Conversion of Industrial Waste of Pineapple (Peel) into Vinegar by Accelerated Method for Commercialization

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Abstract

Pineapple (*Ananas comosus* L.) is a popular fruit among Sri Lankans. The peel (41 % of whole fruit) is usually discarded during its processing, and high amount of sugars in the attached flesh of pineapple peel favorable substrate for fermentation process. The present study was focused in production of pineapple peel vinegar in two modes i.e., development of condiment (3% acetic acid) with spice addition and development of vinegar (4% acetic acid) for commercialization. Mature pineapple (*Anans comosus L*) peel (Mauritius) obtained from a fruit processing industry was used for the study. Spice added condiment was produced by two-step process, i.e., alcoholic and acetic acid fermentation using pineapple peel. Alcoholic fermentation was done in both 25±1°C and room temperature (30±1°C) until the alcohol content reached 9% (w/v). Acetic acid fermentation was carried out with unpasteurized vinegar (*Acetobacteraceti)* with continuous aeration until acid level reached 2% and 3% (in separate batches) followed by pasteurization (72°C, 15 sec) and filtration using muslin cloth. Crushed (0.5-1.0 mm) cardamom and cinnamon were added separately at 1.5 and 2 % (w/v) levels to the above condiments and were aged at room temperature for two weeks. Spiced condiment were obtained by filtration and subjected to sensory evaluation. The best temperature found for alcohol fermentation was 25°C ($P< 0.05$). The 3% acetic acid incorporated with 1.5% of cardamom showed the highest ($P< 0.05$) Total Phenolic Content (4.87±0.03 mg gallic acid equivalent /mL) and Total Flavonoid Content (2.07±0.02 catechin equivalent / mL) and DPPH radical scavenging activity (9.81 μ mol/g ±0.38) followed by 2% of Cinnamon added sample. Sensory panelist were preferred 3% acetic acid incorporated 2% cinnamon >1.5% cardamom. It took 4 weeks for the production of spiced condiment.

Optimization of alcohol fermentation process in the 2nd study was carried out with three-sugar concentration (16, 18 and 22°brix) and three methods of sugar addition (adding sugar at once,

adding equal portions sugar in four days, gradual addition of sugars i.e. 36% in 1st and 2nd day and 28% in 3rd day). Gradual addition of sugar with 18°brix produced highest alcohol (13.5 %) within 5 days, thus it was used to optimize acetic acid fermentation with 5% (w/v) of mother pineapple peel vinegar (1.4 x 10^5 CFU/mL). In addition, acetic acid production was tested with five levels of unpasteurized coconut vinegar (0%, 10%, 15%, 20% and 25% v/v) with different rates of aeration (0, 15, 30, 60 and 120 L/hour/L of liquid). Further, effect of addition of wood shavings i.e. *Albizia lebbeck (L.) Benth* (Albizia) and *Pongamiapinnata (L.) Pierre* (Beech) in order to increase fermentation rate was tested with mother pineapple peel vinegar and 15 L/hour/L aeration which was selected as the best. Beech wood shavings added sample produced vinegar with 5.03% acidity within 4 days at 29°C and showed better functional properties i.e. Total Phenolic Content (0.476±0.01 mg gallic acid equivalent/mL), Total Flavonoid Content (41.67±4.41 mg rutin equivalent/ mL) and DPPH radical scavenging activity (61.33 % ±3.51). The produced vinegar contains acetic acid 77.53 %, Glycerin 13.7 %, 2,3-butanediol 3.02 %. It can be concluded that industrial waste pineapple peel can be successfully utilized to produce functional vinegar within 9 days and the process is environmental friendly and commercially feasible. Converting pineapple peel into a condiment or vinegar could save huge wastage in an environmental friendly manner.

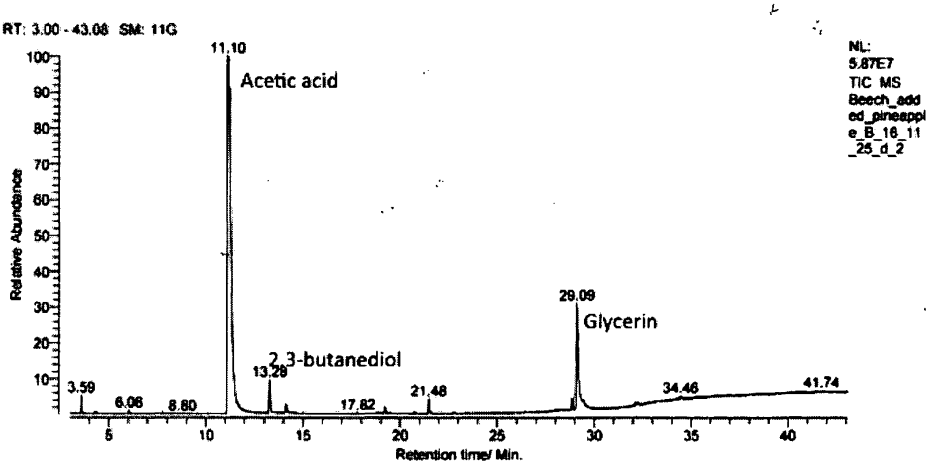

Figure 1: GC-MS Spectrum of Beech wood added pineapple peel vinegar

Keywords: Pineapple peel functional vinegar; *Pongamiapinnata (L.) Pierre* (Beech) wood shavings; Spice added condiment; Accelerated process

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