Development of Kombucha Flake from Kombucha Tea

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ABSTRACT

Haw flakes are sweets made from the fruit of the Chinese hawthorn. It is usually used in the production of Asam Manis Layer Cake in Malaysia. In our research, we have developed kombucha flakes as a substitute for haw flakes. Kombucha is a drink made from fermented tea using microorganisms and has many health benefits. The activity of microorganisms during fermentation produces various health-promoting compounds. The objectives of this study were to examine the sensory properties and nutritional content of kombucha flake. Three formulations have been developed for producing kombucha flakes: F1 (using kombucha tea 70.4%, pineapple powder 4.87%), F2 (using kombucha tea 72.4%, pineapple powder 2.87%), and F3 (using kombucha tea 74.4%, pineapple powder 0.87%). The sensory evaluation was done to determine consumer acceptance using a 7-point Likert scale Hedonic test. The best formulation was obtained from the formulation with the highest mean score between the three formulations, which was Formulation 2. Sensory evaluation analysis also conducted on Asam Manis Layer Cake using Kombucha Flakes and Haw Flakes showed that both have no significant difference for all attributes except color. It indicated that both were comparable and well-liked by respondents, as indicated by a mean score above 5. Proximate Analysis revealed that 100 grams of Kombucha Flake contain 365 calories, 0.2 grams of fat, 90.3 grams of carbohydrates, 0.67 grams of protein, and 9.7 grams of vitamin C. In conclusion, Kombucha Flake is a product with numerous health benefits that is comparable to Haw Flake in terms of quality and flavor.

INTRODUCTION

In making "asam manis layer cake", bakers in Malaysia usually use haw flakes to create the sweet-tart taste when baking the cake. However, the main ingredients used in baking the cakes are flakes imported from China and known as "haw flakes". Haw flakes are processed foods known as Chinese sweets and are made from the hawthorn fruit. The light and dark pink candies are usually formed into two-millimeter-thick slices and packaged in cylindrical stacks. The goal of this research was to transform kombucha drinks into kombucha flakes so that a nutritionally equivalent food product could be developed to attract younger consumers to consume kombucha. The commercially available haw flake contains sodium benzoate as a preservative and an artificial coloring. However, the production of kombucha flakes will provide an alternative to the use of Haw flakes containing more health benefits and nutrients.

Kombucha is a functional beverage made from a symbiotic relationship between yeasts and microbes, whose metabolisms are interdependent and mutually beneficial [1]. The microorganisms in this beverage can become part of the intestinal flora of those who drink it [2-3]. Kombucha tea has the same benefits as other fermented beverages such as yogurt, yakult, buttermilk, and kefir because it is rich in probiotics that are good for the human digestive system. Kombucha is a source of bioactive compounds that include organic acids and amino acids, vitamins, probiotics, sugars, polyphenols, and antioxidants. The composition of the tea beverage and symbiotic culture of yeast and bacteria (SCOBY) layer depends on the locality, climate, bacterial and yeast strains, and source of the inoculum. Kombucha tea consists of osmophilic

strains of yeast such as Brettanomyces spp., Candida spp., Lachancea spp., Pichia spp., Saccharomyces spp., Schizosaccharomyces spp., and Zygosaccharomyces spp., as well as acetic acid bacteria such as Acetobacter spp. The SCOBY yield is high during the first 14 days of fermentation; however, due to unfavourable growth conditions, the growth of the microbes will progressively decrease and eventually cease [4].

Therefore, kombucha contains numerous beneficial substances and biological activities attributable to its constituents. As a common and beneficial beverage, tea contains a high concentration of polyphenols that may affect human health [5]. In addition, the phenol content of the source material and the cooperation between yeasts and bacteria during fermentation are responsible for the production of kombucha's numerous bioactive properties. The association between yeast and bacteria utilises substrates in various metabolic pathways to produce a variety of efficient metabolites, including organic acids, vitamins, tea polyphenols, ethanol, amino acids, hydrolytic enzymes, and minerals [6]. Black tea is the traditional raw material for kombucha manufacture, as it contains various nutrients necessary for SCOBY activation. Since the late 20th century, research on kombucha and its health benefits has been conducted, and kombucha has been shown to be an effective source of antioxidant, antimicrobial, anti-inflammatory, and antiaging compounds, as well as having the ability to boost the immune system and prevent certain diseases, such as diabetes, hypertension, and cardiovascular diseases [7].

The innovation of this study was the transformation of fermented beverages into kombucha flakes. For the optimal formulation of the flakes, kombucha tea, pineapple powder, brown sugar, corn starch, pectin and citric acid were used in the production of kombucha flakes in this study. This product did not contain preservatives to prolong the expiration life of the kombucha flakes because it contains a high concentration of vitamin C, an antioxidant. In addition, its acidity eliminates harmful microbes and substances that combat free radicals and reactive molecules that can damage cells. Therefore, this product is a more nutritious alternative to haw flakes. In addition, the cost of production will certainly be lowered, because we don’t have to import the raw materials from other countries. Besides, this innovation can also be used as a source of income for locals, comprising of small entrepreneurs.

THE MATERIAL AND METHOD

Kombucha were obtained from our own cultivation from parent. Meanwhile, other ingredients to produce kombucha flakes were purchased from retail outlets around Pagoh area. The ingredients used are kombucha tea, pineapple powder, brown sugar, corn starch, pectin and citric acid.

The Production of Kombucha Flake

Preparation of Kombucha Tea

Kombucha tea is produced and fermented in the Food Processing Laboratory (C15), Politeknik Tun Syed Nasir Syed Ismail. According to Leal et al. [8], the process of creating the beverage involves fermenting sugared tea with SCOBY. In this work, we modified Leal et al.'s [8] method for making kombucha by using 5g of tea leaves per litre of water and 50g of sugar per litre of water as the substrate for the bacteria that ferment sugar. After 10 minutes of boiling, the water is added along with the sugar and mixed to dissolve it fully. The tea leaves are then added, brewed for a little time and then filtered off. In the end, we added 10% w/v of kombucha culture to the mixture before transferring it into a sterile container. After that, we cover the jar with a sterile cloth and ferment it for 10–14 days at room temperature. It is crucial that all steps in the production of kombucha tea be carried out in an aseptic environment, and that all equipment utilized be sanitized. To stop the excessive synthesis of acetic acid in kombucha, the pH of the beverages must be regulated and stopped at pH 4.2v [9].

According to Malbasa et al., [10] the concentration of Vitamin B2 was 8.3 mg/100ML during the tenth day of the fermentation, while Leal et al., [8] analyzed that concentration of vitamin C was increased reaching to 28.98 mg/L on the tenth day of fermentation, thus we harvest the kombucha tea during the tenth-day fermentation in order to get highest Vitamin C content to our kombucha flakes.

The Production of Kombucha Flakes

The fermented Kombucha tea was produced at Politeknik Tun Syed Nasir Syed Ismail's Food Processing Laboratory (C15). First, tea water was used to ferment the kombucha. On the tenth day of fermentation, the kombucha water was consumed. The kombucha water was then heated until it was boiling. Then, before adding them to the cooked kombucha tea, additional components, including pectin, brown sugar, and cornstarch, will be carefully blended. Stir the mixture slowly until all of the pectin, cornstarch, and brown sugar have completely dissolved. Then wait until the spread has thickened. The burner was then heated to a higher temperature for one minute, reaching 80 °C, before being allowed to cool to 50 °C. Citric acid and pineapple powder were then added to the spread and thoroughly combined. The formulas created for the study's Kombucha flakes are displayed in Table 2.1.

The next step was the mixture then are spread on the parchment paper and will be dried using the food dehydrator at 60 °C for 17 hours to remove the moisture content of the kombucha spread through evaporation process as much as possible to obtain the flake like texture. The flakes were then let to cool off at room temperature for 5 minutes before they are peeled off the parchment paper and stored into an air sealed container for further analysis. Formulations are described in Table 1.

Product Formulation

Table 1 Formulation of Kombucha Flake

Ingredients	**Formulation 1, % (F1)**	**Formulation 2, % (F2)**	**Formulation 3, % (F3)**
Kombucha water	70.4	72.4	74.4
Pineapple powder	4.87	2.87	0.87
PECTIN CITRIC ACID BROWN SUGAR CORN STARCH			

Flow Chart of Production of Kombucha Flake

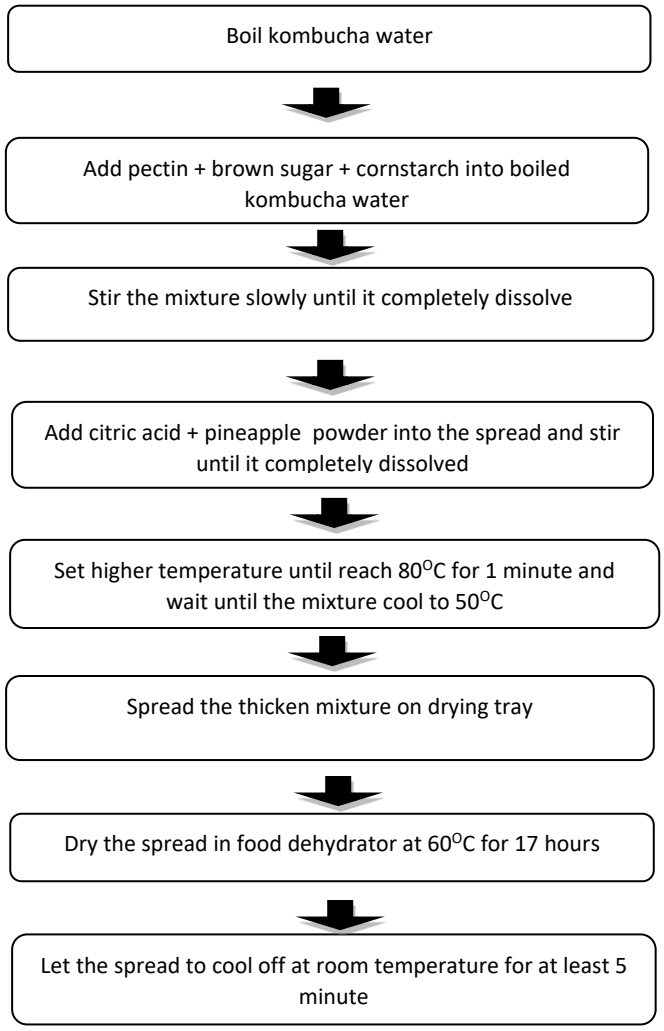

Figure 1. Flow Chart of the Production of Kombucha Flake.

Sensory Evaluation Analysis

A sensory evaluation test was conducted to determine the organoleptic characteristics of product in scoring test and to determine the best formulation in hedonic scale for the flakes produced. The use of human senses such as taste, smell, touch and sight serve as a measurement tool to determine the quality and/or to describe the condition of the food. There are 5 determined characteristics of product produced which are adhesiveness to teeth, aroma, sourness, sweetness and overall acceptance in scoring test that represented in 7 Likert scale and the level of liking from extremely like with scale 7 and extremely dislike with scale 1 was determined for all formulation in Hedonic scale. In the sensory evaluation test, 60 panelists randomly selected from PTSN population and residence area. Each individual is chosen entirely by chance and each member of the population has an equal chance of being included in the sample. There are 3 samples prepared for sensory evaluation of kombucha flakes. The results obtained were analyzed by using 'One-Way Analysis of Variance (ANOVA) with the aid of 'Statistical Package for Social Science (SPSS Version 17).

Another sensory evaluation has been done between kombucha flakes compared to Haw flakes that commercially available in the market. Sensory evaluation was conducted on Kombucha flakes and Haw Flakes samples using 7 Hedonic Test scales, which is score 1 for dislike very much

and score 7 for like very much. The Hedonic Test is to measure the panel's level of liking for the sample. There are 2 types of flakes, which are for sample code 353, Kombucha Flake and for sample code 975, was Haw Flakes. Several attributes were analyzed on the sample in the sensory assessment which is sweetness, sourness, color, adhesiveness to teeth and overall acceptance.

Proximate Analysis

The quantitative measurement of macromolecules in food is referred to as proximate analysis. Kombucha flakes sample have been analyzed by Melaka Biotechnology Corporation. The proximate analysis was done to evaluate the nutritional composition that contained in the 100 g sample of kombucha flakes produced in this study. Energy content, total carbohydrate, protein, total fat, and vitamin C content on kombucha flakes were determined for this study. The analysis was done according to the Standard AOAC method.

RESULTS AND DISCUSSION

Sensory Evaluation of Kombucha Flakes Between Formulation

Hedonic scales, in which participants indicate how much they like or detest a sample based on a specific sensory property, such as appearance, flavour, taste, and texture, and can also include overall liking/acceptance, are frequently used to evaluate acceptability. The most prevalent scale is the nine-point hedonic scale, which ranges from "like extremely" to "dislike extremely" [11]. Sensory evaluation was conducted among 60 panelists on Kombucha Flakes samples using 7-scales Hedonic Test, which is score 1 for dislike very much and score 5 for like very much. There were three formulations of Kombucha Flakes, referring to Table 3.3. Several attributes were analyzed on the sample in the sensory assessment which is sweetness, sourness, aroma, adhesiveness to teeth and overall acceptance. The results obtained were analysed by using 'One-Way Analysis of Variance (ANOVA) with the aid of 'Statistical Package for Social Science (SPSS Version 23). Table 2 show that, in terms of adhesiveness to teeth between the three samples, there was no significant difference of panelist liking between F2 and F3, but there was significant different between F2 and F3 with F1. In terms of aroma, sourness and sweetness attributes, it can be concluded here, that there was no significant difference between the three samples. While for overall acceptance showed there was no significant difference between the three samples. From the results, it can be concluded that, in terms of degree of liking between the five attributes, panel less like the adhesiveness to teeth of F1. But for other attributes, there was no significant difference for other four attributes. From the Hedonic Test of Kombucha Flakes between three formulations, it can be concluded that panelist prefer kombucha flake that had less adhesiveness to teeth and had less sourness. While the best formulation was obtained from the highest mean score between three formulations. From the Hedonic Test result in Table 3.4, it can be concluded that the best formulation was obtained from Formulation 2.

Table 2. Hedonic Test Result of Sample Kombucha Flakes

Ingredients	Formulation 1 (F1)	Formulation 2 (F2)	Formulation 3 (F3)
Adhesiveness to teeth	5.70±1.442a	6.57±1.617b	6.46±1.298b
Aroma	5.36±1.623a	5.72±1.485a	5.33±1.274a
Sourness	5.26±1.548a	5.51±1.660a	5.43±1.565a
Sweetness	6.05±1.309a	6.49±1.545a	6.39±1.498a
Overall acceptance	5.80±1.492a	6.36±1.601a	6.26±1.482a

Sensory Evaluation of Asam Manis Layer Cake Using Kombucha Flakes and Haw Flakes

Sensory evaluation was conducted on Kombucha flakes and Haw Flakes samples using 7 Hedonic Test scales, which is score 1 for dislike very much and score 7 for like very much. The Hedonic Test is to measure the panel's level of liking for the sample. There are 2 types of flakes, which is for sample 1, code with 353 using Kombucha Flakes and for sample 2, code with 975 using Haw Flakes. Several attributes were analyzed on the sample in the sensory assessment which is sweetness, sourness, color, adhesiveness to teeth and overall acceptance. Data were analyzed using T-Test. From the result data in Table 3.4, it indicates the mean score and also the P-value for each sample and attribute. For P-values greater than 0.05, indicates no significant difference between samples, while for P-values less than 0.05, indicates there's significant difference between samples. From the table above, it can be concluded that, in terms of sweetness between the two samples, there is no significant difference. In terms of sourness attributes, it can be concluded here, there was no significant difference between the two samples. As for the color attributes, there was a significant difference between the two samples, where the panel preferred the color of Haw Flakes. As for the adhesiveness to teeth attribute, there was also no significant difference between the two samples. While for overall acceptance showed no significant difference between the two samples. From the results, it can be concluded that Kombucha Flake is accepted among the respondents because it gets a mean score above 5 and there is no significant difference for all of attributes of Haw Flakes except color.

Table 3 Result Hedonic Test for Cake Masam Manis Using Kombucha Flakes and Haw Flakes

Attributes	Sample 1 (353)	Sample 2 (975)	Sig.(2-tailed) P-Value
Sweetness	6.20 ± 0.997	6.03 ± 1.033	0.509
Sourness	5.80 ± 0.887	6.07 ± 1.258	0.374
Colour	5.90 ± 0.803	6.43 ± 0.728	0.003
Adhesiveness to teeth	5.37 ± 0.850	5.80 ± 1.031	0.010
Overall acceptance	6.00 ± 0.830	6.20 ± 0.847	0.405

Results of Proximate Analysis

Table 4 shows the result of proximate analysis of kombucha flakes and Haw flakes. The samples were analyzed in 100g. From the result, we found that Haw flakes had more energy content than Kombucha Flakes, which is Kombucha Flakes had 365 kcal while Haw Flake had 383 kcal. For carbohydrates, it was found Kombucha Flakes had a slightly greater amount of carbohydrate content than Haw Flakes which is 90.3g in Kombucha Flakes and 87.2g in Haw Flakes respectively. For protein content, it was found that Kombucha Flakes had a few amounts of protein content which is 0.67g, while for Haw Flake, there was no protein content. For fat content, it was found that Kombucha Flakes had a smaller amount of fat content than Haw Flakes which is 0.2g, while for Haw Flakes, there was 0.9g of fat content. For Vitamin C content, it was found Kombucha Flakes had a greater amount of Vitamin C content than Haw Flakes which is 9.7g in Kombucha Flakes and 0.0175g in Haw Flake respectively. From the results, it can be concluded that Kombucha Flakes give us more beneficial nutrient content which provides slightly lower energy, provides a few amounts of protein content and has greater amounts of Vitamin C content compared to Haw Flakes.

Result of Proximate Analysis

Table 4 Result of Proximate analysis between Kombucha Flakes and Haw Flakes

No.	Test Parameter	Unit	Result	
			Kombucha Flakes	Haw Flakes
1	**Energy**	kcal/100g	365	383
2	**Carbohydrate**	g/100g	90.3	87.2
3	**Protein**	g/100g	0.67	0
4	**Fat**	g/100g	0.2	0.9
5	**Vitamin C**	g/100g	9.7	0.0175

CONCLUSION

In conclusion, the use of 72.4% kombucha tea in the production of kombucha flake is more acceptable than the use of other percentage formulations. This indicates that this formulation is acceptable to the general public and has market viability potential. Comparative sensory evaluation of Asam Manis Layer Cakes made with kombucha flakes and haw flakes revealed that Asam Manis Layer Cake with Kombucha Flake was comparable to Asam Manis Layer Cake with Haw Flake and was well received by respondents. Comparable to Haw Flake in terms of quality and flavor, Kombucha Flake has numerous nutritional health benefits and is comparable to Haw Flake in terms of quality and flavor.

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