

## Study of Formulation of Soybean (*Glycine max L.*) Milk and Purple Sweet Potato (*Ipomoea batatas Poir*) Crude Extract in The Making of Non-Dairy Ice Cream

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### Abstract

Soybean milk and purple sweet potato are used as the main ingredients in the making of non-dairy ice cream. This study aims to determine the best characteristics of non-dairy ice cream from the formulation of soybean milk and purple sweet potato crude extract. The research design used a completely randomized design with one-factor treatment and four replications and was analyzed statistically with the F test Analysis of Variance at 5% level. The treatment in this study was the formulation of soybean milk and purple sweet potato extract consisting of 60%:0%; 52%:8%; 44%:16%; 36%:24%; 28%:32% of the total ice cream dough. The parameters observed were fat content, protein content, total solids, overrun, melting time, and hedonic sensory evaluation (appearance, texture, taste, and odor). Based on the Indonesian National Standard for ice cream 01-3713-1995 qualified showed that the formulation of soybean milk and purple sweet potato extract crude extract 52%:8% was the best treatment with 9.83% fat content, 2.89% protein content, 34.15% total solids, 49.26% overrun, 13.12 minutes melting time, and hedonic scale for appearance 6.76 (like extremely), texture 5.32 (like), taste 5.58 (like very much), odor 5.56 (like very much). The formulation soybean milk and purple sweet potato crude extract are effects of physicochemical properties and sensory evaluation of non-dairy ice cream.

**Keywords:** non-dairy ice cream, purple sweet potato, soybean milk

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### INTRODUCTION

Ice cream is a frozen food made by freezing a mixture of dairy products, sugar, stabilizers, emulsifiers, and other ingredients that have been pasteurized and homogenized to obtain uniform results (Geovani et al., 2013). The raw material for ice cream in general is skim milk that contains lactose. People with lactose intolerance are unable to fully digest lactose, therefore many people prefer to plant-based ice cream. Non-dairy ice cream as a type of ice cream, is a frozen dessert that has characteristics almost similar to ordinary ice cream only the difference is that plant-based ice cream does not use skim milk with the lower fat content. The fat used in non-dairy ice cream originated from non-dairy fat (Darma et al., 2013).

Soybean (*Glycine max L.*) milk has been used together with cow's milk in the making of sweet potato ice cream (Handajani et al, 2008). The making of soybean milk-based ice cream with the formulation of other ingredients has been widely developed including soybean milk ice cream with cucumber suri (Oxilia et al., 2012),

soybean milk and wuluh starfruit extract (Oktavia, 2019), the substitution of soybean milk and cow's milk with the addition of purple sweet potato puree (Pamungkasari, 2008). The addition of other ingredients besides soybean milk generally functions as a natural colorant for making ice cream. People want natural food colorants for their long or short-term impacts, as well as their reliability, functionality, biological potential, and health effects, which continue to be utilized worldwide and are known to offer substantial benefits when consumed. Natural colorants are perceived as safer by consumers than synthetic colorants, which are regarded to be hazardous (Martins et al., 2016). Natural dyes can be obtained from anthocyanin pigments sourced from plants, one of which is purple sweet potato (*Ipomoea batatas* Poir.). The anthocyanin content in purple sweet potato is 519 mg/100 g wet weight which is higher and more stable than other anthocyanin sources (Handajani et al., 2008). The purpose of this study was to determine the best characteristics of non-dairy ice cream from the formulation of soybean milk and purple sweet potato.

## RESEARCH METHODS

### Materials and Equipment

The main ingredients used in making ice cream are soybean milk and purple sweet potato obtained from local market Pontianak area, as well as other additives food such as carrageenan, sugar, coconut milk, salt, and emulsifiers commercial. The chemicals material for analysis of non-dairy ice cream is chemical with quality pro analysis.

The tools set for making non-dairy ice cream are measuring cups, mixer (Philips), weighing scales (Starco), freezer (Panasonic), and tool pasteurization. The tools used for physicochemical includes glassware and spectrophotometer UV-Vis 160 (Shimadzu, Japan), as well as a set of tools for sensory evaluation.

### Research Design

This study was conducted using a completely randomized design (Putri, 2020), with one treatment factor, namely the formulation of soybean milk and purple sweet potato extract consisting of 60%:0%; 52%:8%; 44%:16%; 36%:24%; 28%:32% of the total ice cream dough. Each treatment was repeated four replications, therefore a total of 20 treatment combinations were obtained.

### Soybean Milk Preparation (Liana et al., 2017)

The first procedure for making soybean milk is to determine the raw material for soybean with a distinctive aroma of soybean, yellow color, clean and still good. 100 grams of soybean seeds are sorted and then soaked for 12 hours until they expand. The ratio between soybean and water is 1 : 5. The next procedure is to clean the dirt and epidermis, then boil it until it is cooked and after that, clean the dirt and epidermis again. The next process is refining using a blender with the addition of 500 ml of water. After that filtered using a clean cotton cloth. The resulting soybean milk was then heated at 80°C for 5 minutes.

### Purple Sweet Potato Crude Extract Preparation (Wijaya et al., 2021)

Making purple sweet potato crude extract begins with washing purple sweet potato in running water. Purple sweet potato is reduced in size by 5 x 5 cm, then steamed for 15 minutes. After steaming, the skin of the purple sweet potato is peeled and mashed using a blender to get a purple sweet potato paste. The purple sweet potato paste was then extracted using water as a solvent. The ratio of purple sweet potato puree and water was 1:2 and the extraction was carried out for 2 hours. After

the extract process is complete, it is filtered using a cheese cloth to obtain purple sweet potato crude extract.

### Non-dairy Ice Cream Preparation (Oxilia et al., 2012 modified)

The main ingredients of non-dairy ice cream made from the formulation of soybean milk and purple sweet potato extract consisted of 60%:0%; 52%:8%; 44%:16%; 36%:24%; 28%:32%. The additional ingredients used are 6.5% sugar, 0.2% salt, 32% coconut milk and 0.32% carrageenan from the total ice cream dough. The mixed dough is then heated until it boils with stirring. The ice cream dough was then homogenized using a mixer for 10 minutes. This mixing or stirring process is carried out up to four times with the same time for 10 minutes and 4 hours of storage to obtain softer ice cream. The dough that has risen is stored in the freezer until it hardens for 24 hours. The resulting ice cream is then analyzed.

### Data Analysis

The results of the research observations were analyzed statistically with the F test Analysis of Variance (Anova) at 5% level if it had a significant effect, then continued with the further test at the 5% level. Each treatment was repeated with five replications. Duncan's Multiple Range Test (DMRT) is carried out if there is a significant difference at the 5% level (Putri, 2020). The observations made were the physical properties of ice cream including overrun, melting time (Susilawati et al., 2014), chemical properties including fat content, total solids, protein content (Sudarmadji et al., 1997), and hedonic sensory evaluation (appearance, texture, taste, and odor) using a hedonic scale started from 1 to 7 scale with a rating of dislike extremely to like extremely (Setyaningsih et al., 2010).

## RESULTS AND DISCUSSION

Table 1. Physicochemical and Sensory Characteristics of Ice Cream from Formulation of Soybean (*Glycine max* L.) Milk and Purple Sweet Potato (*Ipomoea batatas* Poir.) Crude Extract

Parameters Observed	Indonesian National Standard Ice Cream	Formulation of Soybean Milk and Purple Sweet Potato Crude Extract (%)				
		60:0	52:8	44:16	36:24	28:32
<i>Physicochemical analysis</i>						
Fat content (%)	5,0% minimum	10.52±0.25 <sup>e</sup>	9.83±0.36 <sup>d</sup>	9.67±0.30 <sup>cd</sup>	9.43±0.42 <sup>ab</sup>	9.17±0.28 <sup>a</sup>
Protein content (%)	2,7% minimum	3.37±0.12 <sup>e</sup>	2.89±0.18 <sup>d</sup>	2.72±0.15 <sup>c</sup>	2.39±0.19 <sup>bc</sup>	2.08±0.14 <sup>abc</sup>
Total solids (%)	34% minimum	30.87±0.22 <sup>a</sup>	34.15±0.32 <sup>b</sup>	34.44±0.35 <sup>c</sup>	35.64±0.20 <sup>d</sup>	36.26±0.18 <sup>e</sup>
Overrun (%)	35% - 50%	50.14±0.19 <sup>e</sup>	49.26±0.10 <sup>d</sup>	49.05±0.15 <sup>c</sup>	48.85±0.20 <sup>b</sup>	47.63±0.22 <sup>a</sup>
Melting time (minute)	10 - 15 menit	11.98±0.38 <sup>a</sup>	13.12±0.27 <sup>b</sup>	14.25±0.24 <sup>c</sup>	15.36±0.31 <sup>d</sup>	15.42±0.29 <sup>de</sup>
<i>Sensory (hedonic scale)</i>						
Appearance		5.35±0.82 <sup>a</sup>	6.76±0.91 <sup>e</sup>	6.32±0.89 <sup>bc</sup>	6.43±0.66 <sup>cd</sup>	6.49±0.85 <sup>cd</sup>
Texture		6.58±0.92 <sup>e</sup>	5.32±0.71 <sup>d</sup>	5.27±0.53 <sup>cd</sup>	5.19±0.57 <sup>ab</sup>	5.07±0.65 <sup>a</sup>
Taste		5.52±0.72 <sup>a</sup>	5.58±0.68 <sup>a</sup>	5.53±0.82 <sup>a</sup>	5.56±0.66 <sup>a</sup>	5.55±0.90 <sup>a</sup>
Odor		4.20±0.95 <sup>a</sup>	5.56±0.92 <sup>b</sup>	5.64±0.87 <sup>ab</sup>	5.69±0.89 <sup>ab</sup>	5.60±0.72 <sup>ab</sup>

Note: hedonic scale started from 1 to 7 scale with a rating of dislike extremely to like extremely. Different notations in the same row show a significant difference at the 5% level.

### **Fat Content**

The fat content of non-dairy ice cream ranged from 9.17% – 10.52% (Table 1). The formulation of soybean milk and purple sweet potato crude extract had a significant difference in the fat content of non-dairy ice cream based on Anova ( $p < 0.05$ ). The fat content in all treatments qualifies with Indonesian national standard ice cream 01-3713-1995 of 5% minimum. Most of the fat content in non-dairy ice cream is obtained from pure coconut milk which is added to all treatments as much as 32%. The less soybean milk was added, the lower the fat content of non-dairy ice cream. This result was similar observed in milk pumpkin ice cream with soy milk as substitute cow's milk (Prihatin et al., 2018). Ice cream with low fat content affects the texture of ice cream to be less soft and provides a greater cold sensation compared to high fat ice cream, however it is appropriate for individuals who avoid high-fat foods and a low-fat diet (Failisnur, 2013).

### **Protein Content**

The protein content of non-dairy ice cream ranged from 2.08% – 3.37% (Table 1). The formulation of soybean milk and purple sweet potato crude extract had a significant difference in the protein content of non-dairy ice cream based on Anova ( $p < 0.05$ ). The treatment formulations of soybean milk and purple sweet potato crude extract 60%:0% and 52%:8% qualified with Indonesian national standard ice cream 01-3713-1995 for protein content of 2.7% minimum. The more purple sweet potato extract was added, the protein content of non-dairy ice cream tended to decrease. This is influenced by the protein content of purple sweet potato, which is 0.05% lower than the protein content of soybean milk which is 2,87%. A similar result was observed in red sweet potato ice cream, the addition of sweet potato can reduce the protein content of ice cream (Fatimah, 2013). Protein functions to stabilize the fat emulsion after the homogenization process, add flavor, form foam, increase and stabilize the water holding capacity which affects the viscosity and texture of ice cream, and increases overrun (Jumiati et al., 2015).

### **Total Solids**

Total solids of non-dairy ice cream ranged from 30.87% – 36.26% (Table 1). The formulation of soybean milk and purple sweet potato crude extract had a significant difference in the total solids of non-dairy ice cream based on ANOVA ( $p < 0.05$ ). Treatment of formulation of soybean milk and purple sweet potato extract 52%:8%; 44%:16%; 36%:24%; 28%:32% qualify with Indonesian national standard ice cream 01-3713-1995 for total solids of 34% minimum. The more purple sweet potato extract was added, the total solids of non-dairy ice cream tended to increase. The similar result observed which is the more purple sweet potato added, the higher the total solids content of ice cream (Rachmawanti & Sri, 2011). Purple sweet potato is known to have a high carbohydrate content of 19.87% (Setiawan, 2009).

### **Overrun**

The expansion volume of ice cream is expressed as an overrun value. It is calculated based on the difference in the volume of the dough at the same time (Simanungkalit 2016). The overrun value of non-dairy ice cream ranged from 47.63%-50.14% (Table 1). The formulation of soybean milk and purple sweet potato crude extract had a significant difference in the overrun value based on ANOVA ( $p < 0.05$ ). The overrun value in all treatments qualifies with Indonesian national standard ice cream 01-3713-1995 of 35% - 50%. The more purple sweet potato extract was added, the lower the overrun value. This result has similar phenomenon in skim milk ice cream with addition purple sweet potato (Rachmawanti & Sri, 2011). The overrun

value is correlated to the fat content. Ice cream that uses non-dairy sources has a small fat content so that the emulsion process becomes unstable which results in a decrease in the overrun value (Prihatin, 2018).

### **Melting Time**

The melting time of non-dairy ice cream ranged from 11.98-15.42 minutes (Table 1). The formulation of soybean milk and purple sweet potato extract has a significant difference in the melting time of non-dairy ice cream based on Anova ( $p < 0.05$ ). The more purple sweet potato extract is added, the slower the melting time of non-dairy ice cream. The melting time in all treatments qualifies with Indonesian national standard ice cream 01-3713-1995 of 10 - 15 minute. The melting time in this study faster than purple sweet potato ice cream with full cream milk (Luckman et al., 2014) and pumpkin ice cream with soybean milk (Prihatin et al., 2018). The melting time is affected by the solids contained in the ice cream (Pathonah, 2008).

### **Sensory of Appearance**

The mean value of the hedonic scale for the appearance of non-dairy ice cream from the formulation of soybean milk and purple sweet potato extract ranged from 5.35-6.76 i.e. like to like extremely (Table 1). The formulation of soybean milk and purple sweet potato crude extract had a significant difference in the appearance of non-dairy ice cream based on Anova ( $p < 0.05$ ). The addition of purple sweet potato extract has a purplish color from the anthocyanin pigment in non-dairy ice cream. The more purple sweet potato extract was added, the higher the appearance value. Anthocyanin stability is affected by pH, light radiation, metals, oxidizing reducing agents, and temperature (Al-Lawi, 2011). In previously study, the process of processing soybean milk ice cream with the addition of star fruit flowers does not effect stability of anthocyanin (Oktavia, 2019).

### **Sensory of Texture**

The mean value of the hedonic scale for the texture of non-dairy ice cream from the formulation of soybean milk and purple sweet potato extract ranged from 5.07-6.58 i.e. like to like extremely (Table 1). The formulation of soybean milk and purple sweet potato extract had a significant difference in the texture of non-dairy ice cream based on Anova ( $p < 0.05$ ). The texture of ice cream is affected by the overrun value. The more addition of purple sweet potato extract resulted in a lower overrun value. The decrease in overrun due to the large size of ice crystals that cannot trap water and air, thus affecting the sandy texture of the ice cream (Handajani et al., 2008). The results of this study are in accordance with previously study, the addition of purple sweet potato in the making of skim milk ice cream affect the decrease in texture preference by panelists (Rachmawanti & Sri, 2011).

### **Sensory of Taste**

The mean value of the hedonic scale for the taste of non-dairy ice cream from the formulation of soybean milk and purple sweet potato extract ranged from 5.52-5.58 i.e. like (Table 1). The formulation of soybean milk and purple sweet potato extract had no significant difference in the taste of non-dairy ice cream based on Anova ( $p > 0.05$ ). The taste of ice cream is influenced by the level of sweetness. The sugar content in non-dairy ice cream is equivalent in each formulation, therefore it does not have a significant effect on the taste of non-dairy ice cream.

### **Sensory of Odor**

The mean value of the hedonic scale for the odor of non-dairy ice cream from the formulation of soybean milk and purple sweet potato extract ranged from 4.20 - 5.69 i.e. neither like nor dislike to like to like very much (Table 1). The formulation of

soybean milk and purple sweet potato crude extract had a significant difference in the odor of non-dairy ice cream based on Anova ( $p < 0.05$ ). Soybean milk has an undesirable beany flavor. The unpleasant adour of soybean milk decreases with the addition of purple sweet potato extract. The result that were also found in the skim milk ice cream with the addition of purple sweet potato affect the increase in texture preference by panelists (Rachmawanti & Sri, 2011).

## CONCLUSION

The formulation of soybean milk and purple sweet potato crude extract affected the fat content, protein content, total solids, overrun, melting time, and hedonic sensory evaluation (appearance, texture, taste, and odor) of non-dairy ice cream produced. Based on Indonesian National Standard for ice cream 01-3713-1995 qualified showed that the formulation of soybean milk and purple sweet potato extract crude extract 52%:8% was the best treatment with 9.83% fat content, 2.89% protein content, 34.15% total solids, 49.26% overrun, 13.12 minutes melting time, and hedonic scale for appearance 6.76 (like extremely), texture 5.32 (like), taste 5.58 (like very much), odor 5.56 (like very much).

## REFERENCES

- Al-Lawi, M. U. S. (2011). Kapasitas Antioksidan Dan Stabilitas Ekstrak Pigmen Antosianin Kulit Kacang Gedu Hitam (*Cajanus cajan* [Linn.] Millsp.) Dengan Variasi Pelarut. *Skripsi*. Solo: Fakultas Pertanian UNS.
- Darma, G. S., Puspitasari, D., & Noerhartati, E. (2013). Pembuatan Es Krim Jagung Manis Kajian Jenis Zat Penstabil, Konsentrasi Non-Dairy Cream Serta Aspek Kelayakan Finansial. *Reka Agroindustri*, 1(1):45-55.
- Failisnur, F. (2013). Karakteristik Es Krim Bengkuang Dengan Menggunakan Beberapa Jenis Susu. *Jurnal Litbang Industri*, 3(1):11-20. <http://dx.doi.org/10.24960/jli.v3i1.623.11-20>
- Fatimah. (2013). Pemanfaatan Ubi Jalar Merah sebagai Bahan Tambahan dalam Pembuatan Es Krim Secara Tradisional dengan Penambahan CMC. *Skripsi*. Surakarta: Universitas Muhammadiyah Surakarta.
- Handajani, S. (2008). *Pengembangan Es Krim Ubi Jalar Dengan Substitusi Susu Kedelai sebagai Makanan Fungsional*. Seminar Nasional Umbi dan Kacang-Kacangan. Surakarta: Universitas Sebelas Maret, 2008: 419-424.
- Jumiati, J., Johan, V. S., & Yusmarini, Y. (2015). Studi Pembuatan Es Krim Berbasis Santan Kelapa Dan Bubur Ubi Jalar Ungu. *JOM Faperta*, 2 (2):1-12.
- Liana, L., Ayu, D. F., & Rahmayuni. (2017). Pemanfaatan Susu Kedelai dan Ekstrak Umbi Bit dalam Pembuatan Es Krim. *JOM Faperta*, 4 (2): 1-10.
- Martins, N., Roriz, C. L., Morales, P., Barros, L., & Ferreira, I. C. (2016). Food colorants: Challenges, opportunities and current desires of agro-industries to ensure consumer expectations and regulatory practices. *Trends in Food Science & Technology*, 52, 1-15.
- Oksilia, M. I., Syafutri, & Lidiasari, E. (2012). Karakteristik Es Krim Hasil Modifikasi Dengan Formulasi Bubur Timun Suri (*Curcumis melo* L.) dan Sari Kedelai. *Jurnal Teknologi dan Industri Pangan*, 23(1):17-22.
- Oktavia, Y. A. (2019). Sifat Kimia Dan Daya Terima Es Krim Susu Kedelai Dengan Pewarna Bunga Belimbing Wuluh (*Averrhoa bilimbi* L.). *Skripsi*. Surakarta: Program Studi S1 Gizi Institut Teknologi Sains Dan Kesehatan PKU Muhammadiyah Surakarta.

- Pamungkasari, D. (2008). Kajian Penggunaan Susu Kedelai Sebagai Substitusi Susu Sapi Terhadap Es Krim Ubi Jalar (*Ipomoea batatas*). *Skripsi*. Surakarta: Fakultas Pertanian. Universitas Sebelas Maret.
- Prihatin, N., Faizah, H., & Yusmarini. (2018). Pemanfaatan Susu Kedelai Sebagai Bahan Pensubstitusi Susu Sapi dalam Pembuatan Es Krim Labu Kuning. *JOM Faperta*, 5(2), 1-15.
- Putri, D.N. (2020). *Rancangan Penelitian Bidang Teknologi Pangan. Analisa Data Dengan SPSS dan Minitab*. Malang: UMM Press.
- Rachmawanti, A.D. & Handajani, S. (2011). Es Krim Ubi Jalar Ungu (*Ipomea batatas*): Tinjauan Sifat Sensoris, Fisik, Kimia, Dan Aktivitas Antioksidannya. *Jurnal Teknologi Hasil Pertanian*, IV(2): 94-103.
- Setiawan, H. (2009). Kajian Pembuatan Es Puter Ubi Jalar Ungu (*Ipomea batatas L.*) dan Analisis Finansialnya. *Skripsi*. Fakultas Pertanian. Bogor: Institut Pertanian Bogor.
- Setyaningsih, D., Apriyanto, A., & Sari, M. P. (2010). *Analisis Sensori Untuk Industri Pangan dan Agro*. Bogor: PB Press.
- Simanungkalit, H., Indriyani, & Ulyarti. (2016). Kajian Pembuatan Es Krim Dengan Penambahan Kacang Merah (*Phaseolus vulgaris L.*). *Jurnal Penelitian Universitas Jambi Seri Sains*, 18(1):20-26.
- Sudarmadji, S., B. Haryono, & Suhardi. (1997). *Prosedur Analisa Untuk Bahan Makanan dan Pertanian*. Yogyakarta: Liberty.
- Susilawati, Nuriny, F., & Nugraha., A.W. (2014). Pengaruh Penambahan Ubi Jalar Ungu Terhadap Sifat Organoleptik Es Krim Susu Kambing Peranakan Etawa. *Jurnal Teknologi dan Industri Pertanian*. 19(3): 243-256. <http://dx.doi.org/10.23960/jtihp.v19i3.243%20-%20256>
- Wijaya, H., Slay, A., & Abdullah, N. (2021). Ice cream products made from processed purple sweet potatoes: a product organoleptic study. In IOP Conference Series: Earth and Environmental Science (Vol. 807, No. 4, p. 042074). IOP Publishing. doi:10.1088/1755-1315/807/4/042074