Poster Session | Food Function/Nutrition
[6-1130-P] Functional/Wellness Foods &Nutrition (6th)
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[6-1130-P-02] Effect of Sucrose and Glucose on Coffee Kombucha Carbonation

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Keywords: kombucha, carbonation, fermented beverage, coffee, functional food

Kombucha is a functional food and a traditional carbonated soft drink. Natural carbonation is formed by microorganism during kombucha fermentation. However, coffee kombucha has a lower gas when compared to tea kombucha. The objectives of this study were to investigate effect of sugars on increasing gas formation and evaluate sensory characteristics of the coffee kombucha. The sugars including sucrose, glucose and mixture of sucrose and glucose were studied. The results found that the mixture of sucrose 5 % (w/v) and glucose 5 % (w/v) aerobically fermenting for 4 days, and then continuously fermenting in the closed container (without aeration) for 5 days revealed highest gas production. Acidity of the product was pH 3.14 and total acid 7.44% (v/v). The number of yeast, lactic acid bacteria and total bacteria in the product were 7.8, 6.8 and 6.7 log CFU/ml, respectively. Additionally, sensory characteristics were evaluated, overall acceptance, carbonation and mouthfeel were marked with 6.96 ± 0.49, 6.67±0.92 and 7.16±0.63, respectively.

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ABSTRACT

Kombucha is a functional food and a traditional carbonated soft drink. Natural carbonation is formed by microorganism during kombucha fermentation. However, coffee kombucha has a lower gas when compared to tea kombucha. The objectives of this study were to investigate effect of sugars on increasing gas formation and evaluate sensory characteristics of the coffee kombucha. The sugars including sucrose, glucose and mixture of sucrose and glucose were studied. The results found that the mixture of sucrose 5 % (w/v) and glucose 5 % (w/v) aerobically fermenting for 4 days, and then continuously fermenting in the closed container (without aeration) for 5 days revealed highest gas production. Acidity of the product was pH 3.14 and total acid 7.44% (v/v). The number of yeast, lactic acid bacteria and total bacteria in the product were 7.8, 6.8 and 6.7 log CFU/mL, respectively. Additionally, sensory characteristics were evaluated, overall acceptance, carbonation and mouthfeel were marked with 6.96 ±0.49, 6.67±0.92 and 7.16±0.63, respectively.

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1. INTRODUCTION

Kombucha is a fermented functional beverage, which has slightly acidic, carbonated and sweet taste. Most common substrate for kombucha fermentation is tea. kombucha is obtained from tea leaves by the fermentation of a symbiotic association of bacteria and yeasts (Chen and Liu, 2000). kombucha tea is prepared by placing the SCOBY (symbiotic culture of bacteria and yeast) into a sugared tea broth for fermentation. The taste of the kombucha changes during fermentation from a pleasantly fruity sour‐like sparkling flavor after a few days to a mild vinegar‐like taste after a long incubation period (Jayabalan et al., 2014). Yeasts in kombucha hydrolyze sucrose into glucose and fructose by invertase and produce ethanol. Acetic acid bacteria use glucose to produce gluconic acid and ethanol to produce acetic acid. The pH value of kombucha beverage decreases due to the production of organic acids during fermentation (Dutta and Gachhui, 2006). Acetic acid and gluconic acids are major organic acids that are produced from kombucha fermentation. Microorganism in kombucha, acetic acid bacteria: *Gluconacetobacter europaeus*, *Gluconobacter oxydans*, *G. saccharivorans* and *Acetobacter peroxydans* emerged as dominant species. Yeasts were mainly identified as *Dekkera*, *Hanseniaspora* and *Zygosaccharomyces* during all fermentations (Coton et al., 2017).

Coffee is one of the most popular beverages worldwide. There are different kinds of coffee beverages, coffee kombucha is fermented coffee with SCOBY. The coffee kombucha generally use 5-10 % (v/v) sucrose as a substrate for fermentation, these can produce acid but low gas formation. Thus, the objective of this study was to enhance carbonation in coffee kombucha by comparing sugars such as sucrose and glucose with different concentration for increasing gas formation. Sensory evaluation of the coffee kombucha was also tested.

2. MATERIALS AND METHODS

2.1 Materials

Arabica roasted coffee was provided form Thai Lahu Coffee and Tea Co., Ltd, Chiang Mai, Thailand.

SCOBY (Symbiotic Culture of Bacteria and Yeast) was obtained from Jib-Kefir shop, Bangkok, Thailand

2.2 Methods

2.2.1 Preparation of coffee

Arabica roasted coffee 40 g was added to boiling water 4 L for 5 min, the ground coffee was removed. Sucrose 200 g was dissolved in the hot coffee and heated at 100 ºC for 10 min. The coffee was allowed to cool at room temperature (30 ºC) before fermentation.

2.2.2 Coffee kombucha fermentation

The coffee was poured into a wide-mouthed clean vessel. The SCOBY was added to the coffee (200 g SCOBY/ 4 L coffee) and left to ferment at room temperature. First fermentation, the coffee was fermented for 4 days in the covering jar with cloth (this period required oxygen for obligate aerobic microorganism). To end the first fermentation, the SCOBY was removed from the kombucha. The kombucha was poured into the bottles and tightly capped for secondary fermentation for 5 days and then stored at 4 ºC for 5 days.

2.2.3 Sugars for kombucha fermentation

Sucrose and/or glucose with different concentration: 5 % sucrose, 7 % sucrose, 10 % sucrose, 5 % glucose and mixture of 5 % glucose and 5 % sucrose were used as carbon sources for coffee kombucha fermentation. The broth samples were analyzed pH, acidity and number of microorganism. Gas formation volume was measured at the end of fermentation.

2.3 Analysis

2.3.1 Acidity

To study acid production during fermentation, acidity was determined by titrating 50 mL of samples against 0.1 N NaOH. The pH of samples were determined by a pH meter.

2.3.2 Number of microorganism

In order to numerate total bacterial counts, liquid samples were serially diluted with normal saline and plated on plate count agar and then incubated for 72 h at 30°C. Lactic acid bacteria (LAB) were enumerated on De Man Rogosa Sharpe (MRS), incubated at 30°C under anaerobic conditions for 72 h. Yeast and fungi were numerated on potato dextrose agar, incubated at 25°C for 72 h.

2.3.3 Sensory Evaluation

Sensory characteristics of the coffee kombucha were tested using 9-Point Hedonic Scale from 30 subjects. Characteristics of the kombucha: coffee smell, sweetness, sourness, sparkling taste, mouthfeel and overall acceptance were evaluated.

3. RESULTS AND DISCUSSION

3.1 Sugars for gas and acid formation in coffee kombucha

Coffee kombucha usually use sucrose as a carbon source for fermentation. For the Arabica roasted coffee, the use of sucrose could produce high content of acid but low gas formation. In this study, sugar types and concentration were investigated for increasing gas formation in coffee kombucha. The result found that high gas production was observed in coffee kombucha producing from 5% glucose + 5% sucrose as shown in Table1.

Acidity of coffee kombucha, the initial pH of the coffee kombucha containing 5% glucose + 5% sucrose was 5.41, and it dropped to 3.16 during the fermentation period (Figure 1). In the coffee kombucha containing 5% glucose + 5% sucrose, the acid concentration continuously increased from 0.71 % (v/v) to 7.44% (v/v) at day 14 of fermentation. However, high acid content (12.08 % v/v) was found in the kombucha making from 10% sucrose, pH dropped from

5.20 to 2.09 at day 14 of fermentation. The 5% glucose + 5% sucrose could produce highest gas formation because yeast could survive at pH 3.2-3.7 (second fermentation) and produce higher CO_2. The other treatments, the pH value during second fermentation was lower than 3.0, which was much lower than the pH for optimum growth of yeasts (Chen and Liu, 2000), resulting to low gas production. Malbaša et al. (2008) reported kombucha converted sucrose to glucose and fructose, and further to ethanol, acetic acid, lactic acid, and a large number of other compounds.

Table 1. Gas formation of coffee kombucha when compared with different concentration of sugars: 5% sucrose, 7% sucrose, 10% sucrose, 5% glucose and 5% glucose + 5% sucrose

Sugar content	Gas formation level	Gas formation
5% sucrose,	+	
7% sucrose,	+	
10% sucrose,	++	
5% glucose	++	
5% glucose + 5% sucrose	+++	

Gas formation level: low (+), medium (++), high (+++)

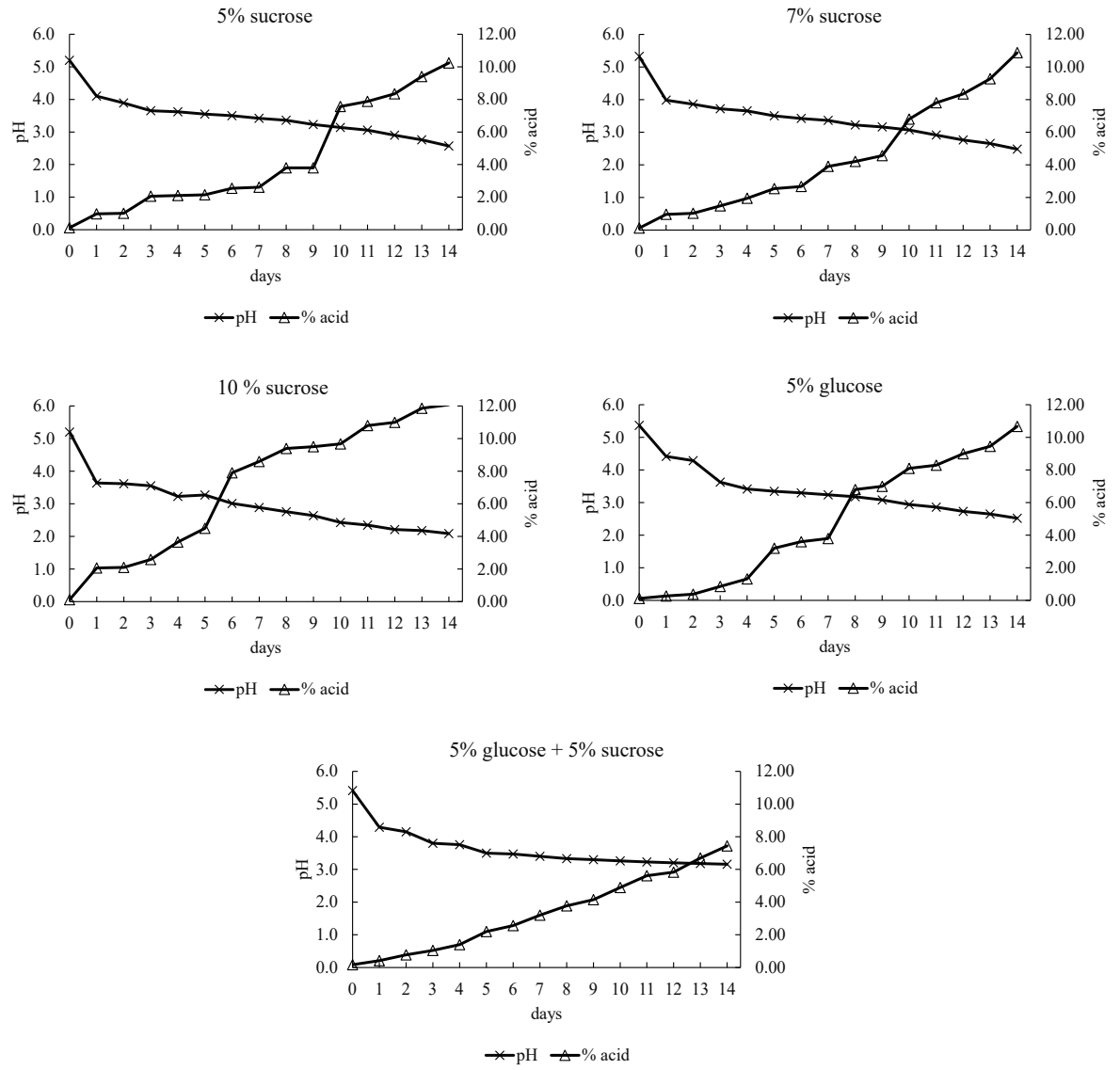

Figure 1. Changes of pH and acid concentration during 14 days of coffee kombucha fermentation compared with 5% sucrose, 7% sucrose, 10% sucrose, 5% glucose and 5% glucose + 5% sucrose

3.2 Number of Microorganism

Total bacteria, Lactic Acid Bacteria (LAB) and yeast was enumerated from the kombucha with 5% glucose + 5% sucrose as shown in Figure 2. During first fermentation, total bacteria and yeast slightly increased from 6.46 to 7.8 log CFU/mL and 6.36 to 7.93 log CFU/mL, respectively. After day 10 of fermentation (second fermentation), number of microorganism decreased from 7.35 to 6.86 log CFU/mL, however yeast mainly grew in this period. The result related to Chakravorty et al. (2016) that *Candida*, *Lachancea* and *Kluyveromyces* were found in secondary fermentation. The bacterial community in kombucha was dominated by the genera *Acetobacter* and *Gluconacetobacter* (Jarrell et al., 2000). Lactic acid bacteria was found both in first and secondary fermentation. Yeasts and bacteria in Kombucha are involved in such metabolic activities that utilize substrates by different and in complementary ways. Yeasts hydrolyze sucrose into glucose and fructose by invertase and produce ethanol via glycolysis, with a preference for fructose as a substrate. Acetic acid bacteria use glucose to produce

gluconic acid and ethanol to produce acetic acid. The pH value of kombucha beverage decreased due to the production of organic acids during fermentation (Sievers et al., 1995)

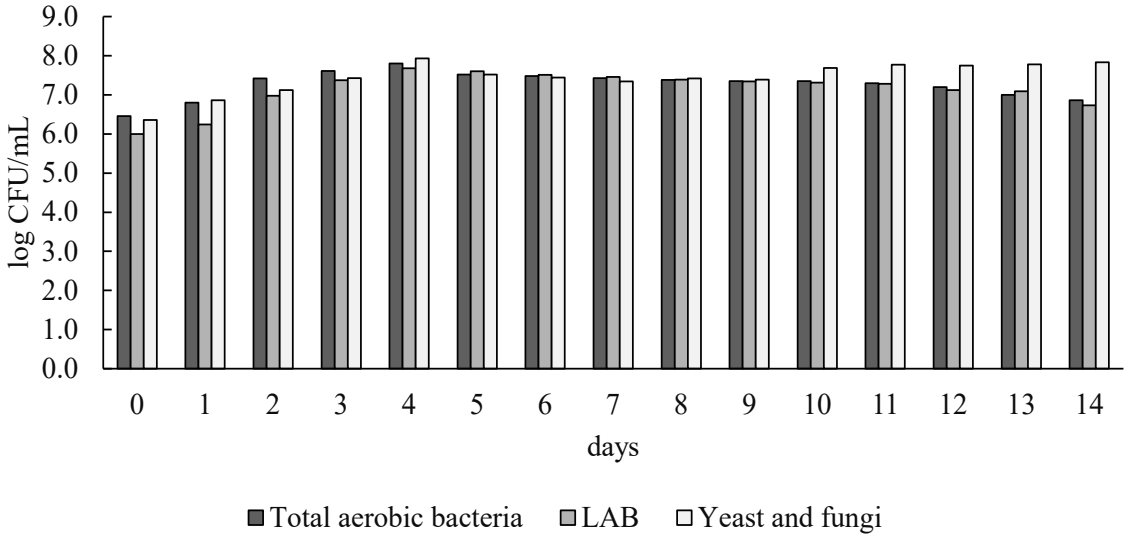

Figure 2. Number of total aerobic bacteria, lactic acid bacteria (LAB) and yeast and fungi during coffee kombucha fermentation

3.6. Sensory characteristics of coffee kombucha

Sensory scores for coffee smell, sweet, sour, sparkling and mouthfeel of coffee kombucha with 5% glucose + 5% sucrose were showed in Table 2. The Coffee kombucha was sparkling, sour and slightly sweet. Carbonation enhancement could improve sparkling taste of product.

Table 2. Sensory evaluation of coffee kombucha

Characteristics	Score
coffee smell	6.10 ± 0.48
sweetness	5.10 ± 0.92
sourness	7.00 ± 0.83
sparkling taste	6.67 ± 0.92
mouthfeel	7.16 ± 0.63
overall acceptance	6.96 ± 0.49

4. CONCLUSION

Coffee kombucha usually prepare by 5-10 % sucrose as a carbon source. Low gas formation obtained from these sugar content. The concentration of sugar that could improve carbonation in coffee kombucha were 5% glucose + 5% sucrose. Acidity of product was 7.44 % (v/v) acid with pH 3.16. Aerobic bacteria largely grew in coffee kombucha during first fermentation, whereas yeast was mainly found in secondary fermentation. Moreover, lactic acid bacteria as a probiotic were found in coffee kombucha. Carbonation enhancement could improve sparkling taste of the product.

ACKNOWLEDGMENT

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REFERENCES

Chakravorty, S., S. Bhattacharya, A. Chatzinotas, W. Chakraborty, D. Bhattacharya and R. Gachhui. 2016. Kombucha tea fermentation: Microbial and biochemical dynamics. *International Journal of Food Microbiology,* 220: 63-72.

Chen, C. and B.Y. Liu. 2000. Changes in major components of tea fungus metabolites during prolonged fermentation. *Journal of Applied Microbiology,* 89: 834-839.

Coton, M., A. Pawtowski, B. Taminiau, G. Burgaud, F. Deniel, L. Coulloumme-Labarthe, et al. 2017. Unraveling microbial ecology of industrial-scale Kombucha fermentations by metabarcoding and culture-based methods. *FEMS Microbiology Ecology,* 93.

Dutta, D. and R. Gachhui. 2006. Novel nitrogen-fixing Acetobacter nitrogenifigens sp. nov., isolated from Kombucha tea. *International Journal of Systematic and Evolutionary Microbiology,* 56: 1899-1903.

Jarrell, J., T. Cal and J.W. Bennett. 2000. The Kombucha consortia of yeasts and bacteria. *Mycologist,* 14: 166-170.

Jayabalan, R., R.V. Malbaša, E.S. Lončar, J.S. Vitas and M. Sathishkumar. 2014. A Review on Kombucha Tea—Microbiology, Composition, Fermentation, Beneficial Effects, Toxicity, and Tea Fungus. *Comprehensive Reviews in Food Science and Food Safety,* 13: 538-550.

Malbaša, R., E. Lončar, M. Djurić and I. Došenović. 2008. Effect of sucrose concentration on the products of Kombucha fermentation on molasses. *Food Chemistry,* 108: 926-932.

Sievers, M., C. Lanini, A. Weber, U. Schuler-Schmid and M. Teuber. 1995. Microbiology and Fermentation Balance in a Kombucha Beverage Obtained from a Tea Fungus Fermentation. *Systematic and Applied Microbiology,* 18: 590-594.