International Journal of Eco-Innovation in Science and Engineering Vol 3 (2), 2022 (7-14)
https://ijeise.upnjatim.ac.id/ E-ISSN: 2721-8775

Article

Chemical Characteristics of Banana-Blueberry Velva Product with Various Concentrations of Carboxymethyl Cellulose (CMC)

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Received: 24th March 2022; Revised: 27th July 2022; Accepted: 29th September 2022;
Available online: 22 November 2022; Published regularly: May and November.

Abstract

The aim of this research was to analyze the chemical characteristics of Velva products from the mixture of bananas and blueberries with the addition of CMC. This study used a two-factorial completely randomized design with the first factor being the proportion of bananas and blueberries (40:60, 50:50 and 60:40). The second factor was concentration of CMC (0.1, 0.3 and 0.5%). Chemical analysis in this research included total acid, vitamin C, antioxidant activity, crude fiber content, protein, and fat. The data were analyzed by ANOVA using SPSS version 26 with Duncan Multiple Range Test at 5 % probability level. The best results based on the best chemical characteristics were obtained in the treatment of banana and blueberry proportions of (40:60) and CMC concentration of (0.5%) which had characteristics 0.613% total acid, 7.627 mg/100g vitamin C, 42.893% antioxidant activity, 4.450% crude fiber, 3.657% protein and 0.127% fat.

Keywords: banana, blueberry, CMC, Velva

1. Introduction

Velva is one of the categories of frozen desserts. Velva is different from ice cream because it has low fat content, and the raw material uses fruit juice or puree combined with a stabilizer. Ice cream has a softer texture than Velva because the overrun of Velva is lower than ice cream in general [1].

One of the fruits that can be used in making Velva is a banana. The banana is a fruit that is easily damaged if stored. Hence, it is suitable for use in the manufacture of a product. One type of banana that can be used in making Velva is the Cavendish banana (Anthocyanin colla). Cavendish banana is a type of banana that can be prolific in Indonesia and very popular because it has a sweet taste, a strong banana aroma and fruit that is not easily mushy [2].

Furthermore, the cavendish banana has different characteristics from other types of bananas. This banana is interesting because it has completed nutritional content and is beneficial for the human body. Cavendish banana has nutritional content in 100 g of fruit containing vitamin C (20 mg), Vitamin B6 (0.7 mg), B2 (0.1 mg), B1 (0.1 mg), Vitamin A (0.3 mg). Energy (116-128 Kcal), protein (1%), fat (0.3%) and carbohydrates (27%), as well as minerals such as iron (0.5 mg), potassium (380 mg), calcium (15mg) and sodium (1.2 mg) [3].

The use of Cavendish bananas in making Velva is very helpful in forming the Velva texture. This is because the Cavendish banana contains

0.5-1.28% pectin [4]. Pectin in the manufacture of Velva can increase viscosity. Therefore, it is very suitable for products that require viscosity, such as Velva.

In addition, there are also added blueberry fruits. Blueberries are a fruit that has potential from their nutritional content but is still rarely used in product manufacturing. Blueberries contain anthocyanin and vitamin C, which act as antioxidant. Besides that, anthocyanin can also give color to the product. Hence, they are more attractive.

Anthocyanin and Vitamin C are known to act as antioxidant that are good for the body if consumed. Antioxidant can counteract free radicals that are very harmful to the health of the human body. In addition to the antioxidant benefits, blueberries also contain other nutrients that are beneficial to the body, 100g of blueberries contains 487 mg of anthocyanin, which is higher than 245 mg of black berries and 120 mg of grapes [5]. 100g of blueberries also contain Vitamin E (0.57 mg), Vitamin A (54 IU) and Vitamin C (7.2 mg) [5].

Texture is a problem that often occurs in the manufacture of ice cream products such as Velva. The coarse texture that forms in ice cream occurs due to the excessive amount of air in the dough. Hence, the crystals formed also increase during freezing. Therefore, it is necessary to add a stabilizer for crystal formation and the formation of a softer texture.

The stabilizer added to the velva can improve the quality of the velva which increases the viscosity and homogeneity of the dough. Hence, it is more viscous, stable, continues to keep crystals from forming that it becomes soft and provides a longer melting power [6]. The stable material that is often used in the manufacture of ice cream and Velva is CMC (Carboxymethyl Cellulose) [7]. CMC has different characteristics from other stabilizers. CMC has the advantages of being stable when reacting with fat, high water holding capacity, having a short freezing time, soluble in cold or hot water and affordable prices. [7].

It was stated that soursop-pineapple velva which has the best formula is velva with a 50:50 proportion of soursop-pineapple with a pH of 4.68, crude fiber 4.79% and vitamin C 18.14 mg [20]. Tantono *et al.* (2017), reported that the use of CMC resulted in better velva compared to the use of Arabic gum with a larger proportion.

2. Material and Method

Materials

Raw materials used in this research were cavendish bananas, blueberry, CMC and supporting materials obtained from *Farmers Market,* Surabaya (which can also be ordered through an online application named *HappyFresh* The reagents used in this research were phenolphthalein 1%, NaOH, iod solution, Etanol 96%, DPPH (Brataco Chemical, Surabaya).

2.1 Tools

Ice Cream Maker (GEA ICE-1530, Cina), Spektrofotometer UV-Vis, distillation (Velp, Italia), titrator (Pyrex, Jerman), Brookfield Model DV-E, Blender (Miyako), *Mixer* (Miyako) and *glassware.*

2.2 Procedure

In this research, banana and blueberry puree were made before making velva. The procedure of making the puree was presented as followed:

2.3 Banana puree processing

Bananas were washed then blanched at 90^{o}C for 2 minutes. After that, bananas are cooled at room temperature. The banana was peeled and mashed using a blender with the ratio of fruit and water 2:1. Then, mashed bananas were filtered to get the banana puree.

2.4 Blueberry puree processing

Blueberries were washed then blanched at 90^{o}C for 2 minutes. After that, blueberries cooled at room temperature. Blueberries were peeled and mashed using a blender with the ratio of fruit and water 2:1. Then, mashed blueberries were filtered to get the blueberries puree.

2.5 Banana-blueberry Velva Processing

Procedures of velva in accordance with procedure modification [8] were to mix the

materials as much as 100 g proportion of banana and blueberry (40:60, 50:50 and 60:40). After that, add sugar 20%, water (1:1), then mix for 5 minutes at a fast speed. Furthermore, added CMC (0.1, 0.3 and 0.5%) and mixed at a fast speed. Then, age the mixture at 5-6^{o}C for 8-12 hours. The mixture is put into an ice cream mixer for air incorporation for 30 minutes. The final process is fast freezing the velva at -20^{o}C for 3-4 hours.

2.6 Chemical analysis of Velva

The chemical analysis used in this research were total acid, vitamin C, crude fiber, protein content, fat content [9] and antioxidant activity [10].

3. Results and Discussion

Raw Material Characteristics

Raw Material Analysis carried out on banana and blueberries fruit including total acid, vitamin C content and antioxidant activity, the results of the analysis were presented in Table 1.

Table 1. Result of raw material analysis

Chemical Properties	Banana	Literature	*Blueberry*	Literature
Total Acid	0.60±0.02 %	0.63±0.07 % [11]	0.87±0.02 %	0.93±0.03 % [14]
Vitamin C (mg/100g)	2.29±0.13	2.1 ±0.8 [12]	9.12±0.2	9.7 [15]
Antioxidant Activity (%)	38.42±0.4	36.12 [13]	47.41	49 [15]

Differences in results between raw materials and literature caused by differences in conditions, duration and place of storage and level of maturity. The conditions, duration, place of storage and the level of maturity of bananas will affect the nutritional value thus each different nutritional content [21]. This is reinforced by the statement of Michalska and Lysiak (2015), the process after harvesting and storage factors can affect the nutritional content of blueberries.

3.1 Chemical Characteristics of Velva

The chemical analysis of velva including total acid, vitamin C, crude fiber, protein content, fat content and antioxidant activity.

3.2 Total Acid

The results of the analysis of variance showed that the proportion of banana: blueberry and CMC concentration had no significant interaction ($p \geq 0.05$) with total acid of velva. The banana:blueberry proportion treatment had significant effect ($p \leq 0.05$), while the addition of CMC had no significant effect on total acid of velva ($p \geq 0.05$). The average value of total acid with the banana:blueberry proportion treatment and the addition of CMC can be seen in Table 2 and Table 3.

Table 2. The average value of total acid with the treatment of banana: blueberry proportion.

Banana:*Blueberry*	Total Acid (%)	DMRT 5%
40 : 60	0.652±0.100^{a}	-
50 : 50	0.526±0.106^{b}	0.116
60: 40	0.383±0.083^{c}	0.121

The mean values followed by the same letter are not significantly different($p \leq 0,05$).

Table 2 shows the higher proportion of blueberries, and the lower proportion of bananas can higher the total acid. The increase in total acid is due to the presence of organic acids contained in blueberries more than bananas. Blueberries have 0.87% greater total titrated acid compared to bananas of 0.60%. These organic acids are the source of total titrated acid found in the velva.

This is supported by Sylvi *et al.* (2020), which stated that the higher addition of ingredients that have a greater total acid would higher the total acid level in the resulting Dutch eggplant-jicama velva. According to Ferreira and Freitas (2019), Cavendish bananas have a total acid content of 0.63%. During the ripening process, the amount of acid in bananas will increase. The most dominant acid contained in bananas is malic acid [16]. Aliman *et al.* (2020), blueberries have a total acid content of 0.93% with organic acid components such as ascorbic acid and citric acid as the largest organic acid components.

Table 3. The average value of total acid with CMC concentration treatment

CMC (%)	Total Acid (%)	DMRT 5%
0.1	0.550±0.393[a]	0.121
0.3	0.522±0.442[a]	0.116
0.5	0.489±0.375[a]	-

The mean values followed by the same letter are not significantly different(p≦0,05).

Table 3 showed no significant difference between treatments. This was because CMC is a derivative of cellulose which does not contain organic acids; thus it does not have a significant effect on the total acid of velva.

The addition of CMC did not show a significant difference to the total acid of the fruit juice produced [23]. This was because carboxymethylcellulose (CMC) is a solid substance that belongs to the type of ester derived from cellulose which is commonly used in the food industry to improve texture [17]. According to KEBS (2018), the total acid in products such as sherbet and water ice is 0.35%, thus the total acid in this research had met the standard [24].

3.3 Vitamin C

The results of the analysis of variance showed that the proportion of banana: blueberry and CMC concentration had no significant interaction (p≥0.05) on vitamin C of velva. The banana: blueberry proportion treatment had significant effect (p≤0.05), while the addition of CMC had no significant effect on vitamin C of velva (p≥0.05). The average value of vitamin C with the banana: blueberry proportion treatment and the addition of CMC can be seen in Table 4 and Table 5.

Table 4. The average value of vitamin C with the treatment of banana: blueberry proportion.

Banana:*Blueberry*	Vitamin C (mg/100g)	DMRT (%)
40 : 60	7.622±0.662[a]	1.123
50 : 50	6.178±1.107[b]	1.071
60: 40	4.760±0.762[c]	-

The mean values followed by the same letter are not significantly different(p≦0.05).

Table 4 shows a higher proportion of blueberries, and the lower proportion of bananas will higher the vitamin C of velva. The increase of vitamin C was because blueberries have a higher vitamin C content of 9.12 mg/100g compared to bananas of 4.29 mg/100g. Hence, the greater addition of blueberries to the velva gave higher vitamin C levels.

This is supported by Jariyah et al (2019), who stated that in the manufacture of ice cream using the proportions of pedada fruit and young coconuts would produce ice cream with vitamin C content with larger proportion of pedada fruit compared to young coconuts. Hence, the higher addition of ingredients that have greater vitamin C such as pedada, it will increase the levels of vitamin C produced [25].

Shivembe and Ojinnaka (2020), stated that blueberries contained 9.7 mg/100g, while bananas contained 2.1 mg/100g of vitamin C [12].

Table 5. The average value of vitamin C with CMC concentration treatment

CMC (%)	Vitamin C (mg/100g)	DMRT (%)
0.1	6.471±4.182[a]	1.123
0.3	6.080±4.197[a]	1.071
0.5	6.009±4.557[a]	-

The mean values followed by the same letter are not significantly different(p≦0,05).

Table 5 shows no significant difference between treatments. This was because CMC is a cellulose derivative that does not contain vitamin C. This was in accordance with Jariyah *et al.* (2019), which stated that increasing CMC concentrations had no significant effect on vitamin C in vegetable ice cream with pedada fruit juice and young coconut juice. This is because CMC did not contain vitamin C thus it did not affect vitamin C levels in vegetable ice cream with pedada fruit juice and young coconut juice [25].

3.4 Antioxidant activity

The analysis results of variance showed that the proportion of banana:blueberry treatment and the addition of CMC did not have a significant interaction (p≤0.05) towards the antioxidant activity of Velva. The banana:blueberry proportion treatment had a significant effect (p≥0.05), while the addition of CMC had no significant effect on the antioxidant activity of Velva (p≤0.05). The average value of Velva's antioxidant activity with the banana:blueberry proportion treatment and the addition of CMC can be seen in Table 6 and Table 7.

Table 6. The average value of velva antioxidant activity with the proportion of banana:blueberry treatment

Banana:*Blueberry*	Antioxidant activity (%)	DMRT 5%
40 : 60	43.325±1.292[c]	1.115
50 : 50	42.324±0.830[b]	1.063
60: 40	41.020±0.751[a]	-

Note: Numbers followed by different letters show a significant difference (p≤0.05).

Table 6 shows that the higher the proportion of blueberries and the lower the proportion of bananas added to the velva, the higher the antioxidant activity. The increase in antioxidant activity is due to the presence of anthocyanin and vitamin C contained in blueberries more than bananas, it is known that anthocyanin and vitamin C can act as antioxidants. Blueberries have 47.41% greater antioxidant activity compared to 38.42% bananas.

The higher the addition of ingredients that have greater antioxidant activity, the higher the level of antioxidant activity in the velva of Dutch eggplant-jicama produced, in this case the addition of large amounts of Dutch eggplant will increase antioxidant activity compared to the addition of jicama. This is due to the presence of anthocyanin and vitamin C in large quantities in Dutch eggplant compared to jicama [22].Shivembe and Ojinnaka (2017), stated that blueberries have 49% antioxidant activity. While the Cavendish banana has a lower antioxidant activity of 36.12% [13]

Table 7. The average value of velva antioxidant activity with CMC concentration treatment

CMC (%)	Antioxidant activity (%)	DMRT 5%
0.1	42.546±3.770[a]	1.115
0.3	42.194±3.690[a]	1.063
0.5	41.928±3.054[a]	-

Table 7 shows that there is no significant difference between treatments. This is because CMC does not contain components that can act as antioxidants, so it does not have antioxidant activity.

This is supported by Yudhistira and Meriza (2018), which stated that the addition of CMC did not show a significant difference in the antioxidant activity of the fruit juice produced. This is because carboxymethylcellulose (CMC) is a group of cellulose esters that do not contain bioactive substances in the form of antioxidants formed by ascorbic acid, beta-carotene, and anthocyanins. [1].

3.5 Crude Fiber

The analysis of variance result showed that the treatment of the proportion of banana:blueberry and the addition of CMC had no significant interaction (p≤0.05) on velva crude fiber, but the treatment of the proportion of banana: blueberry and the addition of CMC had a significant effect (p≥0.05). The average value of Velva crude fiber with banana:blueberry proportion treatment and CMC addition treatment can be seen in Table 8 and Table 9.

Table 8. The average value of velva crude fiber with the treatment of the proportion of banana:blueberry

Banana:*Blueberry*	Crude fiber (%)	DMRT 5%
40 : 60	4.326±0.391[a]	-
50 : 50	4.850±0.465[b]	0.090
60: 40	5.269±0.631[c]	0.094

Note: Numbers followed by different letters show a significant difference (p≤0.05).

Table 8 shows that the higher the proportion of bananas and the lower the proportion of blueberries added to the velva, the higher the crude fiber. This increase in crude fiber is due to the higher crude fiber content of bananas than blueberries, so the higher the proportion of bananas, the higher the level of velva crude fiber produced.

This is supported by Yudhistira et al (2020) who stated that the higher the addition of super red dragon fruit in the manufacture of velva, the higher the fiber content in the velva. In bananas the crude fiber content is 6-15.5% [27] and in blueberries it is 3-3.5% [18].

Table 9. Average value of Velva crude fiber with CMC concentration treatment

CMC (%)	Crude fiber (%)	DMRT 5%
0.1	4.641±1.299[a]	-
0.3	4.834±1.422[b]	0.090
0.5	4.969±1.536[c]	0.094

Note: Numbers followed by different letters show a significant difference (p≤0.05).

Table 9 shows that the higher the concentration of the addition of CMC, the higher the crude fiber is. This is because CMC is a fiber; therefore, its addition will increase the crude fiber content of the resulting velva.

This is supported by Nisa and Putri (2014), who stated that the addition of CMC will increase the fiber content [26]. CMC (carboxymethyl cellulose) is a class of food fiber polymer chains in which it .consists of cellulose units which are insoluble fiber which is in small amount compared to soluble fiber, both soluble dietary fiber and insoluble dietary fiber both have an important role for human digestion. [19].

3.6 Protein Content

The results of the analysis of variance showed that the treatment of banana:blueberry proportions and the addition of CMC did not have a significant interaction (p≤0.05) on velva protein content. The treatment with the proportion of banana:blueberry gave a significant effect (p≥0.05), while the addition of CMC did not have a significant effect on the protein content of the velva (p≤0.05). The average value of velva protein content with the banana:blueberry proportion treatment and the addition of CMC can be seen in Table 10 and Table 11.

Table 10. The average value of velva protein content with the proportion of banana:blueberry treatment

Banana:*Blueberry*	Protein content (%)	DMRT (%)
40 : 60	3.714±0.199[a]	-
50 : 50	3.988±0.291[b]	0.266
60 : 40	4.304±0.327[c]	0.279

Note: Numbers followed by different letters show a significant difference (p≤0.05).

Table 10 shows that the higher the proportion of bananas and the lower the proportion of blueberries added to the velva, the higher the protein content. The increase in protein content was since bananas had a higher protein content than blueberries; therefore, the greater the addition of bananas to the velva, the higher the protein content.

This is supported by USDA (2018), which states that the protein content in 100g of bananas is 1.09g while that of blueberries is 0.74g/100g.

Table 11. The average value of total acid of velva with CMC concentration treatment

CMC (%)	Protein content (%)	DMRT (%)
0.1	4.083±0.895[a]	0.279
0.3	4.016±0.976[a]	0.266
0.5	3.908±0.787[a]	-

Note: Numbers followed by different letters show a significant difference (p≤0.05).

Table 11 shows no significant difference between treatments. This is because CMC does not contain protein and is a cellulose derivative which results in its addition not influencing the levels of velva protein produced.

This is in accordance with Puteri et al (2015), which states that CMC is a derivative of cellulose that does not contain protein which acts as a thickener, stabilizer, and gelling agent, as an emulsifier [27].

3.7 Fat Content

The analysis of variance results showed that the proportion of banana:blueberry treatment and the addition of CMC had no significant interaction (p≤0.05) on the fat content of the velva. The banana:blueberry proportion treatment had a significant effect (p≥0.05), while the addition of CMC had no significant effect on the fat content of the velva (p≤0.05). The average value of velva fat content with the banana:blueberry proportion treatment and the addition of CMC can be seen in Table 12 and Table 13.

Table 12. The average value of velva fat content with the proportion of banana:blueberry treatment

Banana:*Blueberry*	Fat content (%)	DMRT (%)
40 : 60	0.138±0.042[b]	-
50 : 50	0.170±0.020[ab]	0.031
60 : 40	0.194±0.015[a]	0.033

Table 12 shows that the higher the proportion of bananas and the lower the proportion of blueberries added to the velva, the higher the fat content. This increase in fat content is due to bananas having a higher fat content than blueberries, so that the greater the addition of bananas to the velva, the fat content will increase.

This is supported by the USDA (2018), which states that the fat content in 100g of bananas is 0.5g while that of blueberries is 0.33g/100g.

Table 13. The average value of total acid of velva with CMC concentration treatment

CMC (%)	Fat content (%)	DMRT (%)
0.1	0.177±0.070[a]	0.033
0.3	0.166±0.091[a]	0.031
0.5	0.160±0.095[a]	-

Note: Numbers followed by different letters show a significant difference (p≤0.05).

Table 13 shows no significant difference between treatments. This is because CMC does not contain fat and is a cellulose derivative which results in its addition not influencing the level of velva fat produced.

This is in accordance with Puteri et al (2015), which states that CMC is a derivative of cellulose that does not contain fat [27].

4. Conclusions

The proportions of banana and blueberry and the concentration of CMC have no significant interactions with all the chemical characteristics of Velva include total acid, vitamin C, antioxidant activity, crude fiber, protein and fat content. The best treatment in this study based on chemical characteristics was proportion of banana and blueberry 40:60 with 0.5% CMC which had 0.613% of acid characteristics, 7.627 mg/100g vitamin C, 42.893% antioxidant activity, 4.450% crude fiber, 3.657% protein and 0.127% fat.

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