

## **EFFECT OF SUGAR SUBSTITUTION WITH DATES PUREE (*Phoenix dactylifera* L.) ON THE PHYSICAL AND ORGANOLEPTIC CHARACTERISTICS OF KEFIR ICE CREAM**

Fahmi Arifan<sup>1)</sup>, Heni Rizqianti<sup>\*2)</sup>, Antonius Hintono<sup>2)</sup>, Nurwantoro<sup>2)</sup>, Siti Susanti<sup>2)</sup>, Luthfiyah Nur Sulistiyan<sup>3)</sup>

<sup>1)</sup>Departemen Teknologi Industri, Sekolah Vokasi, Universitas Diponegoro, Jl. Prof. Sudarto, Tembalang, Kec. Tembalang, Kota Semarang, Jawa Tengah, Indonesia, 50275

<sup>2)</sup>Departemen Pertanian, Fakultas Peternakan dan Pertanian, Universitas Diponegoro, Jl. Prof. Soedarto, Tembalang, Kec. Tembalang, Kota Semarang, Jawa Tengah, Indonesia, 50275

<sup>3)</sup>Mahasiswa Program Studi Teknologi Pangan, Universitas Diponegoro, Tembalang, Kec. Tembalang, Kota Semarang, Jawa Tengah, Indonesia, 50275  
Email: henirizqi92@gmail.com

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### **ABSTRACT**

The sour taste of kefir ice cream is less attractive with consumers, so it is necessary to add sweeteners. Dates can be used as a natural sweetener in making kefir ice cream. The aims of this research is to determine the effect of sugar substitution with dates puree on overrun, melting rates, viscosity, pH value and organoleptic properties of kefir ice cream. The method used in this research was an experimental with Completely Randomized Design (CRD) with 5 treatments and 4 replications. Overrun, melting rates, viscosity and pH values were analyzed by ANOVA test and followed by Duncan Multiple Range Test, meanwhile organoleptic characteristic were analyzed by Kruskal Wallis test and followed by Mann-Whitney test. The results showed that the substitution of sugar with dates puree as a sweetener had a significant effect ( $p < 0.05$ ) on overrun, melting rates, viscosity and pH value of kefir ice cream. Substitution of sugar with dates puree had a significant effect ( $p < 0.05$ ) on sweetness, sourness, brownish color and softness of kefir ice cream. The sugar substitution with dates puree 25%: 75% (T1) had the best overrun, melting rate as well as the organoleptic characteristic because it was able to reduce the sour taste of kefir ice cream.

**Keywords:** Dates puree; kefir ice cream; substitution.

## INTRODUCTION

Food processing technology are now currently growing, one of them is the processing of ice cream. In general, ice cream is made from a mixture of milk, animal or vegetable fat, sugar and with or without other food additives (Haryanti and Zueni, 2015). High nutritional value of ice cream is one of the benefits that can be obtained from consuming ice cream, but nowadays a lot of people choose to consume foods that have functional properties. One of the functional food that can be found nowadays is kefir. Kefir is a fermented product which is also consider as a functional food made from cow's milk fermented with kefir grains and contained about 40 types of beneficial bacteria (Rossi et al., 2016). Kefir has many health benefits, one of them is for digestion because it is known for the good bacteria in kefir that can inhibit the growth of pathogenic bacteria in the digestive system organ. The use of kefir in ice cream making is a new innovation and product diversification from kefir itself. However, ice cream has a fairly high level of acidity. The high acidity in kefir products is due to the high content of lactic acid produced from lactic acid bacteria in kefir grains and the presence of yeast which will convert milk lactose into CO<sub>2</sub> and alcohol (Yusriah and Agustini, 2014). The sour taste of kefir products is one of the organoleptic properties of kefir which is still unpopular for the general public, so it is necessary to add sweetener.

A sweetener that is commonly used in food processing is sugar (sucrose). However, excessive sugar consumption is not good for health due to the high glycemic index (GI) and calorie content of sucrose

(Putri et al., 2015). An alternative that can be used to solve this problem is by substituting sugar with natural sweeteners from fruits, one of them is from dates puree. Dates are one of the fruits that have many benefits because of their high nutritional content. Dates have a high nutritional content and low in sucrose (Hasnaoui et al., 2011). Dates are classified as a very sweet fruits, however, dates have a relatively low glycemic index (GI) value (Maharani, 2018). Until now, the use of dates is still limited, dates are generally only consumed during Ramadan and are only consumed directly without going through further processing (Arisanti, 2017). The substitution treatment of dates puree will affect the physical and organoleptic characteristics of kefir ice cream.

The purpose of this study is to determine the effect of sugar substitution with dates puree on overrun, melting rates, viscosity, pH value, and organoleptic characteristic of kefir ice cream as well as food diversification by utilizing dates as natural sweeteners, resulting a healthy, nutritious and well-received food products.

## MATERIALS AND METHODS

The research was carried out in September – October 2020 at the Laboratory of Engineering and Agricultural Products and Laboratory of Food Chemistry and Nutrition, Faculty of Animal Husbandry and Agriculture, Diponegoro University, Semarang. The materials in this research was kefir ice cream sugar substitution with dates puree. The materials used in this research were fresh cow milk, kefir grains obtained from Omah Kefir Ungaran, dates fruit Sukkari type, sugar, liquid whipping

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\*Corresponding author:

Heni Rizqiati

Email: henirizqi92@gmail.com

Departemen Pertanian, Fakultas Peternakan dan Pertanian, Universitas Diponegoro, Jl. Prof. Soedarto, Tembalang, Kec. Tembalang, Kota Semarang, Jawa Tengah, Indonesia, 50275

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cream, egg yolk, Carboxymethyl cellulose (CMC), *aquadest*, and buffer solutions. The equipment used in this research were ice cream maker (Hakasima, Japan), hand mixer, pan, blender, filter, stirrer, thermometer, analytical scale, stove, pan, plastic wraps, plastic jars, refrigerator, freezer, beaker glass, cup and bob viscometer (Rion VT-06, Japan), stopwatch, pH meter (Ohaus-Starter2100, USA) and plastic cup. This research methods used by a completely randomized design (CRD) with 5 treatments and 4 replications. Substitution treatment of sugar and dates puree on kefir ice cream that was applied included T0 (control) = 100% sugar: 0% dates puree, T1 = 75% sugar: 25% dates puree, T2 = 50% sugar: 50% dates puree, T3 = 25% sugar: 75% dates puree, T4 = 0% sugar: 100% dates puree. The procedures carried out in this research there are making kefir, making dates puree, making kefir ice cream with sugar substitution of dates puree and

analyzing the samples by physical properties and organoleptic characteristics analyze.

### Kefir Preparation

Fresh cow milk was filtered and pasteurized at 70°C for 15 s. Then lowered the milk's temperature until it reached room temperature. The next step, 5% of kefir grains were added from the total milk and stirred until blended, then the fermentation process is carried out at room temperature for 24 h. After the fermentation process is completed, then filtered the kefir to separated the kefir from the kefir grains (Bayu *et al.*, 2017).

### Dates Puree Preparation

Dates were separated from the seeds and then blended it until smooth with the addition of warm water, the ratio of water : dates was 1: 1. After that, the dates puree was filtered to separated the puree of the dates from the pulp (Ismail *et al.*, 2018).

**Table 1.** Formulation of Kefir Ice Cream Sugar Substitution with Dates Puree

Ingredients	Perlakuan				
	T0	T1	T2	T3	T4
Kefir (g)	255.38	255.38	255.38	255.38	255.38
Whipped cream (g)	146.62	146.62	146.62	146.62	146.62
Sugar (g)	81.5	61.125	40.75	20.375	-
Dates puree (g)	-	20.375	40.75	61.125	81.5
Egg yolk (g)	15	15	15	15	15
CMC (g)	1.5	1.5	1.5	1.5	1.5
Total (g)	500	500	500	500	500

### Kefir Ice Cream Preparation

Kefir ice cream is made by pasteurized egg yolk first by HTST processed and then put it in a container for mixing process. Then, sugar and dates puree were added and mixed by using a hand mixer. Then, put in the liquid *whipped cream* and CMC then continued with the kefir and stirred again evenly. After that, left the dough for  $\pm 4$  h on the refrigerator to pass the *aging* process. After the aging process completely done, put the dough into the ice cream maker for  $\pm 60$  min then frozen it in the freezer at -15°C for 24 h (Aulia *et al.*, 2019).

### Variable Analysis:

#### Overrun

Overrun were measured based on the difference in ice cream mass and dough mass at the same ice cream volume. The overrun was calculated by weighing the ice cream dough before put into the ice cream maker as much 100 mL and the weight was recorded as A.

After the dough came out of the ice cream maker, weigh the finished ice cream again as much 100 mL and record its weight as weight B (Sembiring *et al.*, 2019). The overrun value can be calculated by:

$$\text{Overrun} = \frac{A-B}{A} \times 100\%$$

Information:

A = Weight of ice cream dough.

B = Weight of ice cream.

### Melting Rates

Melting rates were analyzed by preparing 10 g of ice cream samples and placed them in the small cups and then freeze them in the freezer for 24 h. After took out the ice cream samples from the freezer, then left them in an open place (room temperature), record the time for the ice cream samples to melt completely (Nofrida *et al.*, 2018).

### Viscosity

Viscosity were analyzed by using a rotary viscometer. Initially, a sample of 100 mL was inserted into the cup. Next, the cup is placed right in the middle of the viscometer rotor. The dough viscosity value will be shown on the monitor screen (Tamimi *et al.*, 2019).

### pH Value

pH value were measured by pH meter. Firstly, turned on the pH meter and calibrated it first. Samples were taken as much as 30 mL and then placed it into 50 mL beaker glass. The next step, pH meter cathode was inserted into the sample until a stable pH value appeared on the pH meter (Afriyani *et al.*, 2020).

### Sensory Evaluation

Organoleptic characteristic were tested using the scoring method including testing for sweetness, sourness, sour aroma, brownish color and softness. Organoleptic characteristic testing was carried out by using 25 semi-trained panelists. Each panelist would be presented with 5 different samples and they would be asked to give a score on the organoleptic characteristic of the ice cream with a rating scale of 1 - 4 by descriptively (not - very) (Susilawati *et al.*, 2014).

### Data Analysis

All the data result from overrun, melting rates, viscosity and pH value were analyzed by using ANOVA test with a significant level of 5% and if there was a significant effect then continued with *Duncan Multiple Range Test*. The data result from organoleptic characteristic test was analyzed using Kruskal Wallis test with a significant level of 5% and if there was a significant effect then continued with *Mann-Whitney* test.

## RESULTS AND DISCUSSION

The results of kefir ice cream with dates puree as sugar substitution on overrun, melting rates, viscosity and pH value can be seen in Table 2. It is known that the sugar substitution with dates puree treatment on kefir ice cream had a significant effect ( $p < 0.05$ ) on overrun, melting rates, viscosity and pH value.

### Overrun

Based on Table 2., The treatment of sugar substitution with dates puree on kefir ice cream had a significant effect ( $p < 0.05$ ) on the overrun of kefir ice cream. The highest overrun value was from T0 (without adding dates puree) which was 21.05%, while the lowest overrun was from T4 (adding 100% dates puree) which was 10.06%. In general, overrun value for the household scale ranging from 30-50% (Widiantoko and Yuniarta, 2014). The results showed that the higher sugar substitution with dates puree on the kefir ice cream, gave the lower overrun value.

The decrease in the overrun value along with the higher concentration of dates puree substitution could be cause by an increase in the total solids of the ice cream. The higher total solids in the ice cream increase the viscosity or thickness of the ice cream, the high viscosity will affect the air trapping process in the ice cream which in turn will affect the overrun (Wijayanti *et al.*, 2017). The thick ice cream dough will limit

the mobility of the water molecules in the dough because the space between the particles is getting limited, the limited space between the particles causing the air to enter the dough during the agitation process only a little so the result for overrun is low

(Oksilia *et al.*, 2012). Low overrun indicates the large number of solids contained so it takes a longer time to melt compared to ice cream which has a high overrun that contains more air bubbles (Rahmasari *et al.*, 2019).

**Table 2.** Results of Testing the Physical Properties of Kefir Kurma Ice Cream

Parameter	Treatment				
	T0	T1	T2	T3	T4
Overrun (%)	21.05±0.58 <sup>e</sup>	16.03±0.96 <sup>d</sup>	13.01±0.97 <sup>c</sup>	11.23±0.51 <sup>b</sup>	10.06±0.32 <sup>a</sup>
Melting rates (min)	25.18±1.71 <sup>a</sup>	30.27±2.71 <sup>b</sup>	32.69±1.86 <sup>bc</sup>	36.00±3.38 <sup>cd</sup>	39.10±2.11 <sup>d</sup>
Viscosity (dPa.s)	6.32±0.71 <sup>a</sup>	6.65±0.81 <sup>ab</sup>	7.35±0.24 <sup>b</sup>	8.40±0.08 <sup>c</sup>	8.80±0.27 <sup>c</sup>
pH Value	4.24±0.03 <sup>a</sup>	4.29±0.06 <sup>ab</sup>	4.32±0.07 <sup>bc</sup>	4.36±0.05 <sup>bc</sup>	4.40±0.05 <sup>c</sup>

Remarks: \* Different lowercase superscripts indicate are significantly effect ( $p < 0.05$ )

### Melting Rates

Based on Table 2., it can be seen that kefir ice cream with the addition of dates puree as sugar substitution had a significant effect ( $p < 0.05$ ) on the melting rates of kefir ice cream. Dates puree substitution treatment significantly ( $p < 0.05$ ) increased the melting rates of kefir ice cream. It can be seen in Table 2., which shows that the melting rates of all samples treatment have from 25.18 min to 39.10 min. The results of melting rates of kefir ice cream were significantly different because of the substitution treatment of dates puree due to the high total solids in dates puree. The increasing total solids contained in the dough will decrease the overrun value, while increasing the melting resistance of an ice cream (Nuryadi *et al.*, 2020). Fiber is one of source of total solids in dates. The fiber content in dates is quite high, there is about 6.4 - 11.5% (Sendra *et al.*, 2016). The amount of fiber content in Sukkari dates is about 9.11% (Habib and Ibrahim, 2011).

The high total solids content in the ice cream dough will cause the water content in the dough to be less, so the ice crystals formed are also smaller. The formation of smaller ice crystals will make the ice cream more resistant to melting (Chen *et al.*, 2019). Increasing the total amount of solids in the ice cream dough also has an effect in increasing the viscosity of the ice cream dough as well as the increasing resistance of

the ice cream to melting. The viscosity of the dough has a significant effect on the resistance to melting and overrun of ice cream, the high viscosity will make the air trapped in the dough during the freezing process in the ICM will be difficult to enter, so the air cavity is small and causes the ice cream can not be melt easily at the room temperature (Ismail *et al.*, 2020).

### Viscosity

Based on Table 2., it can be seen that kefir ice cream with the addition of dates puree as sugar substitution had a significant effect ( $p < 0.05$ ) on the ice cream viscosity. The highest viscosity observed in ice cream with higher date palm *purees* content (T4) and the lowest was found in sample with no added date palm *purees* (T0). The total solid contents in sokkary type of dates fruit range between 44.43 - 49.40%. Meanwhile, 99% of the total material in sugar is total soluble solid content. The increase in viscosity can be associated with higher total solid contents that are able to trap and bind water (Sudajana *et al.*, 2017). One of the components in total solid is sugar.

The main sugar content in sokkary dates is monosaccharides consisting of glucose 33.58% (g/100g) and fructose 22.67% (g/100g) (Al-Asmari *et al.*, 2017). While the main component of granulated sugar is sucrose which is a disaccharide group. Monosaccharides such as glucose

and fructose have better hydrophilic and solubility characteristics than disaccharides so that resulting the solution easier to bind more water (Alizadeh *et al.*, 2014). The fiber content in date fruit is also able to bind water which can cause a higher viscosity value (Syed *et al.*, 2018). Viscosity is an important parameter in ice cream because it can be used as a measurement in the final quality of ice cream product. The viscosity can affect the smoothness, consistency and final texture of ice cream product. The higher viscosity of the ice cream mix, resulting high melting resistance but the overrun is reduced (Bahramparvar *et al.*, 2010).

### pH Value

Based on Table 2., it can be seen that kefir ice cream with the addition of dates puree as sugar substitution had a significant effect ( $p < 0.05$ ) on the pH value of kefir ice cream. Dates puree substitution treatment significantly ( $p < 0.05$ ) increased the pH value of kefir ice cream. The increase in pH value was due to the higher substitution of dates puree. The increase in the pH value of kefir ice cream products is thought to be due to the hydrolysis of cellulose starch from the fiber polysaccharide chain that occurs in solutions with acidic conditions.

In the acid state of cellulose, it will undergo hydrolysis, the  $[H^+]$  ion can break the glycosidic bonds found in cellulose (Azizah and Marziah, 2018). Based on research that has been done by Mayang *et al.* (2019), along with the length of time for hydrolysis, the pH value of the product will be increase. It is suspected that there is a binding of free  $[H^+]$  ions present in the solution with the molecules resulting from the breaking of the glycosidic bonds that occur during the hydrolysis of cellulose, so the free  $[H^+]$  ions in the product decrease and increase the pH value. According to Hayyan *et al.* (2013), glucose has a neutral pH value.

The neutral pH value possessed by the glucose monomers from the hydrolysis of the cellulose is thought to increase the pH value of the resulting kefir ice cream. The

pH value in all treatments is in the range 4.24 - 4.40, this shown that the kefir ice cream still fullfils the standards of the Australia New Zealand Food Standards Code 2.5.3 (2015) regarding fermented milk products, that the pH value at fermented milk products not more than 4.5.

### Organoleptic Characteristic Sweetness

Based on Table 3., the results shown that the sweetness of kefir ice cream with the treatment of sugar substitution with dates puree had a significant effect ( $p < 0.05$ ). The mean score of sweetness of kefir ice cream from T0 - T4 treatment was categorized as sweet - slightly sweet.

The sweetness of kefir ice cream is relatively reduced by the substitution of sugar with dates puree. This is can be happens because the total sugar content in dates is lower than sugar. The total sugar content of dates is 78.5% consisting of 3.2% sucrose (Soebahar *et al.*, 2015). Meanwhile, sugar has high total sugar, it is about 99.9% sucrose (Listyaningrum *et al.*, 2018). The reduced sweetness in kefir ice cream is also influenced by the lower use of sugar, meanwhile sugar can provide a better taste (Laga *et al.*, 2019).

### Sourness

Based on Table 3., the results shown that the sourness of kefir ice cream with the treatment of sugar substitution with dates puree had a significant effect ( $p < 0.05$ ). The mean score of sourness of kefir ice cream from T0 - T4 treatment was categorized as sour - slightly sour. The sour taste that appears in kefir ice cream comes from the breakdown of lactose into lactic acid during the fermentation process of kefir. Lactic acid bacteria in kefir will produce the  $\beta$ -galactosidase enzyme which can convert lactose sugar in milk into lactic acid which gives it a sour taste (Rumeen *et al.*, 2015).

The sour taste of kefir ice cream tends to decrease along with the variation of dates puree substitutions. Dates are known as fruits that have a sweet taste, this is thought

to reduce the sour taste of kefir ice cream (Seerangurayar *et al.*, 2019). Dates fruit contain of reducing sugars such as a sucrose (Said *et al.*, 2014).

### Sour Aroma

Based on Table 3., the results shown that the sour aroma of kefir ice cream with the treatment of sugar substitution with dates puree did not have a significant effect. The mean score of sour aroma of kefir ice

cream from T0 - T4 treatment was categorized as slightly acidic. The results that are not significantly different are thought to occur due to the effect of ice cream storage at low temperatures so that the detectability that can be felt is lower than other food products stored at room temperature (Simatupang *et al.*, 2015). The aroma you feel is a sour aroma that arises from using kefir in the process of making ice cream.

**Table 3.** Results of Testing the Organoleptic Characteristic of Kefir Kurma Ice Cream

Parameter	Treatment				
	T0	T1	T2	T3	T4
Sweetness	2.64±0.91 <sup>a</sup>	2.64±0.81 <sup>a</sup>	2.28±0.84 <sup>a</sup>	1.72±0.68 <sup>b</sup>	1.58±0.65 <sup>b</sup>
Sourness	3.08±0.95 <sup>a</sup>	2.44±0.82 <sup>b</sup>	2.40±0.76 <sup>b</sup>	2.40±0.76 <sup>b</sup>	2.20±0.86 <sup>b</sup>
Sour Aroma	2.00±0.71	2.12±0.72	2.28±0.74	2.32±0.80	2.36±0.95
Brownish Color	1.12±0.33 <sup>a</sup>	1.48±0.51 <sup>b</sup>	1.80±0.64 <sup>b</sup>	2.12±0.78 <sup>bc</sup>	2.24±0.83 <sup>bc</sup>
Softness	3.16±0.74 <sup>a</sup>	2.88±0.92 <sup>ab</sup>	2.60±0.91 <sup>b</sup>	2.56±0.96 <sup>b</sup>	2.28±0.84 <sup>bc</sup>

Remarks: \* Different lowercase superscripts indicate are significantly effect ( $p < 0.05$ )

The distinctive sour and yeast aroma in kefir is caused by the presence of dominant volatile ester compounds and lactic acid from the end result of the yeast fermentation process in kefir (Farag *et al.*, 2020). The increase in orders for volatile compounds such as lactic acid, acetic acid and ethanol in the kefir fermentation process will increase the sharpness of the sour kefir aroma (Lestari *et al.*, 2018). The aroma of a certain component has a specific function in food, including improving or sharpening the aroma of the product (Amir *et al.*, 2017).

### Brownish Color

Based on Table 3., the results shown that the brownish color of kefir ice cream with the treatment of sugar substitution with dates puree had a significant effect ( $p < 0.05$ ). The mean score of brownish color of kefir ice cream from treatment T0 - T4 was categorized as not brownish - a little bit brownish. Data from further test results can be seen that the T0 treatment shows a significant difference with the T1 treatment. The brownish color of kefir ice cream is influenced by the substitution treatment of

dates puree. The tannins in dates can have a brownish effect of the resulting kefir ice cream (Cesia and Judiono, 2018). The type dates that we were used are Sukkari, which have a golden brownish appearance (Astari and Dewi, 2019). The results obtained in the T1 to T4 treatment showed that there was no significant difference between treatments, this can be happens because Sukkari dates have a light brown color and the edges are goldish yellow (Fandi *et al.*, 2020).

### Softness

Based on Table 3., the results shown that the softness of kefir ice cream with the treatment of sugar substitution with dates puree had a significant effect ( $p < 0.05$ ). The mean score of softness of kefir ice cream from T0 - T4 treatment was categorized as soft - not soft. The perceived softness can be influenced by several factors, one of which is total solids. Total solids can affect the texture of the ice cream produced as well as the softness of the ice cream (Tuhumury *et al.*, 2016). The addition of dates puree can reduces the softness of the ice cream because of dates fruit contain many fiber

sources, so the texture of kefir ice cream becomes fibrous and feels flaky (Cesia and Judiono, 2018). The ideal ice cream texture is ice a smooth texture and has a small solid size (Baitirahman and Utami, 2019).

## CONCLUSION

Based on the results presented, it is concluded that the sugar substitution with dates puree on kefir ice cream can reduce the overrun value and increase melting rates, viscosity and pH value of kefir ice cream. Sugar substitution with dates puree can reduce the sweetness, sourness and softness of kefir ice cream also increase the brownish color of kefir ice cream. Kefir ice cream substitution treatment of sugar with dates puree 25%: 75% (T1) gave the best results seen from the overrun, melting rates as well as the organoleptic characteristic because it was able to reduce the sourness of kefir ice cream.

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