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## **Quality of Kefir Combination Between of Goat's Milk and Skim Milk on Variations of Sugar and Fermentation Duration**

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### **ABSTRACT**

**KEYWORDS:**

*Acid Total*  
*Cane sugar*  
*Fermentation Duration*  
*Goat's Milk*  
*Kefir*  
*Organoleptic*  
*Palm sugar*  
*Skim Milk*

Kefir is a probiotic beverage produced by live lactic acid bacteria. One of the innovative ingredients for kefir is goat's milk, skim milk, and variations of sugar (cane sugar and palm sugar). The nutritional content of goat's milk is 2.2% protein, 14.7% fat, and 3% fiber, and 4.80% lactose. The addition of skim milk in the manufacture of kefir can increase the total sugar content. The addition of sugar as a source of nutrition for kefir grain starter bacteria. The purpose of this study was to quality of kefir combination between of goat's milk and skim milk on variations of sugar and fermentation duration. This study used an experimental method and a completely randomized design (CRD) with two factors. The first factor is the variations of sugar (A) palm sugar and cane sugar. Factor II (B) is the variations of fermentation duration for 24 hour, 36 hour, and 48 hour. The results showed that the best total kefir acid content combined with goat milk and skim milk was 0.797%, pH 4 in the A2B1 treatment (30 g cane sugar + 24 hour of fermentation duration). The best organoleptic quality was in the A2B1 treatment (30 g cane sugar + 24 hour of fermentation duration) with a sour taste, white color, tasty flavour, and soft texture.

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### **1. INTRODUCTION**

Probiotic beverage are drinks made with the fermentation process using BAL that can produce organic acids and contain living cells that are able to survive in active conditions in the digestive tract (Elsaputra *et al.*, 2016). Probiotic drinks can be consumed by anyone at any time, including children and adults (Aritonang *et al.*, 2019). One of the probiotic milk drinks is kefir. Kefir is a fermented milk drink that uses kefir seeds as a starter and contains lactic acid and khamir bacteria (Kintekik, 2018). Kefir is very popular among the public as a probiotic drink because it can prevent and treat various diseases such as heart, kidney, lung, and liver diseases, lower cholesterol, increase appetite, and keep the body fresh (Rahmah *et al.*, 2016). Kefir contains proteins with all essential amino acids, vitamins (vitamines A, B1, B2, B5, B6, B7, B9, B12, C and K) and minerals (potassium, calcium, phosphorus, magnesium, iron, zinc, copper, and manganese) (Lararenjana, 2020). According to the Indonesian National Standard (SNI), kefir has a total acidity of about 0.2-0.9%, a pH of 4-4.6, and a protein content of 3.2%. Kefir can be made from various types of milk, including goat's milk.

Goat milk has a relatively high nutritional content, and goat's milk fat and protein are easier to digest (Afrizal, 2019). The nutritional content of goat milk is 22 % protein, 14.7 % fat, 819 mcg vitamin B12, 3 % fiber, 4.80 % lactose, 0.72 % and 87.10 % water (Martharini, 2017). Goat milk contains short chain fatty acids and more easily digestible proteins, and the excess can improve the quality of the kefir produced (Aristya *et al.*, 2013). Goat milk has a complete nutritional

content, but is not popular because the goat flavour that dominates the “prengus” flavour comes from short-chain and moderate fatty acids such as kaproat, caprilate, and kaprat (Balía *et al.*, 2011). Goat milk has a good chemical composition and provides good benefits for body health because it contains many nutrients that play a role in body health, such as those that repair the digestive tract, act as a metabolic agent, and repair damaged cells (Arief, 2018). The “prengus” flavour in goat milk can disappear during the fermentation process and can also occur when goat’s milk kefir needs to be added to skim milk.

Skim milk is milk with a maximum fat content of 1% and a protein content of 35.6% (Anon, 2012). According to Mandei (2019), skim milk has a fat content of 0.50%, protein of 1.10%, ashes of 0.68%, and acidity of 0.8%, skim milk as a source of nitrogen to carry out the growth of microorganisms during fermentation also improves nutritional value. Skim milk can be used as an additive in the manufacture of kefir. Smooth milk can be an alternative to being added to probiotic drinks to improve their consistency and stability. Smooth milk can also add nutritional value and enhance the taste of probiotic drinks (Handayani *et al.*, 2016). The primary function of skim milk in probiotic beverages is as a source of nutrients because it contains lactose, which BAL uses as an energy source for growth (Hakiki, 2022).

The quality of kefir is influenced by various factors such as kefir seeds, milk type, type of sugar, time, temperature, and time of fermentation (Gamba *et al.*, 2020). Sugar is a source of food or energy for kefir grains. Palm sugar has sucrose 84.31%, manganese, boron, nitrogen, phosphorus, folic acid, vitamin A, and vitamin B1 (Ardiana, 2019). The nutritional content of cane sugar consists of potassium, phosphorus, iron, and vitamin A. 100 g of cane sugar contains energy 394 kcal, protein 0 g, calcium 5 mg, phosphate 1 mg, sodium 1 g, and sodium 94 g (Basigili, 2018). A study by Nisa *et al* (2018) found that lactic acid bacteria used sugar as a source of growth energy and produced metabolites of lactic acids during fermentation, where the more sugar was added, the more substrates were available for bacterial microbes to enhance their activity. Fermentation duration is one of the factors in the process of making kefir. Fermentation duration affects the strength of kefir (Safitri, 2017). The pattern of changes in lactic acids, acetate, and citrate is the same, increasing with storage (Leite *et al.*, 2013). The purpose of study was to determine quality of kefir combination between goat’s milk and skim milk on variations of sugar and fermentation duration.

## **2. MATERIALS AND METHOD**

### *2.1. Time and place of research*

The study was conducted in February – June 2023 at the Biology Laboratory of the Faculty of Teacher Training and Education of the Universitas Muhammadiyah Surakarta. Testing of pH levels and organoleptic qualities (flavour, taste, color, texture, and acceptability) in the Biology Laboratory of Universitas Muhammadiyah Surakarta, and acid total testing was carried out in the Chem Mix Laboratory Pratama Yogyakarta.

### *2.2. Materials*

Tools used in the manufacture of kefir combination between goat milk and skim milk are stoves, pots, glasses, pH meters, bottles, tablespoons, analytical scales, thermometers, washing soaps, fabrics, writing tools, and other documentation equipment. On the other hand, the ingredients used for kefir are goat milk, skim milk, palm sugar, cane sugar, and kefir grain.

### 2.3. Research Procedure

The research process includes: 1. Stage of preparation 2. Sterilization of equipment 3. The stage of execution then we test the parameters (pH, organoleptic, and acid total).

### 2.4. Research Design

This research used an experimental method with research design was Completely Randomized Design (CRD). This study is RAL with 2 factors, namely, type of sugar (A1 = Palm sugar 16 g, A2 = Cane sugar 30 g) and fermentation duration (B1 = 24 hour, B2 = 36 hour, B3 = 48 hour). Testing the acid total content by titration method, presenting it in the form of a table with the final result in the shape of a percentage, and performing an organoleptic test with a questionnaire sheet of 15 panelists. To know the results of organoleptic quality research, the data analysis used by the researchers was qualitative and descriptive. Qualitative descriptions to describe the test results of acid total levels through titration methods and the results of organoleptic quality tests include color, flavour, texture, taste, and acceptability of kefir, assisted by the use of a questionnaire. By analyzing the data can be known the final results of the data of the test results and useful to draw conclusions in the research.

### 2.5. Analysis Data

Research data were presented in the form of tables. Acid total testing analysis using quantitative descriptive methods. During organoleptic testing, color, texture, taste, flavour and acceptability. Quantitative test data analysis using a two-way variance analysis test (Two Way ANOVA) and qualitative test data analysis using Excel.

## 3. RESULTS AND DISCUSSION

### 3.1. Result

Based on the study of pH testing and acid total kefir combination between goat milk and skim milk on variation of sugar and fermentation duration that have been performed on six samples, the following results were obtained:

**Table 1.** Results of pH and acid total kefir combination between goat milk and skim milk on variation of sugar and fermentation duration.

Treatment	Acid Total (%)	pH
A1B1 palm sugar 16 g and 24 hour	1.131	4**
A1B2 palm sugar 16 g and 36 hour	1.271	3.8
A1B3 palm sugar 16 g and 48 hour	1.344**	3.4
A2B1 cane sugar 30 g and 24 hour	0.797*	4**
A2B2 cane sugar 30 g and 36 hour	1.059	3.6
A2B3 cane sugar 30 g and 48 hour	1.13	3.1*

Description:

\* The lowest value

\*\* The highest value

Based on the study of organoleptic quality testing levels of acid total kefir combination between goat milk and skim milk on variations of sugar and fermentation duration that has been carried out on six samples, the following results were obtained:

**Table 2.** Result of Organoleptic quality kefir combination between goat milk and skim milk on variation of sugar and fermentation duration

No	Treatment	Organoleptic quality (aspect)				
		Taste	Color	Flavour	Textures	Acceptability
1	A1B1 palm sugar + 24 hour	Sour	Brownish white	Tasty	Softly	Less like
2	A1B2 palm sugar + 36 hour	Sour	Brownish white	Tasty	Softly	Less like
3	A1B3 palm sugar + 48 hour	much sour	Brownish white	Tasty	Softly	Less like
4	A2B1 cane sugar + 24 hour	Sour	White	Tasty	Softly	Like
5	A2B2 cane sugar + 36 hour	Sour	White	Tasty	Softly	Like
6	A2B3 cane sugar + 48 hour	Sour	White	Tasty	Softly	Less like

### 3.2. Discussion

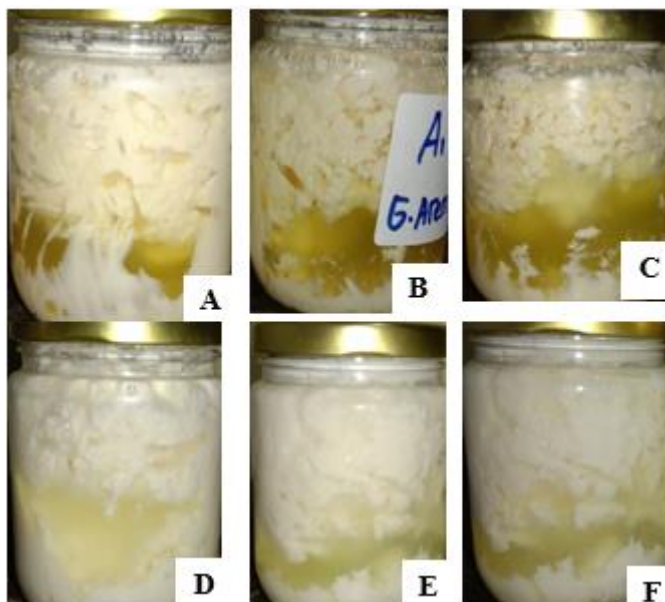
#### 3.2.1 Acid Total

Based on a study of the total kefir acid total test combination between goat milk and skim milk on variations in sugar and fermentation duration carried out on six samples, the results showed that the best acid total value on treatment A2B1 (cane sugar 30 g + 24 hour fermentation duration) was 0.797 % and pH 4. The acid total result of treatment A2B1, according to SNI (2009), was 0.2 – 0.9 % pH of 4-4,6. The decrease in acid total output was affected by bacterial activity. Bacterial activity was influenced by energy sources. The more energy sources available, the more bacterial activity increases, so the acid produced also affects the decrease in the pH of kefir. The total acidity in palm sugar is higher than in cane sugar. Sucrose is a source of energy and carbon that is consumed by BAL and produces acids during the fermentation process of the sugar. Cane sugar content is not higher than palm sugar, so the bacterial activity in kefir added palm sugar is higher than sugar added kefir. Palm sugar contains approximately 84 % more sucrose compared to beet sugar and bit sugar, which are only 20 % and 17 % respectively, so palm sugar is able to provide higher energy than beet and sugar beet (Lempang, 2020). The highest sucrose content was found in palm sugar of 84.31 % compared to cane sugar of 71.89 % (Yudho, 2021). In the study Widya *et al* (2018) also stated palm sugar contains higher sucrose 84 % compared to cane sugar which is 20 %. This is demonstrated by the results of statistical tests with Two Way Annova showed that the significance value obtained of 0,05 (0,000<0,05) means there is a significant influence on the interaction between types of sugars on the acid total of kefir in the combination of goat milk and skim milk. This suggests that there is a real interaction between the types of sugar used. Research by Nisa *et al* (2018) also found that lactic acid bacteria utilized sugar as a source of growth energy and produced the metabolites of lactic acids during fermentation, where the more sugar added, the more substrate available for the microbes, so that their activity increased. The acetic acid formed during fermentation causes a decrease in the pH value. Beverage products are affected by organic acids such as acetic acid and pyruvate acid that form during the fermentation process (Hawusiwa *et al.*, 2015).

The fermentation duration is one of the factors affecting the quality of the combination of goat milk and skim milk. The fermentation duration used has a significant effect on the total acid content. Long-term processing of fermentation will cause the pH to decline due to the BAL activity

in breaking down carbohydrates into lactic acid. High acid total content can be caused by the lactic acid bacteria (BAL) that break down glucose into lactate acid, which is available in large amounts, so that the milk acid produced is also increasing. Similarly, the low total acid content can be caused by the fact that the lactic acid bacteria that break down glucose into lactate acid are available in fewer amounts, so the production of lactic acids is also getting lower. This is in line with the opinion of Hidayat *et al.*, (2013) which states that during the fermentation process, lactic acid bacteria will ferment existing carbohydrates to form lactic acids. The formation of these acid total leads to increased acidity and decreased pH values. This is demonstrated by the results of statistical tests with Two Way Anova showing that the significance value obtained of 0,05 ( $0,000 < 0,05$ ) means there is a significant influence on the interaction between the fermentation duration and the acid total kefir content of the combination of goat milk and skim milk. This suggests that there is a real interacting relationship between the fermentation duration. According to the Rohmah study (2018) the longer the storage time of certain pH values the more it decreases. The pattern of changes in lactic acid, acetate, and citrate looks the same and increases with the duration of storage (Leite *et al.*, 2013). Kartikasari and Nisa (2016) add that the formed lactic acid will be secreted out of the cells and accumulated in the fermentation medium, so that the longer the time of fermentation, the more the total amount of acids will increase and lower the pH. Based on the results of the Two Way Anova statistical test, which shows sig 0.000  $< 0.05$  that there is a significant effect on the total sugar variation and fermentation duration. The results of Duncan's further test showed that the fermentation duration of 48 hour had a significant effect on the acid total of the kefir combination of goat milk and skim milk This is demonstrated in the long-term treatment of the 48 hour fermentation, which produced the highest acid total compared to the 24 hour and 36 hour fermentation treatments.

### 3.2.2 Organoleptic Quality



**Figure 1.** Results of kefir combination between goat milk and skim milk on variation of sugar and fermentation duration

Description:

- A. A1B1 palm sugar 16 g + 24 hour
- B. A1B2 palm sugar 16 g + 36 hour

- C. A1B3 palm sugar 16 g + 48 hour
- D. A2B1 cane sugar 30 g + 24 hour
- E. A2B2 cane sugar 30 g + 36 hour
- F. A2B3 cane sugar 30 g + 48 hour

Based on studies of organoleptic quality testing of kefir combination between goat milk and skim milk on variations of sugar and fermentation duration that have been carried out on six samples, treatment A2B1 (cane sugar 30 g + 24 hour fermentation duration) showed the best results with white color, a sour taste, a tasty flavour, and a soft texture. The results of organoleptic quality treatment A2B1 in accordance with SNI (2009) indicate that the kefir beverage should have a liquid or thick appearance, a typical normal flavour, and a characteristic acid flavour. Based on Table 2, the result indicates that the kefir combination of goat milk and skim milk has a distinctive taste of acid with a characteristic flavour of acid total that is delicious. Consumers are more likely to pay attention to the taste parameters compared to the nutritional content of the product (Putri and Mardesci, 2018). BAL is the main metabolite that plays a role in the formation of acid total which produces an acidic taste (Rohmah and Estiasih, 2019). Rismawati (2015) stated that the smell of a food or beverage product plays an important role in evaluating a product. The resulting characteristic flavour can be felt by the sense of smell depending on the constituent material or different ways of processing can change the resulting flavour. Kefir has a tape-like smell caused by khamir activity in kefir seeds. Harun *et al.*, (2013) added that the smell of fermented milk is due to the presence of acetaldehyde, diethyl, acetic acid and other acids in small amounts. Acetaldehyde is a chemical compound. The acid smell is derived from the conversion of sugar into alcohol. Khamir breaks down simple sugars into carbon dioxide and a little alcohol which causes the Flavour to tend to be acidic. The “prengus” flavour of goat milk is also no longer scented, due to the process of fermentation and the addition of skim milk. The longer the fermentation, the more acidic the taste will be, and the smell will be more intense.

Based on Figure 1 it is clear that in terms of color, the kefir combination of goat milk and skim milk on the treatment A1B1 (palm sugar 16 g + 24 hour) A1B2 (palm sugar 16 g + 36 hour), and A1B3 (palm sugar 16 g + 48 hour), The color is chocolate of the equipment can appear due to the basic ingredients of the palm sugar. On the treatments A2B1 (cane sugar 30 g + 24 hour), A2B2 (cane sugar 30 g + 36 hour), and A2B3 (cane sugar 30 g + 48 hour), the color is white. This is in line with the study by Kinteki *et al* (2018) Changes in visible color are influenced by the fat content and color of different types of sugars. Sugar is brown color so when kefir is differentiated, it produces a bright white color. Cane sugar has a white color, so the resulting kefir is also white. The lactic acid bacteria, or BAL play a role in causing color changes due to the fermentation process. This shows that the kefir produced has met the SNI quality criteria, so it is safe to consume.

Based on Table 2, it is shown that in terms of texture, the combination of goat milk and skim kefir in all treatments has the same texture, which is soft. The composition of goat milk and skim milk kefir has a soft texture due to its low flavor content, which is consistent with the results of the Nurkhoeriyati (2017) study, which stated that the flavor sourness that goat's dairy kefir possess is lower compared to commercial kefir. Skim milk also affects the texture produced by kefir. This is in line with the study of Lestari (2021), which stated that the higher the total kefir solidity of corn milk, the thicker the texture of the kefir milk products produced. This is also due to the process of milk coagulation due to microbial activity in the starter because of the use of lactose and casein,

resulting in the occurrence of kefir texture changes. The soft texture formed in fermented milk is due to the agglomeration of proteins by the acid produced during the fermentation process.

Based on Figure 1, the average rate of preference for kefir combination of goat milk and skim milk on treatment A2B1 (cane sugar 30 g + 24 hour fermentation duration) is highly preferred by panelis. This is because most panelis love the sour taste, white color, sweet smell, and soft texture that kefir possesses. This is in line with Rohman (2019) research that shows that the taste and smell that appear on kefir will affect the overall preference of panelists toward kefir. Consistency in a food product will affect the level of consumer acceptance. Color, smell, and taste parameters can be said to be a combination of the overall assessment of the appearance (Angraiyati, 2017).

#### 4. CONCLUSIONS

The best acid total kefir combination between goat milk and skim milk on treatment A2B1 (cane sugar 30 g + 24 hour fermentation duration) was 0.797 % and pH 4. It is in accordance with the standard quality of probiotic beverages kefir according to SNI 7552 : 2009 which is the total amount of acid 0.2 – 0.9 % and pH 4 – 4.6.

The best organoleptic quality of kefir on the A2B1 treatment (cane sugar 30 g + 24 hour fermentation duration) has an sour taste, a white color, a tasty flavour, a soft texture, and the level of preference preferred by the panelists. Acid total content and organoleptic quality of the kefir combination between goat milk and skim milk have been in accordance with SNI quality.

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