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UTILIZATION OF DATE PALM (PHOENIX DACTYLIFERA L.) IN THE MAKING OF LOW-FAT PUMPKIN (CUCURBITA MOSCHATA DUCHESNE) ICE CREAM

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ABSTRACT

Date palm (Phoenix dactylifera L.) and pumpkin (Cucurbita moschata Duchesne) are foods that have antioxidant activity because they contain phenolic, flavonoid, and carotenoid compounds. Date palm is known to have a high level of dietary fiber. This research study aimed to make low-fat pumpkin and date palm ice cream as a source of antioxidant and dietary fiber using different types of stabilizers (gelatin and carboxymethyl cellulose; CMC). The pumpkin puree was made by adding water in a 1:1 ratio to pumpkin pulp based on previous research. The date palm puree was made with several different ratios of water (1:1, 1:2, and 1:3). The best formulations of date palm puree and pumpkin puree were analyzed for their physicochemical characteristics (pH, total soluble solids, and color), antioxidant activity, total phenolic, total flavonoid, total carotenoid content, and dietary fiber content. The date palm puree with a 1:1 ratio was selected as the best puree. Ice cream was made with different ratios of pumpkin puree and date palm puree, 1:1, 1:2, 1:3, 2:1, and 3:1, using different stabilizers (gelatin and CMC). Each formulation was analyzed for its physicochemical (pH, total soluble solids, color, overrun, melting characteristic, and texture) and sensory characteristics. Ice cream with gelatin as its stabilizer and the 1:2 ratio of pumpkin puree and date palm puree was selected as the best ice cream formulation; it has 6.12% dietary fiber and 3.47% fat. Thus, the ice cream with the best formulation was high in fiber and low in fat.

Keywords: Antioxidant activity; Date palm; Dietary fiber; Ice cream; Pumpkin

1. INTRODUCTION

Ice cream is a frozen dessert that is made by mixing milk-based ingredients (milk, cream, and butter) and non-milk-based ingredients (stabilizer, emulsifier, flavor, sweetener, and colorant) that has been previously pasteurized and homogenized (Arbuckle & Marshall, 2012). Usually, ice cream is high in fat, has a high number of calories, is low in antioxidants, and has a low amount of dietary fiber. Adding vegetables and fruits can increase the functional value of ice cream (Viquez et al., 2018). Fruits and vegetables are rich in phenolic, flavonoid, and carotenoid compounds that lead to antioxidant activity (Kesuma & Yernrina, 2015; Iswanto et al., 2019). An antioxidant is a compound that can delay, prevent, or eliminate the negative effects of oxidants in the body (Winarsi, 2007). Fruits and vegetables also contain high dietary fiber that is useful for preventing various degenerative diseases, such as colon cancer, heart problems, and hypertension (Kesuma & Yernrina, 2015). Low-fat ice cream is generally preferable by consumers because it can be consumed in larger quantities (Sarofa et al., 2014).

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Pumpkin is a high productivity vegetable cultivated around the world; it is rich in a variety of nutrients, such as phenolic, flavonoid, and carotenoid compounds, minerals, and vitamins. Pumpkin has a long shelf life, low calories, and high fiber in its pulp and seeds (Santos et al., 2017). Pumpkin contains carotenoid compounds in the form of α-carotene and β-carotene. Pumpkin can contribute to the visual appeal of food as a natural yellow or orange colorant (Rantono et al., 2015). Pumpkin is known to have antioxidant properties because it contains carotenoid compounds, especially β-carotene, as a precursor of vitamin A (Santos et al., 2017). However, carotenoids can be easily damaged and degraded in high temperatures (Mulia et al., 2018).

Date palm is one of the oldest fruit corps in the Middle East and North Africa that can be directly consumed. Date palm is usually harvested during the fully ripened Rutab and Tamar stages to maintain low moisture and high levels of sugar. Date palm could be categorized as a source of carbohydrate because it contains glucose, fructose, and sucrose. Date palm is also a good source of minerals, amino acids, fiber, and vitamins (Chao & Krueger, 2007). Date palm has been known to haven antioxidant activity due to its phenolic, flavonoid, and carotenoid compounds. The fiber and phenolic content depend on the ripening stage of the date palm (Ghnimi et al., 2017).

Two types of stabilizers are usually used in making ice cream: animal-based stabilizers and plant-based stabilizers. Carrageenan, pectin, guar gum, alginate, and carboxymethyl cellulose (CMC) are plant-based stabilizers. Gelatin is an animal-based stabilizer. CMC is used as a stabilizer in ice cream because it is lower in cost than other stabilizers, easily dissolved, and has high water holding capacity (Goff & Hartel, 2013). Different types of stabilizers produce different textures of ice cream (Arbuckle & Marshall, 2012). As a stabilizer in ice cream, gelatin can usually prevent crystallization of sugar and lactose during the freezing and storage process, so it produces ice cream that has a smooth body and texture (Mariod & Adam, 2013).

This present research study aimed to make low-fat pumpkin ice cream by adding date palm as a source of antioxidants and dietary fiber. The characteristics of the ice cream were determined using gelatin and CMC as stabilizers.

2. METHODOLOGY/ EXPERIMENTAL

2.1. Raw Materials

The following materials used to make the ice cream: pumpkin, date palm (sukari al madinnah), skim milk powder (nzmp), full cream milk (ultra milk), randu honey (madu murni nusantara), a stabilizer (gelatin carboxymethyl cellulose; cmc), and an emulsifier (mono-diglyceride; mdg).

2.2. Making the Pumpkin Puree

Pumpkin puree was produced using a modification of the method described by Claudia et al. (2016). The fresh pumpkin was cleaned and sorted before weighing and cutting. The cut pumpkin was steamed for 5 minutes at 85ºC to soften the flesh. Pumpkin puree was made by combining the pumpkin with water at a ratio of 1:1 in a food processor.

2.3. Making the Date Palm Puree

The date palm puree was produced using a modification of the method described by El-Sharnouby et al. (2014). The date palm was cleaned and sorted before weighing to separate the fruit flesh and seeds. The date palm puree was made by combining the date palm with water (at ratios of 1:1, 1:2, and 1:3) in a food processor.

2.4. Making the Ice Cream

The ice cream was made using different stabilizers (gelatin and CMC) and different pumpkin puree-to-date palm puree ratios (1:0, as the control; 1:1, 1:2, 1:3, 2:1, and 3:1, as the formulations). The ice cream was produced using a modification of the method described by

Clarke (2012). Pumpkin puree, date palm puree, full cream milk, skim milk powder, honey, and MDG, according to the formulation, were mixed and pasteurized for 20 minutes at 72°C. After the pasteurization process was completed, a stabilizer (CMC or gelatin) was added and stirred until homogeneous, then the mixture was left to sit at room temperature. In the next step, the ice cream mixture was placed in the refrigerator at 4ºC for 24 hours for the aging process. Then, the mixture was placed in an ice cream maker for 20 minutes for the freezing process. For the hardening process, the ice cream was stored in a freezer with temperatures ranging from -20ºC to -50ºC for 5 hours. The basic formulation of the ice cream is shown in Table 1.

Table 1 Ice cream formulation

Composition	Percentage (%)
Full cream milk	62.5
Skim milk powder	7.1
Honey	10.0
MDG	0.2
Gelatin or CMC	0.2
Ratio of pumpkin puree and date palm puree	20.0

2.5. Chemical Analysis

Determination of the moisture, ash, protein, lipid, carbohydrate, dietary fiber, and sucrose content was performed according to the Association of Official Analytical Chemists (AOAC) (2005) guidelines. The antioxidant activity was measured by using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) method (Tangkanakul et al., 2009). The total phenolic and total flavonoid contents were measured by using the Folin-Ciocalteau and colorimetric method (Al-Rimawi et al., 2014; Mulia et al., 2015). The total carotenoid content was measured using the spectrophotometric method (Kalaikandhan et al., 2014).

2.6. Physical Analysis

The melting time of the ice cream was determined by placing 5 g of ice cream in a beaker glass and measuring the melting time using a stopwatch (Sun-Waterhouse et al., 2013). The total amount of soluble solids was determined by using a hand refractometer (AOAC, 2005). The lightness (L*) value of the color was measured by using a chromameter (Inglett et al., 2005). Overrun was determined by using the method described by Hamad et al. (2017).

2.7. Sensory Evaluation

Sensory evaluation was performed using a hedonic test that was conducted to determine the panelists' preference for ice cream based on several parameters, including milky aroma, color, sweetness, texture, and overall acceptance (Ekissi et al., 2014).

2.8. Statistical Analysis

Statistical analysis was performed by using one-way analysis of variance (ANOVA) with one factor, and a completely randomized design (CRD) with two factors and three replications.

3. RESULTS AND DISCUSSION

3.1. Characteristics of the Pumpkin and Date Palm

The species identification results done at LIPI (Indonesia Institute of Sciences) show that the species of pumpkin and date palm used in this experiment were *Cucurbita moschata* Duchesne and *Phoenix dactylifera* L., respectively. The results of the chemical composition analysis of the pumpkin and date palm are shown in Table 2.

Table 2 Chemical composition of the pumpkin and date palm

Chemical Composition	Pumpkin	Date Palm
Moisture (%)	91.28±0.04	24.18±0.05
Ash (%)	0.18±0.01	1.25±0.01
Protein (%)	1.15±0.04	2.76±0.04
Fat (%)	0.34±0.01	2.38±0.05
Carbohydrate (%)	7.05±0.02	69.43±0.09

3.2. Antioxidant Characteristics and Dietary Fiber of Date Palm Puree

The one-way ANOVA statistical analysis results show that several different ratios of water had a significant effect ($p<0.05$) on the IC_{50}, total phenolic, total flavonoid, total carotenoid, and dietary fiber value of date palm puree. For all treatments, date palm puree is considered to have a high level of dietary fiber since has more than 6 g of dietary fiber in 100 g of puree (National Agency of Drug and Food Control; BPOM, 2016).

Table 3 Antioxidant characteristics and dietary fiber of date palm puree

Parameters	Date Palm:Water Ratio		
	1:1	1:2	1:3
IC_{50} (ppm)	49882.65 ± 194.36^{a}	74702.27 ± 224.71^{b}	104207.12 ± 169.89^{c}
Total phenolic (mg GAE/L)	705.13 ± 7.85^{c}	410.26 ± 7.85^{b}	296.47 ± 7.24^{a}
Total flavonoid (mg QE/L)	101.45 ± 0.13^{c}	68.27 ± 0.07^{b}	45.42 ± 0.10^{a}
Total carotenoid (ppm)	1.28 ± 0.03^{c}	0.97 ± 0.05^{b}	0.80 ± 0.02^{a}
Dietary fiber (%)	8.90 ± 0.31^{c}	7.82 ± 0.66^{b}	6.17 ± 1.12^{a}

Notes: Different superscript notations mean a statistically significant effect at $p<0.05$

3.3. Determination of the Best Date Palm Puree

The date palm-to-water ratio of 1:1 was selected as the best date palm puree. This treatment was chosen due to its antioxidant activity, its total phenolic, total flavonoid, and total carotenoid content, and because it has the highest dietary fiber content.

3.4. Physical Properties of the Ice Cream Mixtures

The univariate two-way ANOVA statistical analysis results show that different stabilizers and different pumpkin puree-to-date palm puree ratios had a statistically significant effect ($p<0.05$) on the total soluble solid value, the overrun, the melting time, and the color of the ice cream. Moreover, interaction between different stabilizers and different pumpkin puree-to-date palm puree ratios was statistically significant ($p<0.05$).

The ice cream with the CMC stabilizer had a higher total soluble solid content than the ice cream with the gelatin stabilizer. This is because CMC has a greater water holding capacity than gelatin (Widiantoko & Yunianta, 2014). Adding more date palm puree to the ice cream, based on different ratios, resulted in a higher total soluble solid content. This is because date palm puree has a higher total soluble solid content than pumpkin puree (Hamad et al., 2017).

The ice cream made with the CMC stabilizer has a higher overrun, but a lower melting time than the ice cream made with the gelatin stabilizer because CMC has a higher water holding capacity, which causes the ice cream mixture to become more viscous, and the formation of air is more stable. The ice cream mixtures with an increasing amount of date palm puree, based on different ratios, had a lower overrun value, but a longer melting time than the mixtures with a lower amount of date palm puree, since date palm contains a high amount of sugar and more total solids. High sugar content and total solids causes the ice cream mixture to swell less, which decreases the

overrun since less air can be trapped inside the ice cream mixture, which increases its viscosity causing the water to be easily trapped (Widiantoko &Yunianta, 2014; Yudhistia et al., 2018).

Table 4 Physical properties of the ice cream

Parameters		Total Soluble Solids	Overrun	Melting Time	Color (L*
Stabilizer	Ratio	(°Brix)	(%)	(minute)	value)
Gelatin	1:0	19.75±0.05^{a}	54.42±0.04^{f}	24.31±0.04^{g}	59.40±0.19^{h}
	1:1	22.25±0.05^{e}	49.92±0.09^{c}	26.20±0.05^{j}	55.12±0.21^{c}
	1:2	23.07±0.05^{f}	48.37±0.06^{b}	27.13±0.07^{k}	53.99±0.13^{b}
	1:3	23.77±0.05^{h}	47.45±0.04^{a}	28.26±0.06^{l}	53.09±0.20^{a}
	2:1	21.57±0.05^{d}	51.57±0.15^{d}	25.51±0.05^{i}	57.11±0.07^{c}
	3:1	21.10±0.06^{b}	53.17±0.05^{e}	25.17±0.03^{h}	59.10±0.40^{g}
CMC	1:0	19.77±0.05^{a}	96.93±0.11^{l}	17.46±0.04^{a}	59.93±0.32^{i}
	1:1	22.30±0.09^{e}	90.83±0.12^{i}	19.23±0.04^{d}	55.51±0.25^{d}
	1:2	23.30±0.06^{g}	84.86±0.04^{h}	20.42±0.05^{e}	54.08±0.22^{b}
	1:3	23.87±0.05^{i}	76.59±0.05^{g}	22.27±0.07^{f}	53.10±0.12^{a}
	2:1	21.62±0.04^{d}	93.24±0.06^{j}	19.05±0.02^{c}	57.96±0.22^{f}
	3:1	21.18±0.04^{c}	95.81±0.05^{k}	18.29±0.02^{b}	59.21±0.18^{gh}

Notes: Different superscript notations mean a statistically significant effect at $p<0.05$

The ice cream made with the CMC stabilizer has a higher L* value than the ice cream made with the gelatin stabilizer. Since the ice cream made with the CMC stabilizer has a higher overrun, it causes the lightness value to increase. The ice cream mixtures containing an increasing amount of date palm puree, based on different ratios, had a lower L* value. This is because date palm puree contains melanoidin and color pigments that have lower brightness than pumpkin puree (Ardali & Akbarian, 2014; Ghnimi et al., 2017).

3.5. Hedonic Evaluation of the Ice Cream

The univariate two-way ANOVA statistical analysis results show that the different stabilizers had no statistically significant effect ($p>0,05$) on the hedonic value of milky aroma, color, sweetness, texture, and overall acceptance of the ice cream. The different pumpkin puree-to-date palm puree ratios did have a significant effect ($p<0.05$) on the hedonic value of milky aroma, color, sweetness, texture, and overall acceptance of the ice cream. However, the interaction between different stabilizers and different pumpkin puree-to-date palm puree ratios were not statistically significant ($p>0.05$).

Table 5 Hedonic evaluation of the ice cream

Ratio	Milky Aroma	Color	Sweetness	Texture	Overall Acceptance
1:0	4.34±1.35^{a}	5.74±0.83^{b}	4.50±1.23^{a}	4.52±1.27^{a}	4.72±1.18^{a}
1:1	5.29±0.96^{c}	5.48±0.94^{a}	5.43±1.09^{d}	5.33±1.01^{d}	5.27±0.97^{c}
1:2	5.52±0.83^{c}	5.46±0.93^{a}	5.64±1.01^{d}	5.43±0.92^{bc}	5.65±0.91^{d}
1:3	5.54±0.89^{c}	5.44±0.95^{a}	5.08±1.11^{c}	5.30±0.90^{bc}	4.91±1.05^{ab}
2:1	4.73±1.11^{b}	5.54±0.97^{ab}	4.79±1.14^{b}	5.16±1.10^{b}	5.00±1.09^{b}
3:1	4.70±1.20^{b}	5.71±0.84^{b}	4.68±1.29^{ab}	5.12±1.09^{bc}	4.93±1.08^{ab}

Notes: Different superscript notations mean a statistically significant effect at $p<0.05$;
Hedonic range: 1 (extremely dislike) – 7 (extremely like)

The lowest hedonic value for the milky aroma of the ice cream was found for the treatment ratio of 1:3, which means the panelists preferred ice cream with a higher amount of date palm puree since it has a less milky aroma (Hashim & Shamsi, 2016).

The highest hedonic value for the ice cream color was found for the treatment ratio of 1:0, which means the panelists preferred the color of ice cream with a higher amount of pumpkin puree. The

higher the amount of the pumpkin puree, the lighter the color of the ice cream due to its carotenoid content (Hashim & Shamsi, 2016; Sari et al., 2017).

The highest hedonic score was found for the sweetness of ice cream with the treatment ratio of 1:2. The higher amount of date palm puree resulted in the ice cream being sweeter than the mixtures with lower amounts of date palm puree. However, too much date palm puree resulted in an ice cream that was too sweet, and it was not preferred by the panelists (Lemine et al., 2014).

The ice cream with the treatment ratio of 1:2 had the highest hedonic score on texture. The higher amount of date palm puree resulted in softer ice cream due to the higher fat content and lower water content, which causes the formation of smaller ice crystals in the ice cream (Hartatie, 2011).

The ice cream with the treatment ratio of 1:2 had the highest overall acceptance score, which means the panelists preferred ice cream that had more date palm puree. The addition of more date palm puree, based on different ratios of puree, resulted in a higher overall acceptance. Consequently, the ice cream with a pumpkin puree-to-date palm puree ratio of 1:2 with a gelatin stabilizer was chosen as best formulation 1, the ice cream with a pumpkin puree-to-date palm puree ratio of 1:2 with a CMC stabilizer was chosen as best formulation 2, and the ice cream with a pumpkin puree-to-date palm puree ratio of 1:1 with a gelatin stabilizer was chosen as best formulations 3 based on the hedonic evaluation.

3.6. Antioxidant Characteristics of Ice Cream

The one-way ANOVA statistical analysis results are shown in Table 6. A comparison of the three ice creams with the best formulations and the two controls shows that the antioxidant characteristics of the ice cream had a statistically significant effect ($p<0.05$) on the IC_{50} value, total phenolic, total flavonoid, and total carotenoid content of the ice cream.

Table 6 Antioxidant characteristics of the ice cream

Antioxidant Characteristics	Control 1	Control 2	Best Formulation 1	Best Formulation 2	Best Formulation 3
IC_{50} (ppm)	213558.33± 407.99^{d}	213070.00± 424.41^{d}	79749.08± 534.24^{a}	88923.75± 707.09^{b}	107708.89± 865.36^{c}
Total Phenolic (mg GAE/L)	62.44±0.35^{a}	62.29±0.13^{a}	127.22±0.07^{c}	127.00±0.12^{c}	108.35±0.18^{b}
Total Flavonoid (mg QE/L)	12.12±0.74^{a}	12.05±0.60^{a}	56.07±0.64^{c}	25.02±0.60^{c}	37.02±0.50^{b}
Total Carotenoid (ppm)	4.92±0.03^{a}	4.92±0.04^{a}	1.98±0.08^{c}	1.98±0.09^{c}	2.89±0.04^{b}

Notes: Different superscript notations mean a statistically significant effect at $p<0.05$.
Control 1 (stabilizer gelatin, ratio 1:0); Control 2 (stabilizer CMC, ratio 1:0); Best formulation 1 (stabilizer gelatin, ratio 1:2); Best formulation 2 (stabilizer CMC, ratio 1:2); Best formulation 3 (stabilizer gelatin, ratio 1:1).

As seen in Table 6, the ice cream mixtures with the best formulations (1, 2, and 3) had a lower IC_{50} and total carotenoid value, but a higher total phenolic and total flavonoid value than the control 1 and control 2 ice cream mixtures. This is because the higher date palm puree and lower pumpkin puree content of the ice cream in these formulations cause it to have a lower amount of carotenoid, but a higher amount of phenolic and flavonoid compounds. However, the ice cream with a higher amount of date palm puree has a lower IC_{50} value, which indicates that it has a higher antioxidant activity than the other mixtures (Hwang et al., 2009).

3.7. Dietary Fiber of the Ice Cream

The one-way ANOVA statistical analysis results are shown in Figure 1. As seen, the dietary fiber content of the ice cream with the best formulations and the controls were compared, and the formulations had a significant effect ($p<0.05$) on the dietary fiber content of the ice cream. The best formulation 1 and best formulation 2 ice cream mixtures can be categorized as being high in dietary fiber, because they contain more than 6 g of dietary fiber in 100 g of ingredients. However, the best formulation 3 ice cream mixture can be categorized as a source of dietary fiber because it contains no less than 3 g of dietary fiber in 100 g of ingredients (National Agency of Drug and Food Control; BPO], 2016).

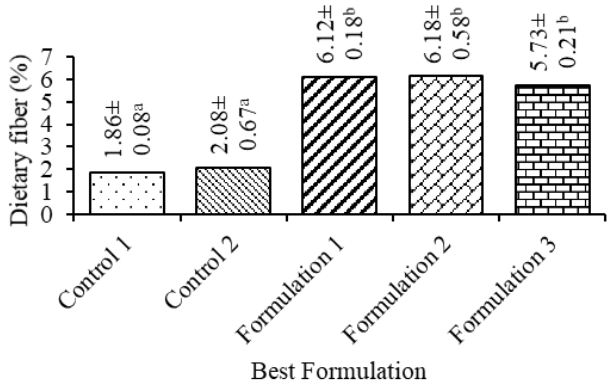

Figure 1 Dietary fiber of ice cream

Notes: Different superscript notations mean a statistically significant effect at $p<0.05$;
Control 1 (stabilizer gelatin, ratio 1:0); Control 2 (stabilizer CMC, ratio 1:0); Formulation 1 (stabilizer gelatin, ratio 1:2); Formulation 2 (stabilizer CMC, ratio 1:2); Formulation 3 (stabilizer gelatin, ratio 1:1).

3.8. Determination of the Best Ice Cream Formulation

The treatment chosen as the ice cream with the best formulation was based on the mixture with the strongest antioxidant activity, the highest total phenolic, total flavonoid, and total carotenoid content. Thus, the best ice cream formulation was best formulation 1 that the mixture made with the gelatin stabilizer and the pumpkin puree-to-date palm puree ratio of 1:2. However, the dietary fiber was higher in the best formulation 2 ice cream mixture than the best formulation 1 mixture, but there was no statistically significant difference between the two formulations.

3.9. Chemical Composition of the Best Ice Cream Formulation

As seen in Table 7, the ice cream with the best formulation contains fat in the range of 2% to 5%, so it can be categorized as a low-fat ice cream (Goff & Hartel, 2013). The protein content of the best formulation ice cream meets the ice cream standard found in SNI 01-3713-1995, but the control 1 did not meet this standard. The sucrose and total solids content of the best formulation ice cream and the control 1 ice cream meet that standard. The fat content of the best formulation ice cream and the control 1 ice cream did not meet the standard since they are considered to be low-fat types of ice cream.

Table 7 Chemical composition of the ice cream

Chemical Composition	Control 1 (%)	Best Ice Cream (%)	Standard*
Moisture	75.22±0.17	71.53±0.04	-
Ash	1.22±0.02	1.45±0.02	-
Protein	2.11±0.02	4.05±0.04	Min. 2.7
Fat	2.57±0.03	3.47±0.04	Min. 5.0
Carbohydrate	18.88±0.15	19.50±0.08	-
Total solid	24.76±0.17	28.47±0.04	Min. 3.4
Sucrose	-	8.25±0.86	Min. 8.0

*) *National Standardization Body (BSN)*-SNI 01-3713-1995

4. CONCLUSION

The difference in the date palm-to-water ratio has a significant effect on the pH, total soluble solids, color, antioxidant activity, total phenolic, total flavonoid, and total carotenoid content, and the amount of dietary fiber of date palm puree. The date palm-to-water 1:1 ratio treatment produced the best date palm puree.

The best formulation is formulation 1, made with the gelatin stabilizer with the addition of pumpkin puree and date palm puree at the ratio of 1:2. The ice cream with the best formulation 1 can be categorized as a high-fiber ice cream because it contains no less than 6 g of dietary fiber in 100 g formulation. Moreover, the ice cream with the best formulation 1 had a fat content of 3.47%; since it is in the range of 2% to 5% it can be categorized as a low-fat ice cream.

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6. REFERENCES

Al-Rimawi, F., Odeh, I., Hroub, A., Abbadi, J., Obeyat, L., Qabbajeh, M., 2014. Effect of Harvesting Date and Variety of Date Palm on Antioxidant Capacity, Phenolic and Flavonoid Content of Date Palm (*Phoenix dactylifera*). *Journal of Food and Nutrition Research*, Volume 2(8), pp. 499–505

Arbuckle, W.S., Marshall, R., 2012. *Ice Cream*. Maryland, New York: Aspen Publisher, Inc.

Ardali, F.R., Akbarian, M., 2014. The Influence of Date Syrup on Color, Texture and Sensory Properties of Gaz. *Bulletin of Environment Pharmacology and Life Science*, Volume 3(2), pp. 159–163

Association of Official Analytical Chemists (AOAC), 2005. Official Methods of Analysis of the Association of Official Analytical Chemists International, 18th ed., AOAC, Inc., Arlington, VA

National Agency of Drug and Food Control (BPOM), 2016. Head Regulation of Supervisory Agency Drug and Food the Republic of Indonesia, Number 13 of 2016, Supervision of Claims on Processed Food Labels and Ads, Jakarta, Indonesia

National Standardization Body (BSN), 1995. Ice Cream. SNI 01-3713-1995. National Standardization Body, Jakarta, Indonesia

Chao, C.T., Krueger, R.R., 2007. The Date Palm (*Phoenix dactylifera* L.): Overview of Biology, Uses, and Cultivation. *HortScience*, Volume 42(5), pp. 1077–1082

Clarke, C., 2012. *The Science of Ice Cream*. Royal Society of Chemistry, Cambridge, United Kingdom

Claudia, N.B., Rusmariin, H., Limbong, L.N., 2016. Effect of Ratio of Pumpkin Juice with Pineapple Juice and Concentration of Gelatin on the Quality of Coconut Juice Sorbet. *Jurnal Rekayasa Pangan dan Pertanian*, Volume 4(4), pp. 500–507

Ekissi, A.C., Konan, A.G., Yao-Kouame, A., Bonfoh, B., Kati-Coulibaly, S., 2014. Sensory Evaluation of Green Tea from *Lippia multiflora* Moldenke Leaves. *European Scientific Journal*, Volume 10(3), pp. 534–543

El-Sharnouby, G.A., Aleid, S.M., Al-Otaibi, M.M., 2014. Liquid Sugar Extraction from Date Palm (*Phoenix dactylifera* L.) Fruits. *Journal of Food Processing and Technology*, Volume 5(12), pp. 1–5

Ghnimi, S., Umer, S., Karim, A., Kamal-Eldin, A., 2017. Date Fruit (*Phoenix dactylifera* L.): An Underutilized Food Seeking Industrial Valorization. *NFS Journal*, Volume 6, pp. 1–10

Goff, H.D., Hartel, R.W., 2013. *Ice Cream.* 7th ed., Springer Science and Business Media, London, New York

Hamad, M.N.F., Nekshara, H.H., Shasta, A.S., Tarabira, D.S., 2017. Effect of Addition Dates "Hayani" on Yield, Chemical Composition and Sensory Evaluation of Ice Cream. *American Journal of Food Science and Nutrition Research*, Volume 4(5), pp. 170–176

Hartatie, E.S., 2011. Formulation Studies (Raw Material, Ingredients, Making Methods for Ice Cream Quality). *GAMMA*, Volume 7(1), pp. 20–26

Hashim, I.B., Shamsi, K.S.A., 2016. Physiochemical and Sensory Properties of Ice Cream Sweetened with Date Syrup. *MOJ Food Processing and Technology*, Volume 2(3), pp. 91–95

Hwang, J.Y., Shyu, Y.S., Hsu, C.K., 2009. Grape Wine Lees Improves the Rheological and Adds Antioxidant Properties to Ice Cream. *LWT Food Science Technology*, Volume 42(1), pp. 312–318

Inglett, G.E., Peterson, S.C., Carriere, C.J., Maneepun, S., 2005. Rheological, Textural, and Sensory Properties of Asian Noodles Containing Oat Cereal Hydrocolloid. *Food Chemistry*, Volume 90(1–2), pp. 1–8

Iswanto, T., Hendrianie, N., Shovitri, M., Altway, A., Widjaja, T., 2019. The Effect of Mixed Biological Pretreatment and PEG 4000 on Reducing Sugar Production from coffee Pulp Waste. *International Journal of Technology*, Volume 10(3), pp. 453–462

Kalaikandhan, R., Vijayarengan, P., Sivasankar, R., Mathivanan, S., 2014. The Pigment Content of *Sesuvium portulacastrum* L. under Copper and Zinc Stress. *International Journal of Current Microbiology and Applied Science*, Volume 3(3), pp. 1056–1066

Kesuma, S., Yenrina, R., 2015. *Natural and Synthetic Antioxidant*, Andalas University Press, Padang

Lemine, F.M.M., Ahmed, M.V.O., Maoulainine, L.B.M., Bouna, Z.A.O., Samb, A., Salem, A.M., 2014. Antioxidant Activity of Various Mauritanian Date Palm (*Phoenix dactylifera* L.) Fruits at Two Edible Ripening Stages. *Food Science and Nutrition*, Volume 2(6), pp. 700–705

Mariod, A.A., Adam, H.F., 2013. Review: Gelatin, Source, Extraction, and Industrial Applications. *Acta Scientiarum Polonorum Technologia Alimentaria*, Volume 12(2), pp. 135–147

Mulia, K., Adam, D., Zahrina, I., Kristanti, E.A., 2018. Green Extraction of Palmitic Acid from Palm Oil using Betaine-based Natural Deep Eutectic Solvents. *International Journal of Technology*, Volume 9(2), pp. 335–344

Mulia, K., Krisanti, E., Terahadi, F., Putri, S., 2015. Selected Natural Deep Eutectic Solvents for the Extraction of α-mangostin from Mangosteen (*Garcinia mangostana* L.) Pericarp. *International Journal of Technology*, Volume 6(7), pp. 1211–1220

Rantono, N.V., Nurhaeni, Razak, A.R., 2015. The Retention of Carotene in Yellow Pumpkin (*Cucurbita moschata* Durch.). *Online Journal of Natural Science*, Volume 4(1), pp. 104–110

Available online at http://bcn.boulder.co.us/basin/watershed/wqi_nsf.html, Accessed on December 25, 2015

Santos, L.C.O., Simao, V., Almeida, J.S.O., Aquino, A.C.S., Carasek, E., Amante, E.R., 2017. Study of Heat Treatment in Processing of Pumpkin Puree (*Cucurbita Moschata*). *Journal of Agricultural Science*, Volume 9(10), pp. 234–243

Sari, N., Widanti, Y.A., Mustofa, A., 2017. Characteristics of Yellow Pumpkin (Cucurbita Moschata) Ice Cream with Variation of Milk. *Journal of JITIPARI*, Volume 4, pp. 96–103

Sarofa, U., Rosida, D.F., Khadik, M. 2014. *Aktivitas Antioksidan Es Krim Buah Merahantioxidant* (Activity of Fruit Red Ice Cream). *Journal of Rekapangan*, Volume 8(1), pp. 1–12

Sun-Waterhouse, D., Edmonds, L., Wadhwa, S.S., Wibisono, R., 2013. Producing Ice Cream using a Substantial amount of Juice from Kiwifruit with Green, Gold or Red Flesh. *Food Research International*, Volume 50(2), pp. 647–656

Tangkanakul, P., Auttaviboonkul, P., Niyomwit, B., Lowvitoon, N., Charoenthamawat, P., Trakoontivakom, G., 2009. Antioxidant Capacity, Total Phenolic Content, and Nutritional Composition of Asian Foods after Thermal Processing. *International Food Research Journal*, Volume 16(4), pp. 571–580

Viquez, E.A., Rolinh, B.F., Krueger, C.G., Rainey, C.J., Reed, J.S., Ricketts, M.L., 2018. An Extract from Date Palm Fruit (*Phoenix dactylifera*) Acts as a Co-agonist Ligand for the Nuclear Receptor FXR and Differentially Modulates FXR Target-gene Expression *in vitro*. *PLoS ONE*, Volume 13(1), pp. 1–23

Widiantoko, R.K., Yunianta, 2014. *Pembuatan Es Krim Tempe – Jahe (Kajian Proporsi Bahan dan Penstabil Terhadap Sifat Fisik, Kimia dan Organoleptik)* (The Making of Ice Cream from Tempe and Ginger – Study of Raw Materials Proportion and Stabilizers Proportions on the Physical, Chemical and Organoleptic Properties). *Jurnal Pangan dan Agroindustri*, Volume 2(1), pp. 54–66

Winarsi, H.M.S., 2007. *Natural Antioxidant and Free Radical: Health Application and Potention*. Kanisius, Deresan, Yogyakarta

Yudhistira, B., Riyadi, N.H., Pangestika, A.D., Pertiwi, S.R., 2018. Effect of CMC and Arabic Gum in the Manufacture of Jackfruit Velva (*Artocarpus Heterophyllus*). *In:* IOP Conference Series: Earth and Environmental Science, Volume 142, pp. 1–8