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Plantain (*Musa X paradisiaca AAB*) and Activated Charcoal Powder towards Ice Cream Quality

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ABSTRACT

Ice cream is a frozen snack made from ingredients such as milk, cream, sugar, and stabilisers that being frozen and mixed with other ingredients to create a variety of ice cream flavours, such as banana ice cream. Plantain (Musa paradisiaca) contains high nutritions such as vitamin A, B6, C, other minerals, and carbohydrates. The addition of plantain and Activated Charcoal Powder (ACP) into the ice cream can increase its nutrition value. This because of bananas as a carbohydrate source and the ACP, made from coconut shell charcoal and create a distinct ice cream colour, as a toxin absorber and immune system enhancer. This research will utilise the Completely Randomised Design (CRD) using two factors. Factor 1 is the plantain substitutions, which are 10%, 15%, and 20%. Factor 2 is the ACP concentrations, which are 0.1%, 0.2%, and 0.3%. Each combination of treatments is conducted through three-time repetitions. Research observation uses proximate analysis and organoleptic test. Parametric data in the analysis, which based on the parametric statistic by utilising Analysis of Variance (ANOVA) shows that the difference between plantain substitution and ACP concentration intangibly influences the protein and fat content. The different plantain substitution and its interaction between the different ACP concentration intangibly influence the sugar content and overrun. The different concentration of ACP intangibly influences the sugar count and tangibly influences the banana ice cream's overrun. Parametric data test results later become the base of effectivity test to obtain the best treatment. The best treatment of this research is obtained from the combination of 20% plantain and 0.3% ACP concentration, with the highest score of 0.84 with the research variable criteria of protein content (3.7%), fat content (2.4%), sugar content (41.3%), and overrun (81.37%).

Keywords: *ice cream; banana; plantain; ACP*

INTRODUCTION

Ice cream is a processed milk product made from the freezing and agitating process with the basic principle of forming the air cavity on the ice cream mix (ICM) that resulted in the development of its volume. ICM in the ice cream can be made from the blend of milk, dairy products, sweetener, stabiliser, emulsifier, and taste enhancer (Sulistyowati, Mujiharjo, Priyono, Haryanti, & Sistanto, 2016).

Plantain (*Musa X paradisiaca AAB*) is a fruit rich in minerals such as potassium, magnesium, phosphor, calcium, and iron, which the body can absorb most of them. Its vitamin content also considerably high, mainly provitamin A of betacarotene. Plantain also contains vitamin B, which are thiamine, riboflavin, niacin, and vitamin B6/pridoxine (Ermawati, Wahyuni, & Rejeki, 2016).

The charcoal element can be obtained from the shell of the old palm oil or sawdust that well-known for poison binder and antidote. The method of charcoal activation is by drowning the charcoal in certain substances (Darmawan, 2008).

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The activated charcoal can be processed and packed in the form of a pill or powder. Besides resulting in the specific ice cream colour, this activated charcoal also can absorb poison in the body and enhance body immunity (Lestari, Gusti, & Lestari, 2019).

The utilisation of banana, including its skin (Hartati, 2018) in the food processing field is already common practice. Ade Herianto, Faizah Hamzah (2015) stated that the usage of 20% of banana paste could result in a banana jam that organoleptically accepted by the panellists. Meanwhile, ACP 0.2% is used in the making of healthy ice cream (Darmawan, 2008). The combination between the banana/plantain and ACP in the making of ice cream has not yet been found. Therefore, the author would like to research the different combination/treatment of plantain substitution and ACP concentration and its influence on banana ice cream's quality.

METHODS

The method used in this research is the laboratory experiment research. Materials used for this research are plantain, milk, sugar, gelatin, ACP, and whipped cream. Chemical materials used for the analysis steps are concentrated H_2SO_4, Kjeldahl table, boric acid 4% (contains indicators of methyl red and bromocresol green in the methanol), 0.2 N of HCl, Pb acetate, $(NH_4)_2$ HPO_4 10%, $(NH_4)_2$ 10%, HCl 25%, NaOH 30%, Luff Schoorl Solution, KI 20%, H_2SO_4 25%, and 0.1 N of Na-thiosulphate.

Tools used in this research are the digital scale, measuring cup, spoon, mixer, stainless bowl, stewpan, wooden spatula, and ice cream cup. Tools for chemical analysis are semi-automatic Kjeltec System Tecator 1026/2006, analytes scale, Kjeldahl and Erlenmeyer flask, burette and statips, Soxhlet Modification Tecator, Muffle Furnace Thermolyne 30400, 650 ^oC, ash cup, measuring flask, beaker glass, pipette, thermometer, boiling stone, stopwatch, and cooler.

Research procedure

This research utilises *Completely Randomised Design* (CRD), formed in two factorials, which each factor is formed of three levels. Those factors are Factor 1: Plantain Substitution with three levels (P1: 10%; P2: 15%; and P3: 20%). Factor 2: ACP Concentration with three levels (C1: 0.1%; C2: 0.2%; C3: 0.3%).

Therefore, there is nine treatment combination, and on the repetition, the determination based on the formula of $(t-1)(n-1)\geq 15$ (Hidayat, 2006), then the repetition will be conducted as many as three times.

Research steps

Based on the ice cream making process by (Ermawati et al., 2016), there has been some modification of the ingredients used. The flowchart of this ice cream making as part of the research can be seen in Figure 1.

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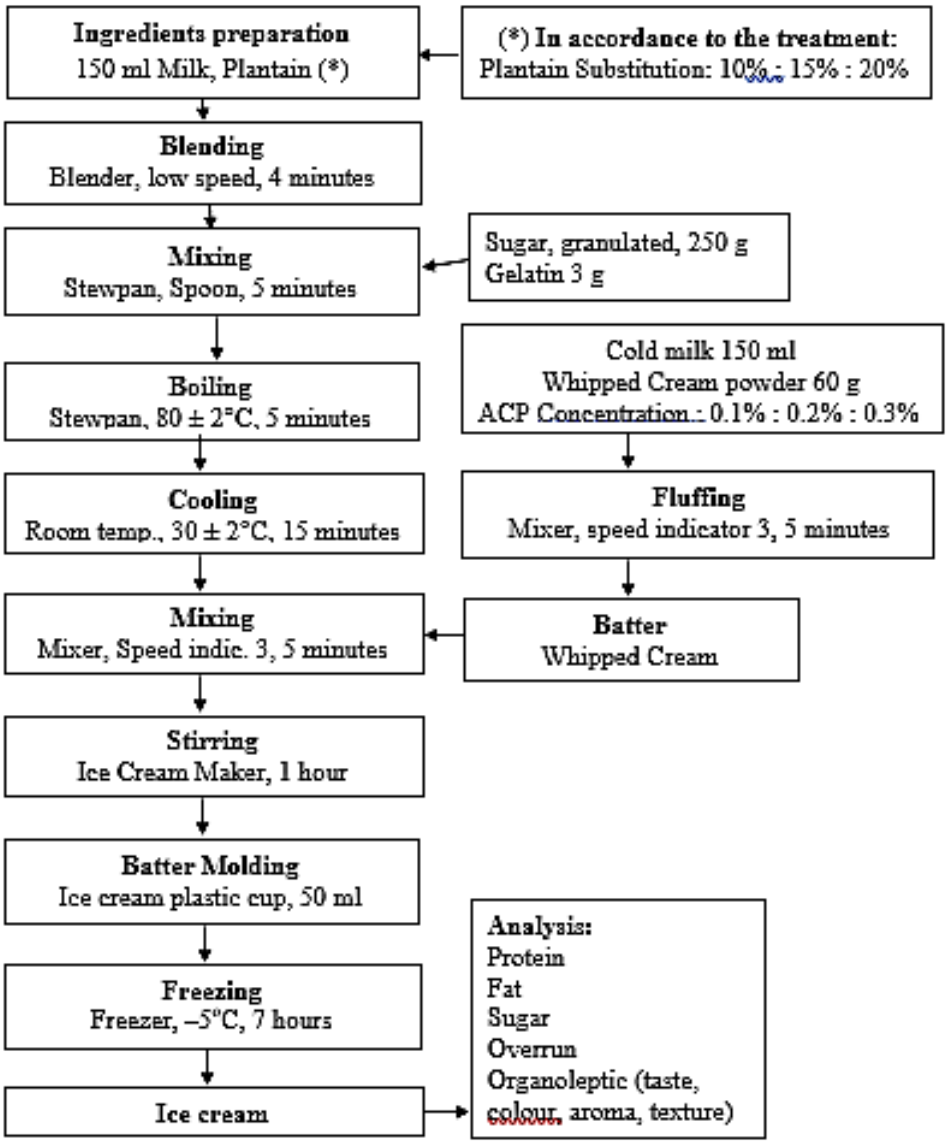

Figure 1. Flowchart of Ice Cream Research
Source: (Ermawati et al., 2016), modified

Variables observed in this research is the protein content determination using Tecator-Foss Modification of Makro-Kjeldahl Method, fat content determination using Tecator-Foss Modification of Soxhlet Method, total sugar content determination using Luff Schoorl Method (Nuri Andarwulan, Feri Kusnandar, 2018), and overrun determination using the testing procedure in accordance to Suci Rahmadhani & Nombiga (2012).

The organoleptic test is conducted through Hedonic test comprises colour, taste, and aroma. According to Mancini, Bonanno, & Clark (2011), this test uses seven scales of liking level: 1 (very dislike), 2 (dislike), 3 (rather dislike), 4 (neutral), 5 (rather like), 6 (like), and 7 (very like).

The data of observation and research results later tested and analysed of its variance (ANOVA) using Statistic Product and Service Solution/SPSS (Hidayat, 2006). If the analysis concluded the tangible difference influence between

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treatment, then there will be an advanced test using Least Significance Different (LSD)/Turkey HSD/Duncan Test on the level of confidence of α=95 %, depends on the size of diversity coefficient. Diversity coefficient of ≤5% uses LSD Test. If the coefficient lays between 5 to 10%, the Turkey HSD will be utilised. If the coefficient reaches ≥10%, Duncan test will be applied.

RESULTS AND DISCUSSIONS

The ANOVA result of this research that comprises the protein, fat, and total sugar content, and overrun indicates that different plantain substitution, different ACP concentration, and the interaction of both intangibly influences protein and fat content. The different plantain substitution and its interaction between the different ACP concentration intangibly influence the total sugar content and overrun. The different ACP concentration tangibly influences the total sugar content and very tangibly influence the overrun of the banana ice cream. The chemical parametric significance can be seen in Table 1.

Table 1. Chemical Parametric Significance of Banana Ice Cream

Parametres	Significance			Criteria	Average Value (%)	Treatment Code (*)
	Plantain Substitution (P)	ACP Concentration (C)	P x C Interaction			
Protein content	NS	NS	NS	Highest	3,7	P3C3
Fat content	NS	NS	NS	Highest	2,5	P3C3
Total sugar	NS	S	NS	Highest	41,3	P3C3
Overrun	NS	HS	NS	Highest	81,7	P3C3

Note: *NS = Non-Significant; S = Significant; HS = Highly Significant*
(*) = See Table 3 for treatment codes

The analysis results of the non-parametric data give the score on colour, taste, aroma, and texture between 6.2 to 6.4, which means that the panellists like this banana ice cream. The average result of ice cream's organoleptic test can be seen in Table 2.

Table 2. Average Score of Banana Ice Cream's Organoleptic Test

Variable	Average Score	Test Criteria	Treatment Code (*)
Taste	6,3	Like	P2C2
Colour	6,4	Like	P2C2
Aroma	6,2	Like	P2C2
Texture	6,2	Like	P2C2

Note: (*) = See Table 3 for treatment codes

Protein content

Analysis result of the average variance of the protein content of this ice cream can be viewed in Table 3.

Table 3. Protein Content Average of Banana Ice Cream (%)

Treatment code	Treatment	Protein Content Average
P1C1	Plantain Substitution 10% : ACP Concentration 0.1%	3
P1C2	Plantain Substitution 10% : ACP Concentration 0.2%	2,9
P1C3	Plantain Substitution 10% : ACP Concentration 0.3%	3,3
P2C1	Plantain Substitution 15% : ACP Concentration 0.1%	2,9
P2C2	Plantain Substitution 15% : ACP Concentration 0.2%	3,2
P2C3	Plantain Substitution 15% : ACP Concentration 0.3%	3,3
P3C1	Plantain Substitution 20% : ACP Concentration 0.1%	2,9
P3C2	Plantain Substitution 20% : ACP Concentration 0.2%	2,9
P3C3	Plantain Substitution 20% : ACP Concentration 0.3%	3,7

The table above also shows that the more ACP addition into the mixture, the protein content in the ice cream would also increase. This is visible on the ACP Concentration of 0.3%, which shows 3.3-3.7% on the protein content. The high protein content number occurred due to ACP that able to absorb water and toxic materials in the ice cream. With the low water content in the ice cream, other nutrients become concentrated. The concentration process will increase all nutrients, including the protein of the banana ice cream, as stated by (Winarno, 2004).

Fat content

Analysis result of the average variance of the fat content of this ice cream can be viewed in Table 4.

Table 4. Fat Content Average of Banana Ice Cream (%)

Treatment code	Treatment	Fat Content Average
P1C1	Plantain Substitution 10% : ACP Concentration 0.1%	2,2
P1C2	Plantain Substitution 10% : ACP Concentration 0.2%	2,3
P1C3	Plantain Substitution 10% : ACP Concentration 0.3%	2,5
P2C1	Plantain Substitution 15% : ACP Concentration 0.1%	1,8
P2C2	Plantain Substitution 15% : ACP Concentration 0.2%	1,5
P2C3	Plantain Substitution 15% : ACP Concentration 0.3%	2,1
P3C1	Plantain Substitution 20% : ACP Concentration 0.1%	2,5
P3C2	Plantain Substitution 20% : ACP Concentration 0.2%	2,5
P3C3	Plantain Substitution 20% : ACP Concentration 0.3%	2,4

The less significant fat content is due to the low-fat ingredients of plantain or banana in general and the ACP itself. The plantain has a high carbohydrate but

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low in protein and fat so it cannot increase fat content in the ice cream. Riana (2000) also stated that a banana contains 0.2% fat. ACP itself is also has a small role in increasing fat content since it does not contains fat, but it has high mineral content (Darmawan, 2008). Therefore, all ACP concentration gives a low fat content in the ice cream.

Total sugar content

Analysis result of the average variance of the total sugar content of this ice cream can be viewed in Table 5.

Table 5. Total Sugar Content Average (%) on Banana Ice Cream on Different ACP Concentration

Treatment Code	Treatment	Total Sugar
C1	ACP Concentration of 0.1%	38,933 [a]
C2	ACP Concentration of 0.2%	38,833 [a]
C3	ACP Concentration of 0.3%	40.133 [b]

LSD Test 5% = 3,402%

Note: The identical letter behind the total sugar number indicates that there is no difference in the 5% LSD Test. The determination of 5% LSD Test can be viewed in Appendix 10 L.

ACP is an activated charcoal powder substance that able to bind water and poison. Therefore, it lowers the water content of the ice cream. The low water content triggers the nutrition concentration, so the nutrition content is increased, including the total sugar content. Winarno (2004) stated that all sugar content contained in a foodstuff or ingredients is called total sugar content. This total sugar depends on the ingredients' water content. It is common that if an ingredient/foodstuffs have low water content, its sugar content would be high.

Overrun

Analysis result of the average variance of the overrun of this ice cream can be viewed in Table 6.

Table 6. Overrun Average (%) on Banana Ice Cream on Different ACP Concentration

Treatment Code	Treatment	Overrun
C1	ACP Concentration of 0.1%	74,59 [a]
C2	ACP Concentration of 0.2%	77,87 [b]
C3	ACP Concentration of 0.3%	81,37 [c]

LSD Test 5% = 1,26%

Note: The identical letter behind the overrun number indicates that there is no difference in the 5% LSD Test. The determination of 5% LSD Test can be viewed in Appendix 11.

The amount of sugar and water in the ice cream influences the formation of overrun. If the ice cream has a lot of sugar, then it will bind the water so that the water content becomes lower and produce denser ice cream. Which, if it processed in the ice cream machine, it would result in a more air volume/overrun of the ice

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cream. The test resulted in the score within 74.59% to 81.37%. The results are considered satisfying, considering the excellent ice cream quality should have the overrun value between 70% to 80% (Padaga, M., & Sawitri, 2005).

Colour organoleptic test

The result of preferential test towards the colour of the ice cream resulted in the score range between 4.2-6.2, which means that the ice cream colour is considered as between "neutral" to "liked" by the panellists. The average colour score can be seen in Figure 2 below.

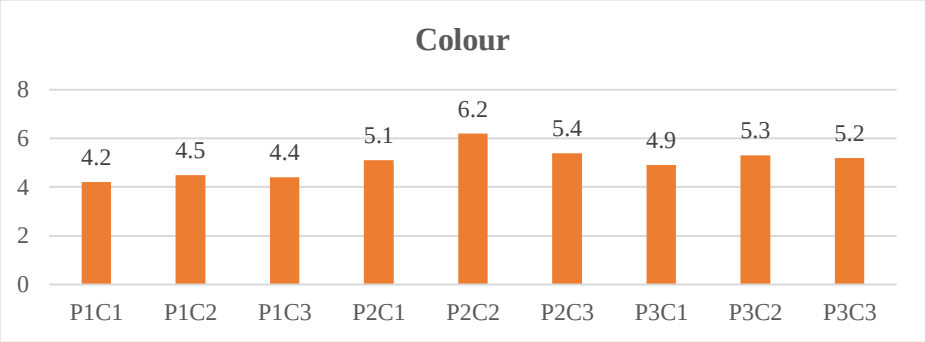

Figure 2. Histogram of Banana Ice Cream's Colour Perception

The P2C2 treatment code is the highest score of this preferential test (6.2) due to the perfect black colour produced by the combination of Plantain and ACP. On the contrary, with the addition of 10% and 20% of Plantain Substitution and 0.1% and 0.3% of ACP Concentration resulted in too dull and too dark, so it is less appealing.

Taste organoleptic test

The result of preferential test towards the taste of the ice cream resulted in the score range between 4.5-6.2, which means that the ice cream colour is considered as between "rather liked" to "liked" by the panellists. The average taste score can be seen in Figure 3 below.

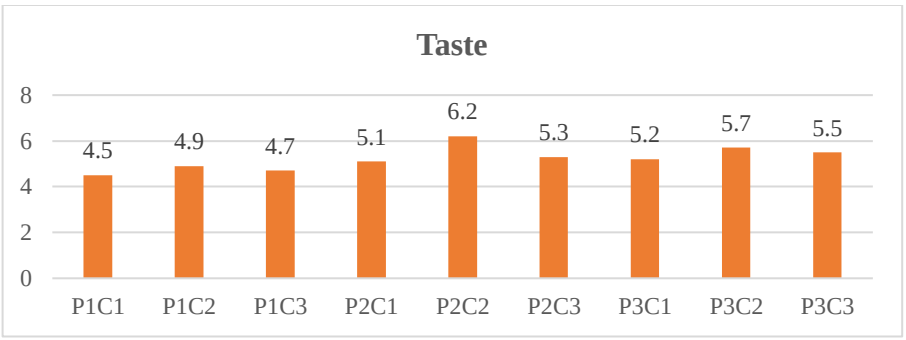

Figure 3. Histogram of Banana Ice Cream's Taste Perception

The P2C2 treatment code is the highest score of this preferential test (6.2) due to the perfect taste (not too sweet, not too bland). On the contrary, with the addition of 10% and 20% of Plantain Substitution and 0.1% and 0.3% of ACP Concentration resulted in the too bland or too sweet taste of ice cream. Moreover,

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the combination with 0.3% of ACP Concentration still has the natural flavour of ACP.

Aroma organoleptic test

The result of preferential test towards the aroma of the ice cream resulted in the score range between 4.3-6.2, which means that the ice cream aroma is considered as between "neutral" to "liked" by the panellists. The average aroma score can be seen in Figure 4 below.

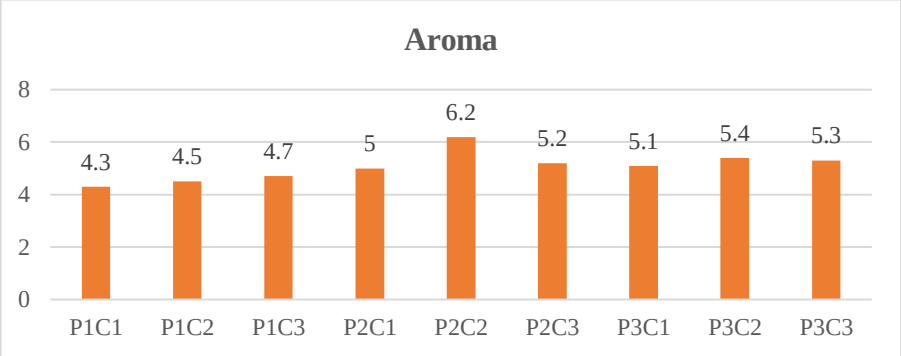

Figure 4. Histogram of Banana Ice Cream's Aroma Perception

The P2C2 treatment code is the highest score of this preferential test (6.2) due to the presence of banana aroma and the absence of ACP aroma. On the contrary, with the addition of 10% and 20% of Plantain Substitution and 0.1% and 0.3% of ACP Concentration resulted in weak ice cream aroma. Moreover, the combination with 0.3% of ACP Concentration still has the natural flavour and aroma of ACP that cannot be concealed by the plantain's aroma.

Texture organoleptic test

The result of preferential test towards the texture of the ice cream resulted in the score range between 4.2-6.2, which means that the ice cream texture is considered as between "neutral" to "liked" by the panellists. The average texture score can be seen in Figure 5 below.

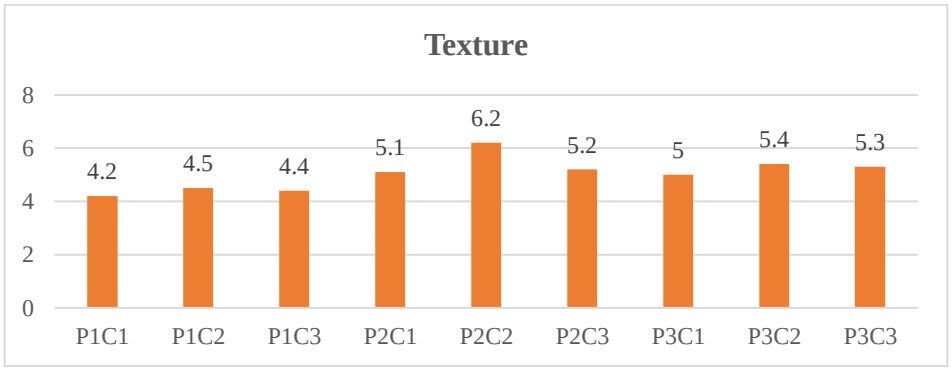

Figure 5. Histogram of Banana Ice Cream's Texture Perception

The P2C2 treatment code is the highest score of this preferential test (6.2) due to its smooth texture felt by the panellists, either when being touched or consumed. On the contrary, with the addition of 10% and 20% of Plantain

Substitution and 0.1% and 0.3% of ACP Concentration resulted in a less smooth texture and tended to runny, so the ice cream melts faster.

Effectivity test

Result Value of the Effectivity Test on all assessment parameters that cover chemical and organoleptic test can be seen in Table 7.

Table 7. Result Value of the Effectivity Test on All Assessment Parameters

Parameters	Result Value (RV) of Treatment								
	P1C1	P1C2	P1C3	P2C1	P2C2	P2C3	P3C1	P3C2	P3C3
Colour	0	0.02	0.01	0.06	0.13	0.06	0.04	0.07	0.06
Taste	0	0.03	0.01	0.04	0.13	0.05	0.05	0.08	0.07
Protein	0.02	0	0.07	0	0.05	0.07	0	0	0.13
Fat	0.09	0.1	0.13	0.04	0	0.08	0.13	0.13	0.12
Total Sugar	0.005	0	0.06	0.03	0.04	0.04	0.02	0	0.13
Overrun	0.004	0	0.01	0.06	0.07	0.06	0.12	0.12	0.13
Aroma	0	0.02	0.01	0.05	0.12	0.06	0.05	0.07	0.1
Texture	0	0.01	0.01	0.04	0.1	0.05	0.04	0.06	0.1
Total	0.12	0.18	0.31	0.32	0.64	0.47	0.46	0.53	**0.84**

Note: Treatment Codes can be seen on Table 3

CONCLUSION

This research concluded that the P3C3 treatment code (Plantain Substitution of 20% and ACP Concentration of 0.3%) is the best treatment with the highest Result Value (0.84) with the criteria variables and scores as follows: colour = 5.2 (rather like); taste = 5.5 (rather like); protein content = 3.7%; fat content = 2.4%; total sugar content = 41.3%; overrun = 81.37%, aroma = 5.3 (rather like); and texture = 5.3 (rather like).

REFERENCES

Ade Herianto, Faizah Hamzah, Y. (2015). Studi Pemanfaatan Buah Pisang Mas (*Musa acuminata*) dan Buah Naga Merah (*Hylocereus polyrhizus*) Dalam Pembuatan Selai. *Jom Faperta*, *2*(2), 400.

Darmawan. (2008). Sifat Arang Aktif Tempurung Kemiri Dan Pemanfaatannya Sebagai Penyerap Emisi Papan Serat Berkerapatan Sedang. *Tesis*.

Ermawati, O. W., Wahyuni, S., & Rejeki, Sr. (2016). Kajian Pemanfaatan Limbah Kulit Pisang Raja (*Paradisiaca* var Raja) Dalam Pembuatan Es Krim. *J. Sains Dan Teknologi Pangan*, *1*(1), 67–72.

Hartati, F. K. (2018). Pemanfaatan Kulit Pisang (*Musa paradisiaca*) Menjadi Donat Tinggi Kalsium. *Food Science and Technology*, *1*(July), 1–4. Retrieved from https://ejournal.unitomo.ac.id/index.php/foodscitech/article/view/1064/520

Hidayat. (2006). *Metode Perancangan Percobaan: Untuk Ilmu-ilmu Pertanian, Ilmu-ilmu Teknik*. Bandung: Armica.

Lestari, I., Gusti, D. R., & Lestari, U. (2019). Introduksi Teknologi Kosmetika Dengan Bahan Baku Arang Aktif Cangkang Sawit sebagai Perawatan Kecantikan di Paguyuban PT SNP Desa Parit, Sungai Gelam. *Jurnal Karya Abdi Masyarakat*, *3*(1), 47–55.

Mancini, A. D., Bonanno, G. A., & Clark, A. E. (2011). Stepping Off the Hedonic Treadmill: Individual Differences in Response to Major Life Events. *Journal of Individual Differences*, *32*(3), 144–152. https://doi.org/10.1027/1614-0001/a000047

Nuri Andarwulan, Feri Kusnandar, D. H. (2018). Pengelolaan Data Analisis Pangan PEND. *Pang4411/Modul 1 1.3*, *1 .1.3*(Net-Work Science .), 1.1-1.39.

Padaga, M., & Sawitri, M. E. (2005). *Membuat Es Krim Yang Sehat*. Surabaya: Trubus Agrisarana.

Suci Rahmadhani, R. F. T., & Nombiga, T. E. (2012). *Uji Penerimaan Hedonik*. Bogor.

Sulistyowati, E., Mujiharjo, S., Priyono, B. S., Haryanti, E., & Sistanto, S. (2016). Tingkat Kesukaan dan Analisis Ekonomi Produk Olahan Susu Spesifik Lokasi. *Jurnal Sain Peternakan Indonesia*, *11*(2), 118–125. https://doi.org/10.31186/jspi.id.11.2.118-125

Winarno, F. G. (2004). *Kimia Pangan dan Gizi*. Jakarta: Gramedia Pustaka Utama.