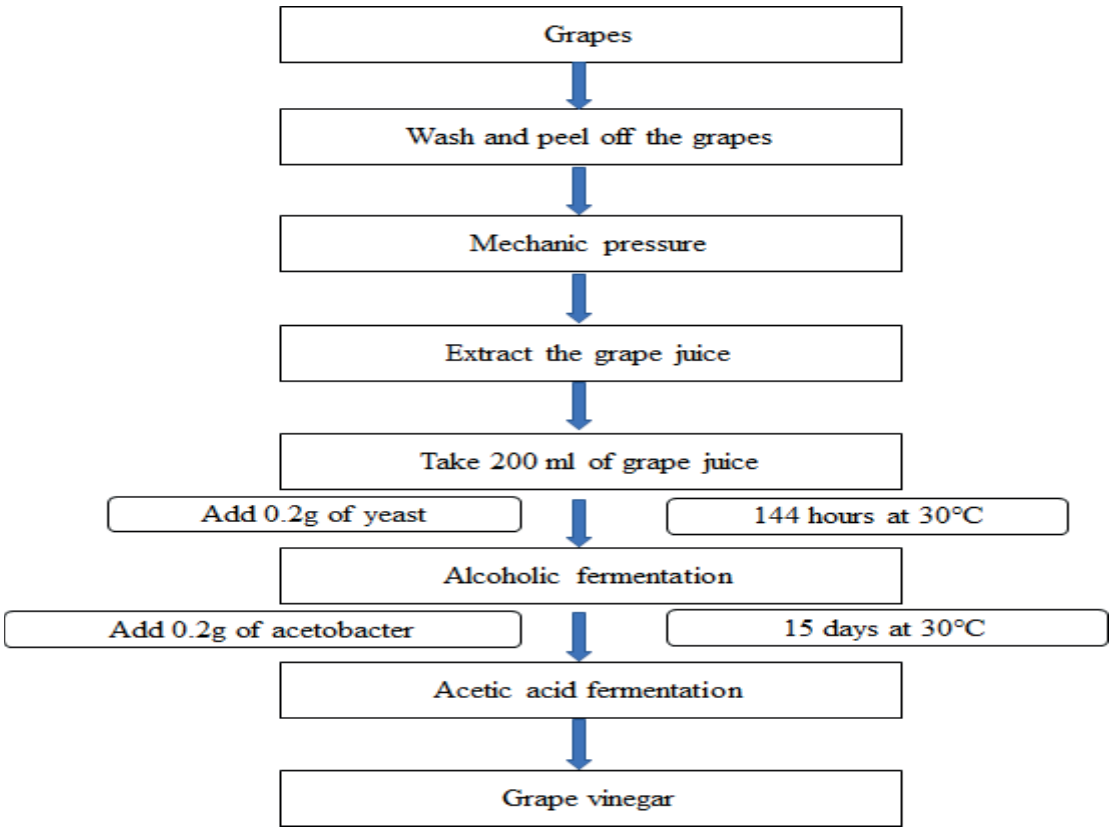

Fig. 1. Production process of grape vinegar

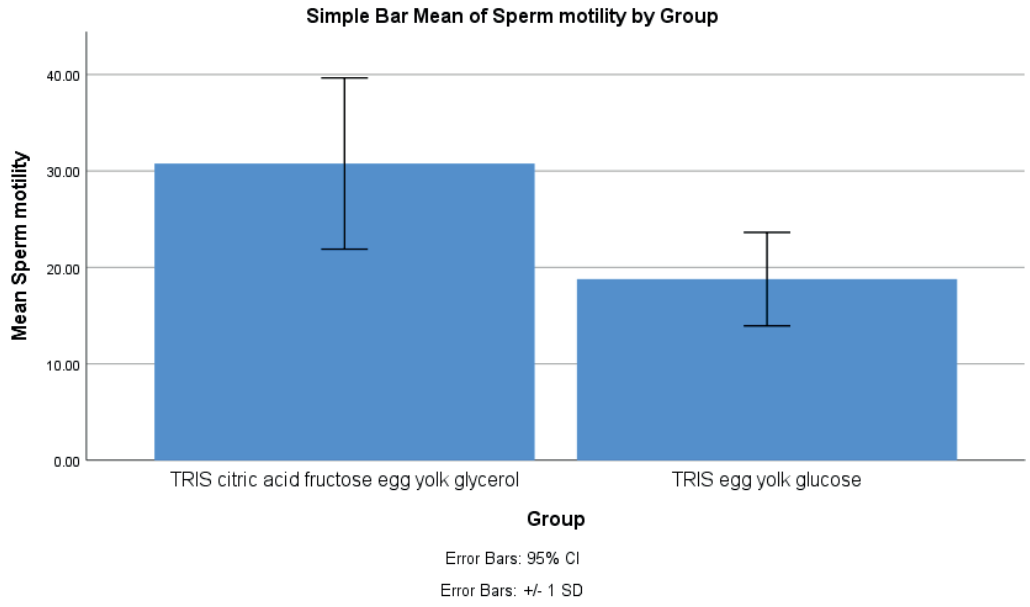

Fig. 2. Acetic acid comparison between commercial and grape vinegar. X axis:Commercial Vinegar and Grape vinegar; Y axis: Mean Acetic Acid Percentage. SD+-2.

in vinegar underwent a sensory examination. When compared to commercial vinegar, grape vinegar has a high acetic acid (7.2%) content. Vinegar with a higher acetic acid concentration can aid to improve the flavour of food.

The concentration of acetic acid in grape vinegar is higher than that of commercial vinegar. Because of the high acetic acid concentration, it is effectively employed as a food preservative, in the marinating process, and in maintaining the quality of the meal. Admas et al. remarked on the food's quality (Adams 2013). Marination flavours food and tenderises it by starting the breakdown process of the meat's tissues. It aids in the tenderization and juiciness of the chicken. Matsu-

moto et al. described the process of meat tenderization using fruit based vinegar (Matsumoto 2012). It tells about the physicochemical properties in the fermentation process. Tanamool et.al described the process of physicochemical properties in vinegar fermentation (Tanamool, Chantarangsee, and Soemphol 2020) . It acts as a preservative and helps to shorten the cooking time. Nurul Khadijah Mat Isham et al. discovered that the mother vinegar and kombucha contained acetic acid concentrations of 2.04 and 2.41 percent, respectively (Isham et al. 2019). According to Ameyapoh et al., the mango has an acetic acid concentration ranging from 0.9 to 2.1% (Ameyapoh et al. 2010).

The grape vinegar's limits include a reduction in the amount of time required for the production procedure. It can be manufactured in a large scale of grape vinegar in a short period of time. The future potential is due to genetically modified organisms producing higher concentrations of acetic acid in a shorter period of time.

CONCLUSION

This study shows grape vinegar has better quality than commercial vinegar with a statistical significance of p=0.001. When compared to commercial vinegar, grape vinegar has a high acetic acid (7.2%) content. Vinegar with a higher acetic acid concentration can aid to improve the flavour of food.

DECLARATION

Conflict of Interest

No conflict of interests in this manuscript.

Authors Contribution

Author VP was involved in data collection, data analysis and manuscript writing. Author MS was involved in the conceptualization, data validation and critical review of the manuscript.

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