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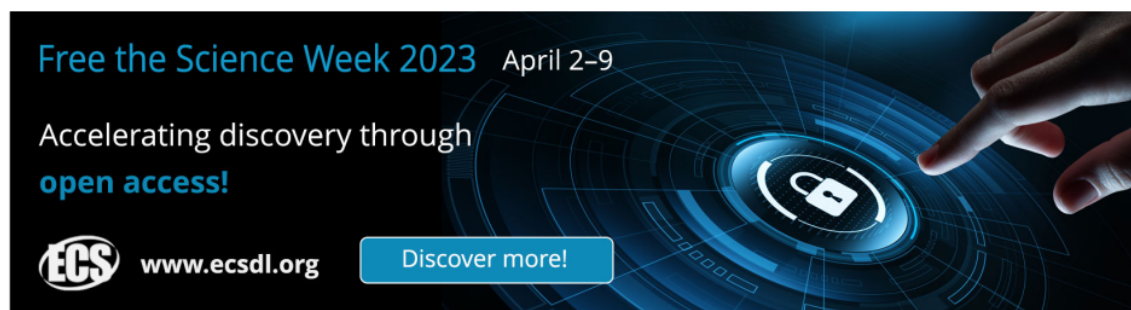
Physical, chemical and organoleptic quality of sweet potato leaves (*Ipomoea batatas* L.) ice cream

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Physical, chemical and organoleptic quality of sweet potato leaves (*Ipomoea batatas* L.) ice cream

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Abstract. During the Covid19 pandemic, many people are looking for healthy foods to boost their immune systems. The immune system can be boosted by consuming foods that contain vitamins, phenols, flavonoids and antioxidants, and one of these foods is sweet potato leaves. Sweet potato leaves have not been utilised optimally. So, to increase its utilisation, sweet potato leaves can be processed into a popular product, one of which is ice cream. The purpose of this study was to make healthy ice cream with the addition of sweet potato leaves extract. This study used a Completely Randomised Design (CRD) 2 factors. The first factor was the concentration of skim milk (10%, 13%, 16%). Meanwhile, the second factor was the sweet potato leaves extract 5%, 10%, 15%. Each treatment was repeated three times. The test parameters used in this study were physical analysis, namely overrun; chemical analysis, namely antioxidants (IC50), fat content, protein content, carbohydrate content, and crude fibre content; and organoleptic tests, including taste, colour, aroma, and softness. The results proved that S3D1 treatment with a concentration of 16% skim milk and 5% sweet potato leaves extract was the best treatment. This treatment obtained the highest Result Value (RV), which is 0.78. The other parameter results obtained were the taste test 6.44 (like); overrun 65%; softness 5.96 (like); IC50 value 112.30 ppm; protein content of 5.63%; fat content 0.76%; carbohydrate content 10.02%; crude fibre content 5.27%; vitamin C content 16.79 mg; aroma 5.52 (like); and colour 5.59 (like).

1. Introduction

Sweet potato is one of the most popular tubers for Indonesian consumers. Consequently, more sweet potato leaves are produced [1]. Unfortunately, until now, the use of sweet potato leaves has only been limited to animal feed and vegetables, which are less favourable than mustard leaves or spinach. In actual fact, according to [2], sweet potato leaves contain beneficial nutrients, such as vitamin B, vitamin C, beta-carotene, iron, calcium, protein and zinc; as well as bioactive components that can function as antioxidants, namely flavonoids and phenolic compounds [3]. Phenolic compounds and flavonoids can function as antioxidants and are often used as antidiabetic, anti-cholesterol, anti-inflammatory and anti-tumour properties [4], [5]. Moreover, during the current Covid-19 pandemic, ingredients that contain vitamins, phenolic compounds, flavonoids, and antioxidants are highly demanded by the public.

One way to increase the consumption level of sweet potato leaves is to process it into a popular, trendy, and healthy product, ice cream [6]. The uniqueness of sweet potato leaves ice cream is that though it is sweet, this product is low in calories and fat, and enriched with ingredients rich in vitamins and bioactive compounds. Based on this phenomenon, the researchers considered that it was necessary to conduct a study to obtain a formula for healthy sweet potato leaves ice cream with specific treatments, namely different concentrations of skim milk and sweet potato leaves extract to obtain the best chemical, physical and organoleptic qualities.



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2. Material and methods

The research was designed using factorial randomised block design (RBD). Factor 1 is the concentration of skim milk (S) which consists of 3 levels (S1=10%, S2=13% and S3=16%) and factor 2 is the concentration of sweet potato leaves extract (D) which consists of 3 levels (D1=5%, D2=10% and D3=15%). Each treatment combination was repeated three times [7]. The process of making orange sweet potato leaves extract was based on to [8], while the making of ice cream on [9], which was modified by replacing full cream milk with skim milk and granulated sugar with stevia sugar. The parameters observed including physical parameters, namely overrun [10]; chemical parameters, namely contents of protein, fat, carbohydrates, crude fibre [11], vitamin C [12]; antioxidant activity / IC50 using the DPPH method [13]; and organoleptic parameters namely taste, aroma, colour and softness [14]. The resulting parametric data were analysed using SPSS 20. On the other hand, non-parametric data were analysed using the Kruskal Wallis test [15]. To determine the best treatment of all studies, researchers conducted an Effectiveness Test [16].

12

3. Results and discussions

3.1. *Observation of physical parameters (overrun) and chemical parameters in the concentration treatment of skim milk and sweet potato leaves extract on ice cream is presented in Table 1.*

Table 1. Average results of physical and chemical parameters

Treatment Code	Overrun (%)	IC ₅₀ (ppm)	Fat content (%)	Protein Content (%)	Carbohydrate Content (%)	Crude Fibre Content (%)	Vitamin C Content (mg)
S1D1	59,64 ^f	114,30 ^h	0,88 ^a	4,16 ^a	10,29 ^a	5,23 ^a	16,82 ^a
S1D2	53,97 ^c	109,53 ^e	0,90 ^b	8,75 ^c	11,31 ^b	6,81 ^b	18,31 ^b
S1D3	47,06 ^a	104,94 ^c	0,80 ^b	11,29 ^f	12,35 ^c	7,03 ^c	19,17 ^c
S2D1	62,27 ^h	113,11 ^g	0,09 ^c	4,21 ^a	10,57 ^a	5,42 ^a	16,93 ^a
S2D2	57,38 ^e	109,32 ^e	0,65 ^d	9,53 ^d	11,63 ^b	6,87 ^b	18,27 ^b
S2D3	52,31 ^b	104,54 ^b	0,09 ^e	11,32 ^f	12,69 ^c	7,11 ^c	19,21 ^c
S3D1	65,00 ⁱ	112,30 ^f	0,76 ^f	5,63 ^b	10,02 ^a	5,27 ^a	16,79 ^a
S3D2	60,00 ^g	108,75 ^d	0,77 ^f	10,02 ^e	11,11 ^b	6,79 ^b	18,35 ^b
S3D3	54,54 ^d	104,21 ^a	0,60 ^g	11,41 ^f	12,18 ^c	7,08 ^c	19,23 ^c

Note: different notations indicate a difference in the LSD test with $\alpha = 5\%$.

Based on the overrun value obtained, the ice cream belongs to the small or medium industrial ice cream category because the value ranged from 50-70% [17]. The higher the concentration of skim milk and sweet potato leaves extract in ice cream, the lower the overrun value. This finding was consistent with the results of the research by [18], where the more grass jelly extract was added. The overrun value decreases because the more grass jelly extract was added, the thinner the dough was [19]. This situation causes the trapping of air to occur very quickly, which leads to the lower stability of the captured air bubbles. As a result, the overrun dropped further. The Indonesian National Standard on the quality requirements for ice cream [20] requires that the fat content in ice cream is at a minimum of 5%, sugar at a minimum of 8% saccharose, and protein at a minimum of 2.7%. Based on these standards, our sweet potato leaves ice cream can be considered healthier because it has low-fat content, higher protein content, contains crude fibre, vitamin C, and antioxidants. The average IC50 value of our sweet potato ice cream ranges from 100-150 ppm, which, according to [21] is classified as a product that has moderate antioxidant activity.

3.2. Organoleptic parameters

The organoleptic test aims to determine the panellists' preference for each treatment. In the organoleptic test, the panellists were asked to give personal responses about their subjective preferences. This hedonic scale analysis data was transformed into a numerical scale according to the panellist's preference level. The scale used was 1 = very dislike, 2 = dislike, 3 = somewhat disliked, 4 = neutral, 5 = rather like, 6 = like, 7 = very like it [22]. The organoleptic test means are presented in Table 2.

Table 2. Mean Results of Sweet Potato Leaves Ice Cream Taste Test

Treatment Code	Taste Average	Colour Average	Aroma Average	Softness Average
S1D1	6,08	5,71	5,37	5,53
S1D2	4,56	4,55	4,16	4,17
S1D3	1,67	4,04	3,27	3,67
S2D1	6,2	5,61	5,44	5,71
S2D2	5,24	4,76	4,19	4,56
S2D3	2,21	4,12	3,4	4,25
S3D1	6,44	5,59	5,52	5,96
S3D2	5,91	4,88	4,37	4,85
S3D3	2,4	4,23	3,61	4,47

Based on the results of the Kruskal Wallis test on the taste, colour, aroma and softness of sweet potato leaves ice cream, it was found that $p = .0001 < 0.05$. This means that the different concentrations of skim milk and sweet potato leaves extract had a very significant effect on the level of panellist acceptance of the colour, aroma, and softness of sweet potato leaves ice cream. This result is in accordance with the opinion of [22]–[24] that the ingredients of the ice cream strongly influence the taste of ice cream. According to [25], colour indicates the way of mixing or processing. The green colour of the ice cream came from the chlorophyll extracted from the sweet potato leaves. In the food industry, aroma testing is considered vital because it can quickly provide an assessment of consumer interest in their production [26]. In this study, sweet potato leaves were treated with blanching in order to reduce the unpleasant aroma of sweet potato leaves extract. [27], [28] stated that blanching treatment could activate enzymes that can affect the stability of foodstuffs, thereby increasing its organoleptic value. The degree of softness is greatly affected by overrun value. The higher the overrun value, the softer the texture of the ice cream is [18], [29]. Meanwhile, according to [19], [30], the more free water content, the bigger the ice crystals will be. The bigger the ice crystals formed, the harder the texture of the ice cream will be.

Table 3. Results Value (NH) of the effectiveness test of sweet potato leaves ice cream

Test Parameter	Result Value (RV) Treatment								
	S1D1	S1D2	S1D3	S2D1	S2D2	S2D3	S3D1	S3D2	S3D3
Flavor	0,12	0,08	0	0,12	0,10	0,01	0,13	0,12	0,02
Overrun	0,09	0,05	0	0,11	0,08	0,04	0,13	0,09	0,05
Softness	0,11	0,03	0	0,12	0,05	0,03	0,13	0,07	0,05
Antioxidant	0	0,06	0,12	0,02	0,06	0,13	0,03	0,07	0,13
Protein	0	0,08	0,13	0,001	0,10	0,13	0,03	0,11	0,13
Fat	0	0,009	0,009	0,07	0,07	0,08	0,12	0,12	0,13
Aroma	0,10	0,04	0	0,11	0,05	0,01	0,11	0,05	0,02
Color	0,11	0,03	0	0,10	0,05	0,006	0,10	0,06	0,01
Total	0,53	0,38	0,26	0,65	0,56	0,44	0,78*	0,69	0,54

Note: * Best treatment

3. Effectiveness test

Based on the results of the effectiveness test on all test parameters including physical tests, chemical tests and organoleptic tests, it was found that S3D1 treatment with a concentration of 16% skim milk and 5% sweet potato leaves extract was the best treatment with the highest Result Value (RV) (see Table 3).

Table 3 shows that S3D1 treatment with a concentration of 16% skim milk and 5% sweet potato leaves extract was the best treatment with the highest result value (RV), namely 0.78. The criteria for the taste test parameters were 6.44 (like), overrun 65%, softness 5.96 (like), antioxidants (IC50 value) 112.30 ppm, protein 5.63%, fat 0.76 %, carbohydrates 10.02%, crude fiber 5.27%, vitamin C 16.79 mg, aroma 5.52 (like), and color 5.59 (like).

4. Conclusion

Making ice cream using stevia sugar, skim milk, and adding sweet potato leaves extract could provide an alternative to new products. Ice cream, which is synonymous with sweetness became a healthy product that is low in fat contains vitamins and antioxidants, and was in accordance with the needs of the community during the Covid-19 pandemic.

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