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A experimental study of vinegar production from different fruit products

Yash P. Surana[1], Prathamesh G. Shende[2], Mahesh A. Suryawanshi[3], Vijay B. Mane[4], G.B.Kumbhar[5]

[1,2]*UG Student, Department of chemical engineering, BharatiVidyapeeth College of Engineering, Navi Mumbai, MH (INDIA)*
[3,4,5]*Assistant Professor, Department of chemical engineering, BharatiVidyapeeth College of Engineering, Navi Mumbai, MH (INDIA)*

Abstract: *Vinegar plays an important role in salad dressings, ketchup, hot sauce and other sauces. This need demands industrial fermentation systems capable of producing a large amount of vinegar. These systems must maintain reliable controls and optimum conditions for acetic acid bacteria fermentation. Many techniques have been developed to improve industrial production of vinegar. Most try to increase the speed of the transformation of ethanol into acetic acid in the presence of the acetic acid bacteria. Today, the most common technology for the vinegar industry is based on the submerged culture with diverse technical modifications which try to improve the general fermentation conditions (aeration, stirring, heating, etc.). The overall aim in the present study is to identify the quality and microbial differences between the generator process and submerged acidifications. Specific goals were to achieve 10-12% acidity using constructed lab scale production facilities and to characterize the species of vinegar bacteria used in acetification.*[3]

2.Introduction

TYPES OF VINEGAR

The predominant type of vinegar in the India is white or distilled vinegar. Vinegar is usually described in terms of grain strength, the grain being ten times the acid percentage. For example 10% acid is referred to as 100 grain

1. APPLE CIDER: Apple cider vinegar is made from cider or apple must, and has a brownish-gold color. It is often sold unfiltered and unpasteurized with the mother of vinegar present, as a natural product. It is often diluted with fruit juice or water or sweetened (usually with honey) for consumption as a health beverage. [4]

2. SUGARCANE: Cane vinegars from Brazil are made in two different ways. One way is to simply place sugar cane juice in large jars and it will become sour by the direct action of bacteria on the sugar. The other way is through fermentation to produce a local wine known as basi. Low-quality basi is then allowed to undergo acetic acid fermentation that converts alcohol into acetic acid. Contaminated basi also becomes vinegar.A white variation has become quite popular in Brazil in recent years, where it is the cheapest type of vinegar sold. It is now common for other types of vinegar (made from wine, rice and apple cider) to be sold mixed with cane vinegar to lower the cost. Sugarcane sirka is made from sugarcane juice in Punjab, India. During summer people put cane juice in earthenware pots with iron nails. The fermentation takes place due to the action of wild yeast. The cane juice is converted to vinegar having a blackish color. The sirka is used to preserve pickles and for flavoring curries. [4]

3. COCONUT: Coconut vinegar, made from fermented coconut water or sap, is used extensively in Southeast Asian cuisine, as well as in some cuisines of India and Sri Lanka, especially Goan cuisine. A cloudy white liquid, it has a particularly sharp, acidic taste with a slightly yeasty note.[5]

4. ORANGE PEEL, GRAPES AND TOMATO: Fruit vinegars are made from fruit wines, usually without any additional flavoring. Common flavors of fruit vinegar include apple, blackcurrant, raspberry, quince, grapes and tomato. Typically, the flavors of the original fruits remain in the final product.[6]

5. HONEY: Vinegar made from honey is rare, although commercially available honey vinegars are produced in Italy, Portugal, France, and Spain. [6]

6. RICE: Rice vinegar is most popular in the cuisines of East and Southeast Asia. It is available in "white" (light yellow), red, and black varieties. The Japanese prefer, light rice vinegar for the preparation of sushi rice and salad dressings. Red rice vinegar traditionally is colored with red yeast rice. White rice vinegar has a mild acidity with a somewhat "flat" and complex flavor. Some varieties of rice vinegar are sweetened or otherwise seasoned with spices or other added flavorings.[6]

7. POMEGRANATE: Pomegranate vinegar is used widely in Israel as a dress for salad but also in meat stew and in dips. [3]

3. PRODUCTION METHOD

Vinegar production methods can range from traditional methods employing wood casks (Orleans Process) and surface culture (Generator Process) to submerged fermentation. Vinegar is an important ingredient in many food products. The need for large amounts of the vinegar demands industrial fermentation systems that are capable of producing volumes that are reliably

controlled. Many technical devices have been developed to improve the industrial production of vinegar. Generally, these improvements increase the speed of the transformation of ethanol into acetic acid in the presence of acetic acid bacteria.

METHODS OF MAKING VINEGAR

SLOW METHOD	FAST METHOD
1.Home making	1.The generator system
2. Orleans method	2.Submerged fermentation system (Bubble method)

5.4 VINEGAR FERMENTATION

Vinegar can be produced by different methods and from various raw materials like wine, rice wine and any kind alcoholic solution. There are several major production techniques for making vinegar such as the Orleans process, the generator process and the submerged process. The Orleans process consists of wood barrels filled with alcohol liquid fermented for about 1 to 3 months at 70ºF to 85ºF (21°C to 29°C). After fermentation, 1/4 to 1/3 of the vinegar is drawn off for bottling purposes and an equivalent amount of alcoholic liquid or mash is added. The generator process was introduced by Schutzenbach in 1823. Non compacting material is filled above a perforated wood grating floor in large upright wood tanks. Re-circulated fermenting liquid trickles over the packing material toward the bottom while air moves from the bottom inlets toward the top. The recirculation process takes about 3 to 7 days after which 2/3 of the final vinegar product is withdrawn from the tank and new alcohol solution is added. In 1955, Hromatka reported on a new method of making vinegar using submerged acetification. In this process, air is forcefully supplied to alcohol liquid in a tank and the material is fermented at 86°F (30°C). At the end of every cycle, 1/3 of the liquid is discharged as final product and the submerged fermentor is refilled with 1/3 mash or fresh alcohol Solution. Then, a new fermentation cycle begins.

4. PROCEDURE

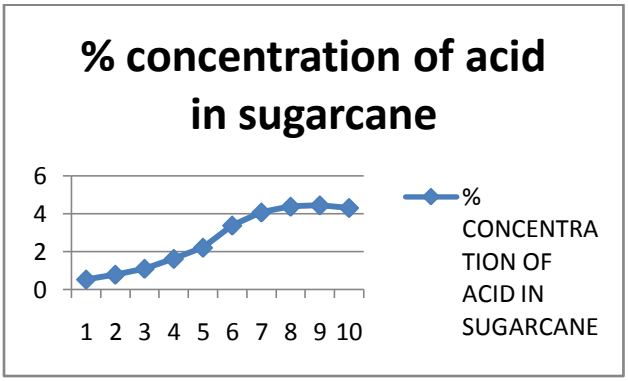
- It is necessary to sterilize the conical flask for which it is to be kept in auto cave for about 12 hrs.
- After autoclaving in conical 400ml of distill water is to be added.
- Then add Tryptone powder and yeast extract to flask in proportion of 1gm for every 100ml of distill water it is required to add 4gm of Tryptone powder and 4gm of yeast extract. (for our process we require 400ml of bacterial suspension per batch)
- Using Nichromelooptake loop full of bacteria from culture tube and transfer it in flask carefully. This transfer process has to be carried out under heap air filter in order to maintain purity of bacteria.
- At last add glucose and calcium carbonate to prepared solution with same proportion as taken for Tryptone powder and yeast extract.
- Keep suspension solution undisturbed for next 24 hrs.
- This solution then can be viewed under microscope to ensure the growth of bacteria (While carrying out every single step utmost has to take of maintaining purity of culture tube and bacterial suspension).
- This prepared solution can be includedin beech wood having in generatorstrength calculation of project
- For strength estimation of vinegar simple procedure of titration can be followed.
- Take 10ml of product sample in conical flask ad 2-3 drops of phenolphthalein indicator toit.
- Rinse and fill the burette with 0.1N NaOH.
- Titrate of flask against burette solution.
- Note the volume of NaOH consumed.
- Follow same procedure for different time.
- **Gram Stain**
- The Gram stain method can be used to classify gram-positive or gram-negative bacteria. Gram staining can narrow down the identity of vinegar cultures to gram-positive and negative classes, and then the cultures can be identified to a specific species by using the polymerase chain reaction (PCR).
- For the Gram stain, 1ml of culture sample was placed into a 1.5ml Eppend tube and centrifuged 12gm. for 8 min.
- A drop (approximate 0.18 gram) of the bacteria culture sample was removed from the tube, smeared on a slide, and allowed to dry.
- After drying, the bacteria were heat fixed to the slide. Crystal violet pigment was added to the smear for 1 minute. After 1 minute, the pigment was washed off with distilled water.
- Then iodine was applied for 1 minute. The iodine was Water Bath Thermometer Nichrome loop Holder and washed off with distilled water again.
- the smear was decolorized with 95% ethyl alcohol for 3 seconds. The alcohol was removed with distilled water and the smear was counterstained with safranin for 1 minute.

- The safranin was removed with distilled water and the slide dried with a paper towel. After drying, the slide was mounted under a microscope (Optics, IL) with 10X100 magnification.
- A pink color demonstrates gram-negative character and a blue color indicates gram-positive. Vinegar cultures are predominantly gram-negative bacteria.
- **Result of gram strain:**

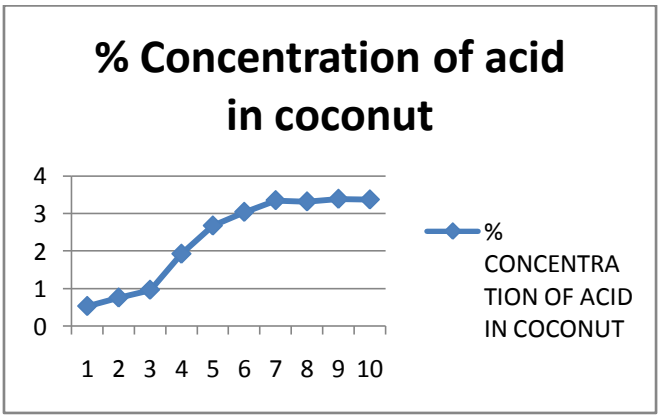
Name of fruit products:	Colour	Result	Conclusion
Apple cider	Pink	gram-negative	Vinegar is present
Sugarcane	Pale pink	gram-negative	Vinegar is present
Coconut	Pale pink	gram-negative	Vinegar is present
Orange peel	Pink	gram-negative	Vinegar is present
Grapes	Pale pink	gram-negative	Vinegar is present
Tomato	Pale pink and lighter blue	gram-negative or gram-positive	Vinegar is may be present
Honey	Pink	gram-negative	Vinegar is present
Rice	pink	gram-negative	Vinegar is present
Pomegranate	Pink	gram-negative	Vinegar is present

5. Result and Discussion

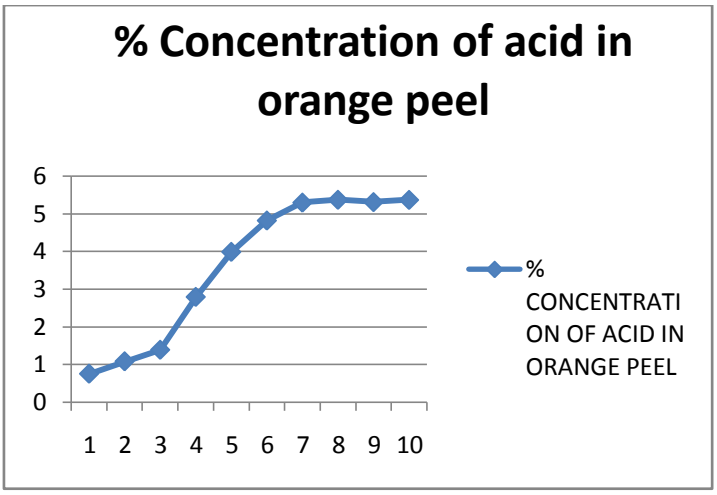
- Sugarcane: In sugarcane acetic acid contain is constantly increase and at the day 10^{th} is 4.303.



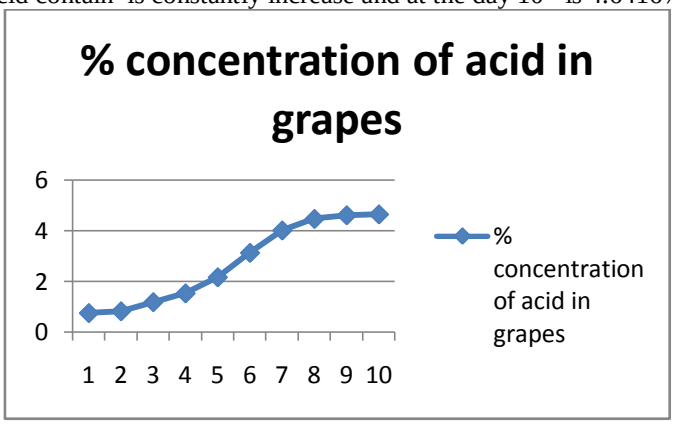
- Coconut:In the Coconut for first three days acidic concentration increase slowly later in day 4^{th}, 5^{th} , 6^{th} ,7^{th} sudden increase in acidic concentration of Coconut then constant percentage is arrived ,at 10^{th} day %concentration of acetic acid in coconut is 3.371%.



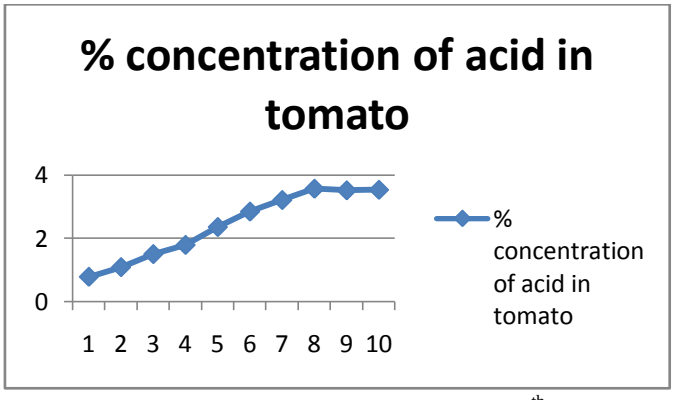
- Orange peel:In theorange peel for first three days acidic concentration increase slowly later in day 4^{th}, 5^{th} , 6^{th},7^{th} sudden increase in acidic concentration of orange peel then constant percentage is arrived ,at 10^{th}day %concentration of acetic acid in Orange peel is 5.3682%.



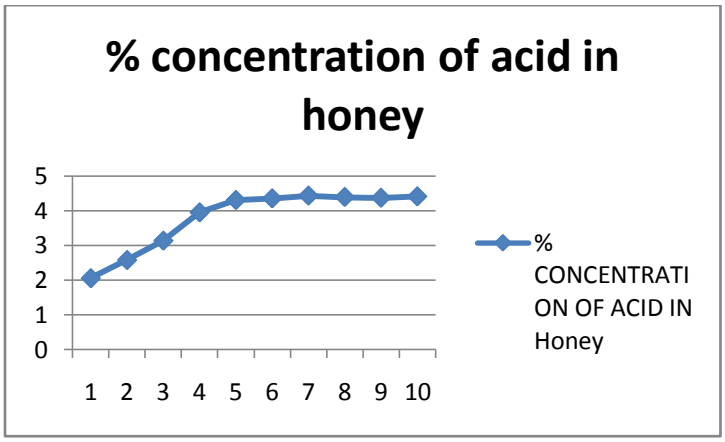
- Grapes: In Grapes acetic acid contain is constantly increase and at the day 10^{th} is 4.6416%.



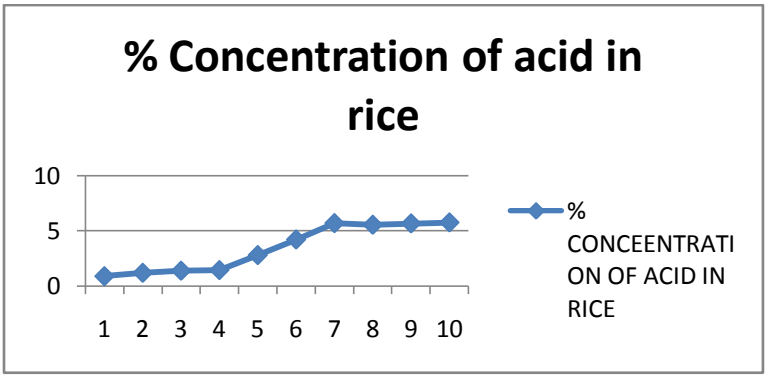
- Tomato:In Tomato acetic acid contain is constantly increase and at the day 10^{th} is 3.5393%..



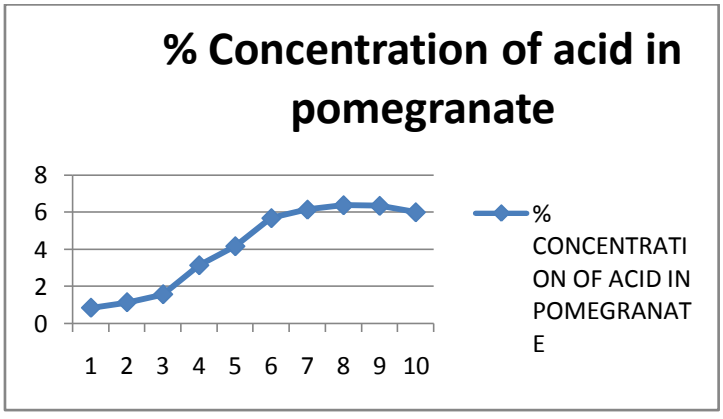
- Honey:Honey having acetic acid contain more precisely increase up to 5^{th}day later constant % concentration of acetic acid in honey and at the day 10^{th} is4.4104 %..



- Rice:In the rice for first four days acidic concentration increase slowly later in day 5^{th} ,6^{th} ,7^{th} sudden increase in acidic concentration of apple cider then constant percentage is arrived ,at 10^{th} day %concentration of acetic acid in apple cider is 5.7398



- Pomegranate:In the pomegranate for first three days acidic concentration increase slowly later in day 4^{th} ,5^{th} ,6^{th} sudden increase in acidic concentration ofpomegranate then constant percentage is arrived ,at 10th day %concentration of acetic acid in pomegranate is 6.00%.



6. Conclusion

Vinegar need demands industrial fermentation systems capable of producing a large amount of vinegar. These systems must maintain reliable controls and optimum conditions for acetic acid bacteria fermentation. Pomegranate, apple cider are the main source of aceto-bacteria. It contain more than 6% acid concentration.Our techniques have been developed to improve industrial production of vinegar. Most try to increase the speed of the transformation of ethanol into acetic acid in the presence of the acetic acid bacteria. From the above results, it is seen that Pomegranate and Rice gives the maximum concentration of acid. Further study will be done on the cost effectiveness aspects of the process.

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