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A REVIEW ON THE PREPARATION OF VINEGAR FROM FRUIT PEELS.

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ABSTRACT

Vinegar is the product obtained exclusively through biotechnological processes such as double fermentation, alcoholic acetic fermentation of the liquid. There are various types of vinegars obtained from various sources such as from fruit peels and berry, cider, malt and honey. vinegar is used as a food additive and also acts as effective preservative against food spoilage. Various investigators have carried out investigations on vinegar production from various raw materials such as fruits, fruit peels, and other agricultural feed stocks. The present review summarizes research and studies carried out on vinegar production.

KEYWORDS: *Acetobacter aceti* , Fruit peels, Fermentation, Vinegar.

INTRODUCTION

Vinegar was known as a seasoning or food preserving agent. Vinegar is defined as "a liquid fit for human consumption, produced from suitable raw material of agricultural origin, containing starch and sugars by the process of double fermentation, alcoholic and acetous, and contains specific amount of acetic acid".[1] Vinegar, a traditional acidic condiment is widely produced from rice, malt, apple, wine and other agricultural material.[2] Vinegar production ranges from traditional methods employing wood casks and surface culture to submerged fermentation in acetators.[3] Vinegar fermentation is essentially a two stage process, being the first one of the anaerobic conversion of fermentable sugars to ethanol by yeasts, usually Acetobacter species[4][5] Horiuchi *et al.*, 2000). Acetic acid yield from fermented sugar is approximately 40%, with the remaining sugar metabolites either lost to volatilization or converted in to other compounds. Vinegar traditionally has been used as a food preservative. Whether naturally produced during fermentation or intentionally added,

Vinegar retards microbial growth and contributes sensory properties to number of foods. The wide diversity of products containing vinegar (sauces, ketchup, mayonnaise etc.) and the current fall in wine consumption have favored an increase in vinegar production.[6]

Acetic acid is the predominant flavoring and antimicrobial component in vinegar. The following review will focus on the importance of acetic acid as direct food additive or more recently as a food processing aid, to decontaminate food prior to distribution and consumption.[7]

Earlier process used for making vinegar were the orleans process(which is also known as the slow process),the quick process(which is also called the generator process), and the submerged culture process. The quick process and submerged culture process were developed and are used for commercial vinegar production today.

Acetic acid is formed in a four step reaction involving conversion of starch to sugar by amylases, anaerobic conversion of sugars to ethanol by yeast fermentation, conversion of ethanol to hydrated acetaldehyde, and dehydrogenation to acetic acid by aldehyde dehydrogenase.[8] The last two steps are preformed aerobically with the aid of acetic acid forming bacteria. Acetic acid yield improvements can be achieved using high rates aeration of during continuous production.[9]

Vinegar bacteria, also called acetic acid bacteria, are members of the genus *Acetobacter* and characterized by their ability to convert ethyl alcohol (C_2H_5OH) into acetic acid(CH_3COOH) by oxidation as shown below,

Anaerobic Aerobic

$$\mathbf{2C_2H_5OH \rightarrow 2CH_3CHO \rightarrow 2CH_3CO_2H + 2H_2O}$$

Common types of vinegar include white distilled vinegar, cider vinegar, wine vinegar, rice vinegar, and malt vinegar. Further processing of vinegar, following substrate conversion to acetic acid may include filtration, clarification distillation and pasteurization at 165.2°F (74°C) before it is bottled. Regulations in the United States requires vinegar to contain at least 4% acetic acid resulting from acetic acid fermentation of ethanol containing substrates. Labels identifying the diluents used to meet the listed concentration of acid are also required. Acetic acid concentration in vinegar may be expressed using the term “grain”. For example, 100 grain distilled vinegar is a 10% acetic acid solution.[10] If higher concentration of acetic

acid is required, the dilute solution of acetic acid may be heat distilled or frozen to slush. The slush is centrifuged to isolate the liquid portion.[11] Concentration from 10-30% may be achieved using this using this technique.

Vinegar plays a very important role in salad dressings, ketchup, hot sauce and other sauces. This need demands industrial fermentation system capable of producing a large amount of vinegar. These systems must maintain reliable controls and optimum conditions for acetic acid bacteria fermentation.[13] Many techniques have been developed to improve industrial production of vinegar. Most try to increase the speed of the transformation of ethanol in to acetic acid in the presence of the acetic acid bacteria.[14] Today, the most common technology for the vinegar industry is based on the submerged culture[15] 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 difference between the generator process and submerged acetification. 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.

REVIEW ON PRODUCTION OF VINEGAR

Production of vinegar from pineapple peels using Acetobacter species isolated from soil sample and its antimicrobial activity by Sarkar *et al.*,2012.[16] The study investigates and reveals that acetobacter species. *Saccharomyces cerevisiae* was isolated from soil sample. Identification was done by performing morphological, biochemical and cultural characteristics of bacteria and fungi. Firstly, wine by *Saccharomyces cerevisiae*, confirmed by performing CO_2 production and iodoform test. The wine produced was inoculated with acetobacter species. It is incubated for 11days aerobic fermentation at 37℃ it was calculated that 4.60% of vinegar was produced.[8] The antibacterial activity of vinegar was tested against *Escherichia coli, Staphylococcus aureus, Salmonella paratyphi and Pseudomonas aeruginosa.* The result of antibacterial activity of vinegar against *Escherichia coli*-16mm ,*Staphylococcus aureus* -20mm, *Salmonella paratyphi* -19mm, and *Pseudomonas aeruginosa* -19mm. subsequently up on this research they concluded that materials like pineapple peel considered generally as waste can be bio converted in to important value- added materials thus aiding environmental safety.

Study of pineapple peel processing into vinegar by biotechnology done by Seyram *et al.*, 2009.[17] The study was done to find the possibility of using peelings of pineapple fruit for vinegar production trough biotechnology to reduce the post-harvest losses of pineapple local variety egbenna by the transformation of juice into vinegar was produced through two successive fermentation is alcoholic and acetic fermentation. They concluded that a strain of yeast named saccharomyces cerevisiae and an acetic bacteria named acetobacter species and acetic bacteria have been isolated pineapple juice. The production of pineapple vinegar to atleast 4.5, brix 5.3%, pH 2.8 requires 23 to 25 days for alcohol and acetic fermentation. Acidity stressful and fungicide on yeast during the production of vinegar and is no longer necessary to develop in the process, an elimination of yeast before beginning the acetic fermentation.[5]

The sugar tolerance is an important technological factor for the growth of acetic bacteria during pineapple juice. Acetic fermentation unlike that of ethanol which has no limit to the growth of acetic bacteria. From all these results they concluded that post- harvest losses of pineapple fruits may be used to vinegar and have a commercial value.[10]

Vinegar production from pineapple wastes was carried out by Arianna Roda *et.al.*,2014.[18] Their research was aimed at completely processing pineapple wastes in to vinegar which may be then used as dressing, food preservative, and disinfectant. They cut and chopped the fruit waste then divided it in to samples of peel and core. Then distilled water was added. For changing yield, they arranged physical treatments in order to disaggregate the fibrous structures followed by enzyme treatments to breakdown cellulose polymers and to hydrolyse sucrose also invertase was added.[18] They obtained more than 100g of reducing sugars per kg fresh peels and about 330g of reducing sugars per kg of fresh core. Praveena and Estherlydia carried out studies on phytochemical screening and antioxidant capacities of vinegar made from peel and fruit of pineapple. They produced vinegar from the peel and fruit of pineapple, sugar and starter culture. They assessed the phytochemical properties and antioxidant activity of pineapple peel versus fruit vinegar. They obtained yellow coloured vinegar from the pineapple fruit mixture. They observed that antioxidant content of peel vinegar (2077mg acetate equivalence/100ml) was higher compared to that of fruit vinegar. They concluded that pineapple peel vinegar can be produced in large scale and marketed for its therapeutic effects.[19]

Bioconversion of papaya peel waste in to vinegar using acetobacter aceti carried out by Vikas.O.V and Mridual umesh.[20] The study revealed that dilute acid hydrolysis resulted in the conversion of complex sugars in papaya hydrolysate in to simpler fermentable sugars. During the anaerobic fermentation , amylase from yeast initially break the starchy residues further into monomeric residues. These residues are utilized for ethanol production. The total ethanol content was found to be 8.11%.finally the acetic acid fermentation is carried out via the conversion of ethanol to hydrate acetaldehyde and dehydrogenation of acetaldehyde to acetic acid by aldehyde dehydrogenase produced by *Acetobacter aceti*. They concluded that production of vinegar from papaya peel suggested an adoptable methodology for turning an potential waste in to a commercially important organic acid.

FUTURE PROSPECTIVES

Vinegar is very important food preservative in food industry. The vinegar can be obtained various raw materials such as various fruits and fruit peels. Various agricultural waste materials can also be used as raw materials. It was observed during various investigations that enzymatic treatments of pineapple wastes had a significant effect on the saccharification process. Also review indicated that Pineapple peel vinegar had comparatively high total phenol content and antioxidant activity. Apple vinegar was also obtained through classical methods by few investigators. It was also found that that fermentation is a better method for obtaining higher antioxidant activity of Roselle products. It can be concluded that, to produce chemicals and pharmaceuticals in optimal way, still substantial amount of research is needed. The effort of waste minimization would substantially reduce the large quantities of fruit wastes accumulated globally.

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