

# 9. The effect of coconut sap and skim milk concentration on physicochemical and sensory characteristic of coconut sap drink yogurt

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**Submission date:** 25-Mar-2023 02:39PM (UTC+0700)

**Submission ID:** 2046118961

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To cite this article: Karseno *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **653** 012045

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**The 17th International Symposium on Solid Oxide Fuel Cells (SOFC-XVII)**

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# The effect of coconut sap and skim milk concentration on physicochemical and sensory characteristic of coconut sap drink yogurt

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**Abstract.** Coconut sap drink yogurt is a fermented product based on coconut sap and skim milk that made by fermentation using lactic acid bacteria of *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. This study aimed to determine the effect of concentration of coconut sap and skim milk on physicochemical and sensory characteristic of coconut sap drink yogurt. The medium fermentation consists of 5% and 10% of skim milk and 0, 10, 30 and 50% of coconut sap. Ten percent of lactic acid bacteria was inoculated into media and it incubated for 6 hours at 37°C. The pH, total acid, reducing sugar, total sugar, viscosity, and sensory characteristic of the product were determined. The results showed that concentration of coconut sap and skim milk affected to pH, total acid, reducing sugar, total sugar, viscosity and sensory characteristic of coconut sap drink yogurt. The combination of 10% skim milk and 50% of coconut sap produce better characteristic of coconut sap drink yogurt than other combination. The product showed similar characteristic with commercial yogurt.

## 1. Introduction

Coconut sap contain high sucrose and other nutrient that suitable for growth of bacteria and yeast and potent to use for producing probiotic drink such as yogurt [1]. Probiotics are referred to as "live microorganisms, which when administered in adequate amounts confer a health benefit on the host" and *Lactobacillus* and *Bifidobacteria* species are the most common types of probiotics [2]. In addition, yogurt is fermented milk by lactic acid bacteria *Lactobacillus bulgaricus* dan *Streptococcus thermophilus*, degrading lactose into lactic acid and produce unique taste and flavor [3]. The unique flavor of yogurt is due several volatile materials such acetaldehyde, diacetyl, acetic acid and other produced by the fermentation of lactic acid bacteria.

Yogurt is among the most common dairy products consumed around the world, and its sensory attributes have a large effect on consumer acceptability [4]. Dairy-based probiotic food and beverages are currently widespread in the market. This could be associated with consumers believing these products are a more credible source of active ingredients than other nondairy functional foods [5].

The main ingredient in making yogurt is milk, both fresh and skim milk. Milk is a natural food ingredient that has high nutritional value. The main constituents of milk are water (87.9%), protein (3.5%), fat (3.5–4.2%), vitamins and minerals (0.85%). The important components in milk are protein, fat, vitamins, minerals, and lactose [6].



Coconut sap is a fluorescent liquid obtained by tapping coconut flowers. It is rich in nutrients such as sucrose, vitamins and minerals. Coconut sap is the main ingredient for making coconut sugar. Coconut sap has also begun to be used to make various products such as syrup, soy sauce, and jelly drinks. The use of coconut sap as ingredient on making yogurt drink has not been found. The idea to making yogurt by combination of skim milk and coconut sap as ingredients namely coconut sap yogurt drink is interesting to study. This study aimed to determine the effect of skim milk and coconut sap on the physicochemical and sensory characteristics of coconut sap yogurt drink product.

## 2. Material and methods

Fresh coconut sap was obtained from coconut plantation in Sumbang distric, Banyumas regency, Central Java, Indonesia. *Lactobacillus bulgaricus* and *Streptococcus thermophilus* were purchased from Inter-university center, Gadjah Mada University. All chemical reagents were purchased from Sigma and Merck, except when stated in the text.

### 2.1. Seed culture

The preparation of seed culture was performed according to Septiani et al [7]. One mL of the bacteria *Lactobacillus bulgaricus* and *Streptococcus thermophilus* were inoculated into 8 mL sterilized MRSB and incubated for 37°C, 48 hours. Five mL of each culture (ratio 1:1) then inoculated into 100 mL pasteurized skim milk, and incubated in 37°C, 6 hours (called mother culture). 50 mL of mother culture then inoculated into 500 mL pasteurized skim milk, incubated in 37°C, 8 hours (working starter).

### 2.2. Yogurt production

Coconut sap is heated for around 20 minutes, then cooled into room temperature. The solution of skim milk and coconut sap was mixed and stirred to homogeneous, then the pH was measured to determine the initial pH. The pH value was measured using a HANNA Instruments digital pH meter. The solution is then pasteurized at 70°C for 15 minutes, allowed to stand that the temperature reaches 45°C. Ten percent of working starter was inoculated, then incubated in an incubator at 37 °C for 6 hours, and the pH was measured using a pH meter. Yogurt drinks are cooled in the refrigerator to stop further fermentation processes [7].

### 2.3. Sensory analysis

Sensory analysis was performed within one day of production. The sensory panel included 25 healthy semi trained panelist (student from the Food Technology Study Program, UNSOED). Participants were asked to evaluate the sensory characteristic of the product including color, aroma of sap, unique aroma yogurt, sweetness and preference [8].

### 2.4. Statistical analysis

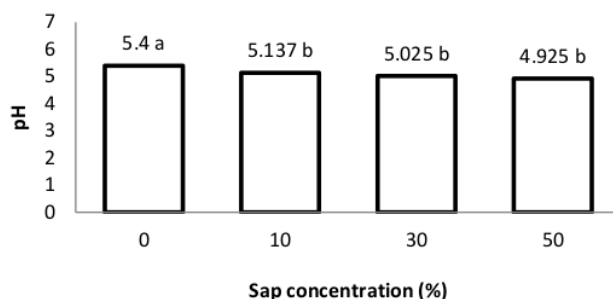
Randomized Block Design method was used in this research. All parameters were conducted in triplicate. Data were analyzed with F test. Differences were considered significant at  $p < 0.05$ , and if the data show significantly different, then continued with Duncan's Multiple Range Test, 5% level. The best treatment combination was determined based on the panelists' preference for the coconut sap yogurt drink product [9].

## 3. Results and discussion

### 3.1. pH

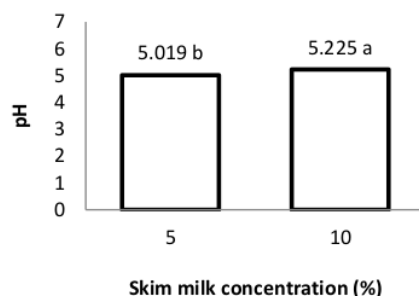
pH is one important indicator of yogurt product. Generally, yogurt has an acidic pH [10]. In this study, the various concentration of coconut sap shows a significant effect on pH of coconut sap drink yogurt. A significant difference was noted between the yogurt with sap addition and non-addition. In addition, data showed a positive correlation between the amounts of coconut sap and the decreasing in pH value. Increasing of coconut sap tend to decrease the pH of coconut sap drink yogurt (Figure 1). This data

indicating that *Lactobacillus bulgaricus* and *Streptococcus thermophilus* bacteria able to use of sucrose in coconut sap as energy source during the fermentation process. *Streptococcus thermophilus* degrade sucrose to fructose and glucose, then *Lactobacillus bulgaricus* use the sugar and convert to lactic acid.



**Figure 1.** The effect of sap concentration on pH of coconut sap yogurt drink

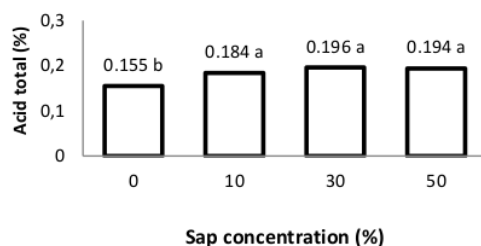
The concentration of skim milk also gives a significant effect on pH of coconut sap yogurt drink. A significant difference was noted between the yogurt with 5% and 10% of skim milk. 10% skim milk resulting higher of pH coconut sap yogurt drink than skim milk 5% (Figure 2). In high concentration of skim milk, it is suspected that *Lactobacillus bulgaricus* and *Streptococcus thermophilus* bacteria cannot use the lactose optimally, resulted the pH of coconut sap yogurt drink was high (more than 5).



**Figure 2.** The effect of skim milk concentration on pH of coconut sap yogurt drink.

### 3.2. Acid total

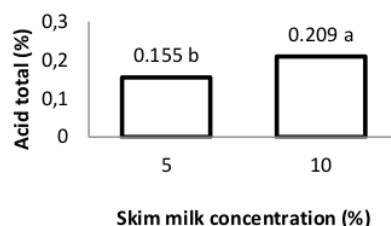
Acidity has an impact on taste and is an indicator of product quality. Total Acidity corresponds to the sum of titratable acids in food and beverages [11]. The various concentration of coconut sap and skim milk give significant effect on acid total of coconut sap yogurt drink. A significant difference was noted between the yogurt with sap addition and non-addition. Data also showed a positive correlation between the amounts of coconut sap addition and the increasing in acid total value. Increasing of coconut sap tend to increase acid total of coconut sap drink yogurt (Figure 3).



**Figure 3.** The effect of sap concentration on acid total of coconut sap yogurt drink

Increasing sap concentration tend to increase acid total value of the product. However, based on DMRT analysis, there are no significant difference among the concentration of coconut sap 10, 30 and 50%.

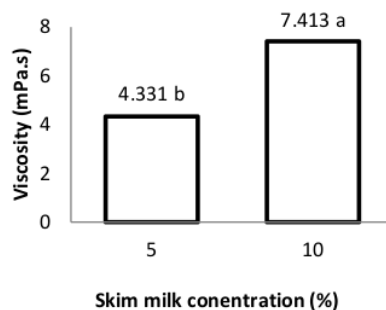
In this study, the various concentration of skim milk shows a significant effect on acid total of coconut sap drink yogurt. A significant difference was noted between 10% and 5% of skim milk concentration (Figure 4). Lactose in skim milk is converted into its monosaccharide namely glucose and galactose to produce lactic acid [7].



**Figure 4.** The effect of skim milk concentration on acid total of coconut sap yogurt drink

### 3.3. Viscosity

Viscosity of coconut sap yogurt drink was determined using viscometer. There is no significant effect of coconut sap concentration on viscosity of coconut sap yogurt drink. In the other hand, skim milk concentration gives significant difference on viscosity of coconut sap yogurt drink. DMRT analysis indicated a significant difference was noted between 10% and 5% of skim milk addition (Figure 5).

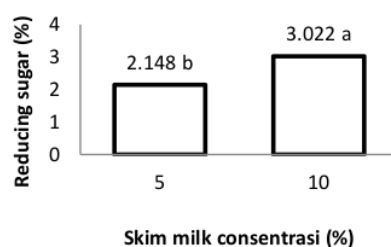


**Figure 5.** The effect of skim milk concentration on viscosity of coconut sap yogurt drink

The average viscosity value of coconut sap yogurt drink in the concentration of 5% and 10% skim milk were 4.3 mPa.s and 7.4 mPa.s, respectively. The high concentration of skim milk tend to high the viscosity of the product. This is inline with Delikanli B [12] which states that the more concentration of skim milk, the viscosity of the yogurt will increase. Skim milk can increase the total solids of yogurt and increase the nutritional value of yogurt drinks [13].

### 3.4. Reducing sugar

Reducing sugar is a sugar that has the ability to reduce due to the presence of free aldehyde or ketone groups [14]. The results shown that a significant difference was noted between 10% and 5% of skim milk. The concentration 10% skim milk resulting higher of reducing sugar of coconut sap yogurt drink than skim milk 5% (Figure 6). Lactose as an energy source for the growth of *Lactobacillus bulgaricus* and *Streptococcus thermophilus* is degraded into glucose and galactose which are all reducing sugars, therefore the reducing sugar in coconut sap yogurt drink with 10% skim milk was high.

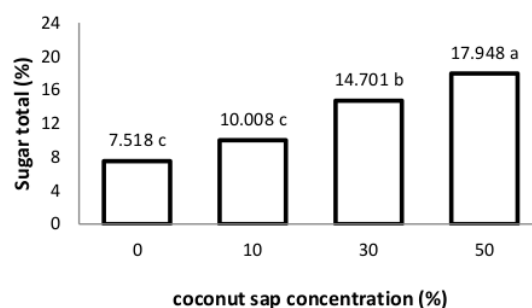


**Figure 6.** The effect of skim milk concentration on reducing sugar of coconut sap yogurt drink

Reducing sugars that to be produced during lactic acid fermentation include glucose, galactose and fructose which may still be present in high enough quantities. It indicated that *Lactobacillus bulgaricus* and *Streptococcus thermophilus* has not been able to use all the sugars contained in skim milk and coconut sap and convert it into lactic acid.

### 3.5. Total sugar

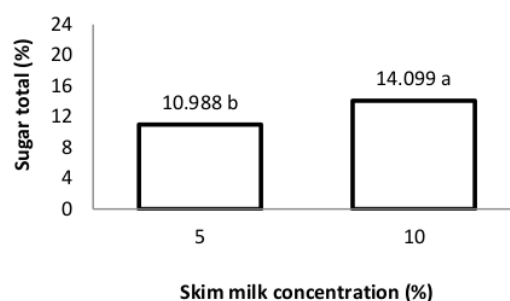
Total sugar is the total amount of sugar contained in an ingredient, both reducing and non-reducing sugars. Various sap concentration gives a significant effect on total sugar of coconut sap yogurt drink. The average value of total sugar content in the product based on sap concentration of 0%, 10%, 30% and 50% were 7.518, 10.01, 14.70 and 17.95%, respectively. Increasing sap concentration tend to increase total sugar of coconut sap yogurt drink. The DMRT analysis resulted that 50% coconut sap shown highest total sugar in the product. Skim milk contains the main sugar in the form of lactose which is converted into glucose and galactose through lactic acid fermentation by *Lactobacillus bulgaricus* and *Streptococcus thermophilus*.



**Figure 7.** The effect of coconut sap concentration on total sugar on coconut sap yogurt drink

Similar to sap concentration, difference concentration of skim milk gives a significant difference on sugar total of coconut sap yogurt drink. 10% skim milk addition resulted higher sugar total in the product than 5% skim milk (Figure 8). The sugar total value was 10.99 and 14.09%, respectively. Skim milk contains the main sugar in the form of lactose which is converted into glucose and galactose through lactic acid fermentation by *Lactobacillus bulgaricus* and *Streptococcus thermophilus*.

The total sugar in product is still high, this indicates that not all of the sugar contained in coconut sap and skim milk can be utilized optimally as a source of energy / substrate for the growth and development of *Lactobacillus bulgaricus* and *Streptococcus thermophilus*.



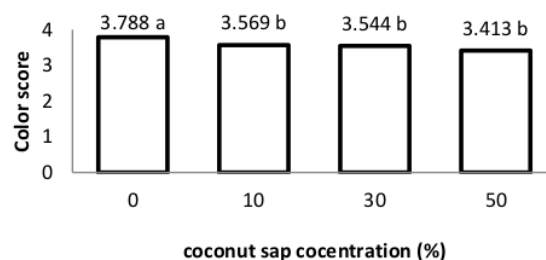
**Figure 8.** The effect of skim milk concentration on sugar total of coconut sap yogurt drink

### 3.6. Soluble protein

Dissolved protein is water-soluble protein. Various sap concentration and skim milk did not give significant effect on soluble protein of coconut sap yogurt drink. The average value of dissolved protein content in coconut sap yogurt drink by the treatment of 5% skim milk and 10% were 0.044% and 0.051%, respectively. Increasing skim milk concentration correspond to high protein in the product that the resulting to increase dissolved protein level.

### 3.7. Sensory characteristic

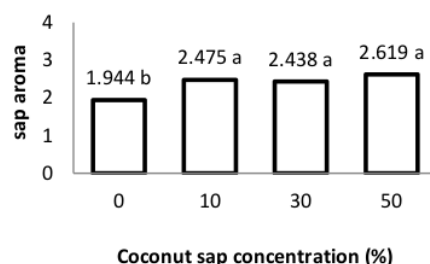
**3.7.1. Color.** The results of the analysis of variance show that the effect of coconut sap give a significant difference on the color of coconut sap yogurt drink. The color value of product based on the sap concentration were 3.788 (brownish white); 3.569 (brownish white); 3.544 (brownish white) and 3.413 (brownish white). The DMRT test found that significantly different of the color coconut sap yogurt drink without sap and sap in the concentration of 10%, 30% and 50%, although no differences among itself. The brown color of coconut sap yogurt drink was caused by the Maillard reaction that occurs during the pretreatment of coconut sap, namely the coconut sap is heated for 20 minutes. The Maillard reaction is formed by the interaction between amino acids and reducing sugars which results in the brown color of a product.



(score 1= brown; 2 = slightly brown; 3 = white brown; 4 = white)

**Figure 9.** The effect of coconut sap on color of coconut sap yogurt drink

**3.7.2. Aroma of sap.** The results of the analysis of variance showed that the concentration of coconut sap had a significant effect on the aroma of sap in coconut sap yogurt drink. The average value of coconut sap yogurt drink aroma in the treatment of coconut sap cocentration of 0%, 10%, 30% and 50% were 1.944 (not strong), 2.475 (rather strong), 2.438 (relatively strong) and 2.619 (relatively strong). This data also shows that the aroma of sap is still detected by the panelists in the product. The high concentration of coconut sap tends to stronger the aroma of the sap was produced (Figure 10).

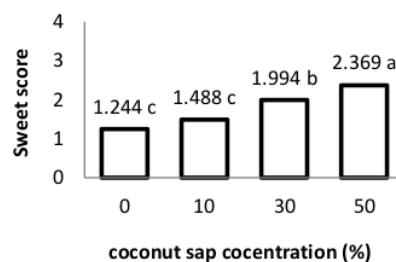


(score 1 = not strong; 2 = slightly strong; 3 = strong; 4 = very strong)

**Figure 10.** The effect of coconut sap on sap aroma of coconut sap yogurt drink

**3.7.3. Unique aroma yogurt.** The results of the analysis of variance show that the concentration of coconut sap had no significant effect on the unique aroma yogurt of coconut sap yogurt drink. Similar result also for the treatment of skim milk concentration. The evaluation results from 20 panelists stated that the unique aroma yogurt of coconut sap yogurt drink is rather strong.

**3.7.4. Sweetness.** The results of the analysis of variance showed that the concentration of coconut sap had a significant effect on sweetness of coconut sap yogurt drink. Increasing the concentration of sap, tend to increase sweetness of coconut sap yogurt drink. The sweet taste of the product may come from coconut sap which is high in sucrose. This data also shows that *Lactobacillus bulgaricus* and *Streptococcus thermophilus* are not able to use all the sucrose in coconut sap to be converted into lactic acid, so it implies the sweet taste in yogurt drink products was remain strong.



(score 1 = not sweet; 2 = slightly sweet; 3 = sweet; 4 = very sweet)

**Figure 11.** The effect of coconut sap on sweetness of coconut sap yogurt drink

#### 4. Preference

The preference parameter is the conclusion of all organoleptic parameters, namely color, aroma of sap, distinctive aroma of yogurt, sweet and sour taste of the product. The preference of panelists is influenced by several factors including color, taste and appearance that attracts consumers, benefits for consumers and the nutritional value of the product [5]. In general, the results of preference test by panellist showed that this product was slightly accepted by the panellists. Products without coconut sap, tend to have a strong sour taste that implies not acceptable by the panellists. Base on the results of sensory evaluation, in general coconut sap yogurt drink has characteristics that are similar to commercial yogurt products.

The results showed that concentration of coconut sap and skim milk affected to pH, total acid, reducing sugar, total sugar, viscosity and sensory characteristic of coconut sap drink yogurt. The combination of 10% skim milk and 50% of coconut sap produce the better characteristic of coconut sap drink yogurt than other combination. The product showed similar characteristic with commercial yogurt.

### Acknowledgements

We would like to thanks to the Ministry of Higher Education and Culture of Indonesia and Rector of UNSOED for the finance support on conducting this research.

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