pH Value, Total Microbes, Alcohol Content and Overall Hedonic Characteristic of Ginger Ale

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pH Value, Total Microbes, Alcohol Content and Overall Hedonic Characteristic of Ginger Ale

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Abstract. Ginger Ale is a type of beverage that is quite well-known in the United States and Europe as a form of beverage that is affiliated with the basic ingredients of rhizomes (roots). This research aims at to analyse the pH value, total microbes, total sugar and overall hedonic properties of ginger ale with palm sugar substitution to white sugar namely T0 = 0%, T1 = 25%, T2 = 50%, T3 = 75%, T4 = 100%. Each treatment was done in 4 replications. The parameters tested were alcohol content, pH, total Saccharomyces and hedonic yeast. The data obtained were analyzed using ANOVA at a significance level of 5% and if there was a difference it was then analyzed by the Duncan Multiple Range Test. Hedonic test result was analyzed using Kruskal-Wallis test with a significance level of 5% and if there were differences then continue to be analyzed using Mann Whitney test. Based on the research, it can be concluded that the substitution of white sugar with palm sugar in ginger ale had significant influence on the level of alcohol content and pH value while had no significant effect on total microbes. Regarding hedonic quality, ginger ale with 75% palm sugar substitution showed as the most preferred formula for ginger ale.

1. Introduction

Ginger is one of biopharmaceutical plant that is comprised of fat, protein, starch, water fiber, ash, volatile oil and resinous matter [1]. It contains natural bioactive components that functions as antiemetic [2], cancer prevention agent [3], antipyretic[4], antioxidant and anti-inflammatory [5]. According to data from the Central Bureau of Statistics Indonesia in 2018, ginger production reached 178,000 kg with the highest harvested area among other biopharmaceutical plant which is 10205.03 hectares. There are three types of ginger in Indonesia and each type demonstrated distinctive level in its prungency due to the different amount of some homologous phenolic ketones, specifically 6-, 8-, 10-gingerol and 6-shogaol that have been distinguished as the main impactful bioactive compound in ginger [6]. The types include white ginger (*Z. officinale var amarum*), elephant ginger (*Z. Officinale var officinarum*) and red ginger (*Z. officinale var rubrum*) and red ginger are generally utilized for dietary enhancement or homegrown prescriptions, while the elephant ginger is typically utilized for cooking flavors or herbal drink [7].

Flavor drink made from elephant ginger in Indonesia is still limited to "Wedang jahe", which is made by boiling the ginger or ginger powder in water. Therefore, due to its potency and high production volume, innovative approach is needed in processing elephant ginger into indigenous

beverages. The Ginger beer (Ginger ale) is a type of beverage that is quite well known in the United States and Europe as a form of drink that is based on rhizomes (roots), just like root beer in general, made from Sarsaparila root [8]. The addition of sugar is an important part in the brewing process. Palm sugar that is known as traditional sweetener with low glycemic index [9] can be potentially used as substitution for white sugar usage in the making of ginger beer thus make it become indigenous flavor drink.

Based on the literature, there was no research that focuses on the substitution of white sugar with palm sugar in the production of ginger ale. Henceforth, this research aim was to analyse the pH value, total microbes, total sugar and overall hedonic properties of ginger ale.

2. Materials and Methods

The Materials used in this research were obtained on a local traditional and modern market with the intention of easy and affordable material gathering.

2.1 Materials

The ingredients used in this study were fresh elephant ginger, bread yeast powder, honey, lime, granulated sugar, palm sugar, water. All ingredients were obtained from the market in the Tembalang area, Semarang, Central Java. The tools used were plastic bottles, grated tools, alcohol meters, scales, 1mm hose pipes, spoons, iron filters, gas stoves, pans, teaspoons.

2.2 Methods

The Methods conducted in this research include research designing, fresh material prep and mixing, pasteurization and fermentation, alcohol volume test, microbes test and hedonic and preference test.

2.3 *Research design*

The design used in this study was to use a Completely Randomized Design (CRD) using a treatment with a ratio of white sugar and palm sugar in grams were as follows 0: 200 (T0), 50: 150 (T1), 100: 100 (T3), 150: 50 (T4), 200: 0 (T4). Each treatment was carried out in 4 replications. The results obtained were marked with a hypothesis in the form of; there was a significant difference in treatment of controls ($P < 0.05$) and there was no significant difference in treatment of controls ($P > 0.05$) with the following hypothesis; H0: there is no effect of substituting white sugar with palm sugar in ginger beer products and H1: there is at least one treatment for substituting white sugar with palm sugar in ginger beer products.

2.4 *Preparation of Ginger Ale*

Ginger was cleaned and cut using a stainless steel knife. Latex gloves were used in this process to prevent direct contact with ginger. Cleansed lime was also prepared according to the treatment and cut into 2 parts. White sugar and palm sugar were then carefully weighed and adjusted for treatment. Ginger that has been cleaned was then sliced into small pieces and then the lime was cut into 4 parts and put into a pan along with ginger. 500 ml of water was added to the pan and heated on the stove, the ingredients were heated and then stirred with a stirring spoon to be homogeneous.

2.5 *Pasteurization and Fermentation*

The mixture of ginger and lime was pasteurized using the HTST method (high temperature short time) at a temperature of ± 83^0C for 25 seconds. The mixture of ginger and lime juice then was allowed to cool in room temperature before adding it to the bottle and adding yeast. Instant yeast (5 g) then was mixed with warm water at 40^0 C then was added with sugar according to the treatment. Fermentation was carried out in plastic bottles under anaerobic conditions at room temperature (± 30^0 C) and were carried out for 3 days for all treatments.

2.6 *Alcohol Content*

The test was conducted using alcoholmeter (i.e hydrometer). The calibrated hydrometer probe was inserted and held up to its stationary position or equiblirium situation, then the test fluid that has been inserted into the probe can be read at a number that was tangent to the test fluid meniscus.

2.7 *Total Microbes*

The total test of *Saccharomyces* on ginger jam was carried out by total plate count (TPC) technique with dilutation. The medium used for the test was PDA (Potato Dextrose Agar). Ginger beer samples from each treatment was diluted with Physiological NaCl solution of 0.85% from 10-4 to 10-6. This capturing was done twice (duplo) for each dilution. After being carried out, the cup containing the PDA and the sample was then incubated for 48 hours at 37 ° C. TPC was carried out using PDA medium and then incubated at 37 ° C for 48 hours. The incubation caused colony formation on the PDA. These formed colonies will then be counted.

2.8 *Hedonic Test*

Panelists were given samples T0, T1, T2, T3 and T4 of ± 20 ml with random codes according to the treatment. Panelists provide an assessment of the product in the form of a score on the organoleptic test blank for the test parameters. Sensory testing was carried out by a hedonic test to determine the quality of the best ginger beer and which product is most preferred by consumers. The test scale used was a scale of 1 to 5, namely: 1 = very dislike, 2 = dislike, 3 = rather like, 4 = like, 5 = really like, with typical flavor parameters of ginger as a consideration of the preferences of panelists and consumers.

2.9 *Data analysis*

Data on alcohol content, pH level, total sugar and total Saccharomyces were analyzed using ANOVA (Analysis of Variance), followed by Duncan Multiple Range Test and hedonic data were analyzed by nonparametric test, namely the Kruskall-Wallis test and followed by the Mann-Whitney test. All data were processed using SPSS Version 24.00.

3. Results and Discussion

Alcohol that was formed as a result of sugar degradation during brewing process of ginger ale with different level of sugar substition was depicted at the table below.

Table 1. Alcohol Content of Ginger Ale

Sample	Alcohol Content(%)
T0	2,64±0,05
T1	2,71±0,09
T2	3,48±0,51
T3	3,74±0,07
T4	3,87±0,10

Based on table 1., the value of alcohol content in the substitution treatment of palm sugar 0%, 25%, 50%, 75% and 100% respectively were 2.64%, 2.71%, 3.48%, 3.74% and 3.87%. There was a tendency to increase within the increasing substitution composition.

The results of statistical analysis on the value of alcohol content showed differences in the level of substitution of white sugar with brown sugar had an effect ($P < 0.05$) on the value of alcoholic content of ginger beer. This might be due to the different fermentable sugar content on each treatment. Palm sugar is comprises of fructose, sucrose and glucose [9]. Hence during brewing process, fermentable sugars such as glucose, fructose, maltose, and sucrose as a source of carbon will turn into pyruvate then turn into ethanol by yeast fermentation [10]. The starch content in the raw ginger can affect the fermentation process [11] the higher the starch contain the higher the alcohol level might be. Other

than that, a few physical (temperature, osmotic pressure), chemical (pH, oxygenation, minerals supplements and natural inhibitors) and microbiological factors (kind and grouping of yeast strain, bacterial contamination) also influence the aging productivity and the proficiency of change of sugar to ethanol [12].

Table 2. Total Microbes of Ginger Beer

Sample	Total *Saccharomyces cerevisiae* (cfu/ml)
T0	Uncountable
T1	$1{,}97x10^6$
T2	Uncountable
T3	$1{,}74x10^6$
T4	$1{,}29x10^6$

Based on table 3, the total *Saccharomyces cerevisiae* in ginger beer with palm sugar substitution 0%, 25%, 50%, 75% and 100% respectively were uncountable, 1.97x106, uncountable, 1.74x106, 1.29x106 where the lowest amount was T4 (1,29x106) and the highest was T0 and T2 which was uncountable. This phenomenon occured because the ginger beer products in this study was included in the types of active alcoholic beverages, where yeast can still reproduce well in an atmosphere of ginger beer that has low alcohol content and nutrients from white sugar sucrose, as well as palm sugar [13].

Table 3. Hedonic Quality of Ginger Ale

Parameter	Treatment				
	T0 0%	T1 25%	T2 50%	T3 75%	T4 100%
Ginger Taste	2,97±1,16	2,87±1,16	2,90±1,16	3,47±0,97	2,77±1,14

The results of statistical analysis showed differences in the substitution rate of white sugar with palm sugar had no effect (P> 0.05) on the organoleptic (aroma) properties of ginger beer, whereas the results of statistical analysis showed differences in the level of sugar substitution in ginger beer (P <0.05) Palm sugar affect the fermentation process and also the taste of ginger ale. The flavor and sweetness of palm sugar resemble brown sugar with its caramelised note to the taste, but it also has slightly bitter and sour aftertase do to its high mineral content [14]. According to the alcohol level and ph, 75% substitution of palm sugar showed the adequate amount which made it more acceptable and become the most preferred one. Sweet but not overpoweringly in taste of beverage will occurs by replacing white sugar with palm sugar [15] resulting in the distinguished aroma of the ginger itself.

Table 4. pH Test Result of Ginger Beer Treatment

Sample	pH Value*
T0	2,80±0,14
T1	2,90±0,08
T2	2,68±0,05
T3	2,83±0,05
T4	2,83±0,15

*Data shown as average value ± deviation standard.

Based on table 4, it is known that the pH value in the substitution treatment of palm sugar T0, T1, T2, T3 and T4 respectively were 2.80, 2.90, 2.68, 2.83, 2.83 where the lowest average was T0 (2.80) and the highest pH Value is T2 (2.90). The decrease in pH value in the product of this research is

caused by the presence of a portion of alcohol / ethanol which turns into organic acids, such as acetic acid as a by-product [15]. The ingridients also affect the low ph value of ginger beer in this case was the addition of lime on the formula [16].

4. Conclusion

The substitution of white sugar with palm sugar in the production of ginger ale had significant influence on the level of alcohol content and pH value while had no significant effect on total microbes. Regarding hedonic quality, ginger ale with 75% palm sugar substitution showed as the most preferred formula for ginger ale.

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