

THE CHARACTERISTICS OF SYNBIOTIC YOGHURT ICE CREAM MADE FROM ICE CREAM MIX AND PURPLE YAM YOGHURT (*DIOSCOREA ALATA*)

Rosida*
Ulya Sarofa
Raden Roro Regita Prasetyo Wardani

Food Technology Department, Engineering Faculty, UPN Veteran Jawa Timur, Jl. Raya Rungkut Madya
Gunung Anyar Surabaya, Indonesia.

ABSTRACT

Synbiotic yoghurt ice cream is a kind of ice cream made from ice cream mix (milk, skim milk and sugar) and purple yam yoghurt as the main ingredient. The inulin, prebiotic compound of purple yam, inulin, can trigger the growth of beneficial bacteria so it would be beneficial for the health. The addition of stabilizer, xanthan gum, aims to produce yoghurt ice cream with a soft texture. The aim of this study to determine the effect of proportion of ice cream mix:yoghurt and concentration of xanthan gum on yoghurt ice cream characteristics. This study used a completely randomized design-factorial pattern with two factors and three replications. The factors are proportion of ice cream mix:yoghurt (70:30; 60:40; 50:50) and concentration of xanthan gum (0.1%; 0.2%; 0.3%). The observed data were analyzed using ANOVA, followed by DMRT test at 5% level if there were significant differences. The study revealed that the best treatment, based on physicochemical properties of ice cream, is the proportion of ice cream mix:yoghurt (60:40) and xanthan gum concentration (0.2%) with total LAB of 8.55 log CFU/ml; overrun 27.69%; melting time 13.51 min/10 gr; total dissolved solids 31.00 °Brix; viscosity 517.00 mPas.

Keywords: purple yam; synbiotic; xanthan gum; yoghurt ice cream

ABSTRAK

Es Krim yoghurt sinbiotik adalah jenis es krim yang dibuat dari *ice cream mix* dan yoghurt uwi ungu sebagai bahan utamanya. Komponen prebiotik di dalam uwi ungu, yaitu inulin, dapat meningkatkan pertumbuhan bakteri baik sehingga bermanfaat untuk kesehatan manusia. Penambahan bahan penstabil, xanthan gum, bertujuan untuk menghasilkan es krim yoghurt dengan tekstur yang lembut. Penelitian ini bertujuan untuk mengetahui pengaruh *ice cream mix*:yoghurt dan konsentrasi xanthan gum terhadap karakteristik es krim yoghurt. Penelitian ini menggunakan Rancangan Acak Lengkap Pola Faktorial dengan dua faktor dan 3 ulangan. Faktor-faktor yang digunakan adalah proporsi *ice cream mix*:yoghurt (70:30; 60:40; 50:50) dan konsentrasi xanthan gum (0,1%; 0,2%; 0,3%). Data yang diperoleh dianalisa menggunakan analisis ragam dan diikuti dengan Uji Duncan's (pada taraf 5%) jika terdapat perbedaan yang nyata. Hasil penelitian menunjukkan perlakuan terbaik (berdasarkan sifat fisiko kimia es krim), adalah proporsi *ice cream mix*:yoghurt (60:40) dan konsentrasi xanthan gum (0.2%) yang mempunyai total BAL 8,55 log CFU/ml; pH 5,33; total asam tertitrisasi 0,46%; overrun 27,67%; kecepatan meleleh 13,51 menit/10 gr; total padatan terlarut 31,00 °Brix; dan viskositas 517,00 mPas.

Kata kunci: es krim yoghurt; uwi ungu; sinbiotik; xanthan gum

Article Information

Article Type: Short Communications
and Notes
Journal Type: Open Access
Volume: 3 Issue 2

Manuscript ID
V3n2885-1

Received Date
15 September 2021

Accepted Date
16 January 2022

Published Date
01 March 2022

DOI: 10.33555/jffn.v3i2.82

Corresponding author:

Rosida
Surabaya, Indonesia, 60294
Email:
rosidaupnjatim@gmail.com

Citation:

Rosida., Sarofa, U., Wardani,
R.R.R.P. 2022. The
characteristics of synbiotic
yoghurt ice cream made from ice
cream mix and purple yam
yoghurt (*Dioscorea alata*). J.
Functional Food &
Nutraceutical, 3(2), pp.57-62

Copyright: ©2022 Swiss German
University. This is an open-access article
distributed under the terms of the Creative
Commons Attribution 4.0 International
License, which permits unrestricted use,
distribution and reproduction in any medium,
provided the original author and source are
credited.

INTRODUCTION

Synbiotic yoghurt ice cream is a kind of ice cream made from ice cream mix and synbiotic yoghurt as the main ingredient. Synbiotic yoghurt is made by combining probiotic bacteria and prebiotic agents (Puspitasari et al., 2015). Making yoghurt ice cream is done by mixing yoghurt and ice cream mix (ice cream dough) then frozen (Goff and Hartel, 2013). In this study, synbiotic yoghurt was made by mixing milk and purple yam filtrate as a source of prebiotics and lactic acid bacteria as a source of probiotics (Rosida, et al., 2019).

Winarti (2010) stated that purple yam (*Dioscorea alata*) contains prebiotic agent in the form of inulin. In the large intestine, inulin undergoes fermentation due to the activity of the microflora contained in the large intestine so that it has positive implications for body health (Widowati, 2005). Based on the research of Maryati et al. (2016), *L. acidophilus* FNCC0051 was able to utilize inulin better than other lactic acid bacteria. Thus, in this study, the probiotic bacteria *L. bulgaricus* was used, besides *S. thermophilus* and *L. acidophilus*.

The characteristics of yoghurt ice cream can be influenced by the proportion or addition of yoghurt to the ice cream mix. According to Soukolis and Tzia (2008) the mixed yoghurt ranges from 5-70% of the volume of the ice cream mix. The addition of yoghurt to the ice cream mix resulted in the texture of the yoghurt ice cream being rough, so it was necessary to add a stabilizer to overcome this problem. The stabilizer serves to increase the thickness of the dough, prolong the melting rate, improve the texture and reduce the formation of large ice crystals, with the presence of a stabilizer making the dessert smoother and softer (Goff and Hartel, 2013).

Research by Soukolis and Tzia (2008) revealed that the use of xanthan gum 0.2% in yoghurt ice cream was the best treatment compared to guar gum and Carboxymethyl Cellulose (CMC). Based on this, this research study the production of synbiotic yoghurt ice cream made by the proportion of ice cream mix:yoghurt and the

concentration of xanthan gum.

MATERIALS AND METHOD

The materials used for the research were purple yam obtained from farmers in Nganjuk, ice cream mix (consists of milk, skim milk, sucrose), xanthan gum, yoghurt starter mix (consists of *L. bulgaricus*, *S. thermophilus* and *L. acidophilus*) obtained from the Faculty of Science and Technology-Airlangga University.

The equipments used for the research are analytical balance, blender, refrigerator, mixer, ice cream maker, pan, stirrer, measuring glass, knife, filter cloth, thermometer, laminar air flow, incubator.

Making purple yam synbiotic yoghurt

The purple yam filtrate was made by crushing the purple yam (purple yam: water = 1:4 (w/v)) using blender. The juice was filtered using filter cloth to obtain the purple yam filtrate. Heating the filtrate at a temperature of 80°C for 15 minutes while stirring continuously. Milk was pasteurized at 80°C for 15 minutes and mixed with purple yam filtrate (50:50) (v/v), 10% skim milk (w/v) and 5% sugar (w/v). The medium was then cooled down to 40°C. Yoghurt starter (*S. thermophilus*: *L. bulgaricus*: *L. acidophilus* =1:1:1) was inoculated (5%) in the medium (v/v), and then incubated at 37°C for 18 hours. (Rosida et al., 2019)

Making synbiotic yoghurt ice cream

Making ice cream mix is done by heating milk, 10% skim milk (w/v), 18% (w/v) sugar to a temperature of 45°C, then added xanthan gum according to treatment (0.1%; 0.2 % ; 0.3%) (w/v). Then pasteurization (temperature 85°C for 10 minutes), homogenization, and aging (temperature 4°C for 12 hours). Then mixed ice cream mix and purple yam synbiotic yoghurt according to treatment (70:30 ; 60:40 ; 50:50) and processed using an ice cream maker for 30 minutes, and frozen of the ice cream (temperature -10°C for 24 hours) (Venkateshaiah et al., 1997). The ice cream yoghurt was directly analyzed for Total LAB by Total Plate Count Method (Fardiaz, 1992), pH (SNI, 2009) , overrun

(Zahro and Fithri, 2015), melting time (Zahro and Fithri, 2015), total soluble solid (SNI, 2009), and viscosity (Zahro and Fithri, 2015).

RESULTS AND DISCUSSION

Analysis of purple yam synbiotic yoghurt

Table 1. Average of chemical composition of purple yam synbiotic yoghurt

Parameter	Analysis Results
Total lactic acid bacteria (logCFU/ml)	9.31±0.137
pH	4.53±0.05
Total acid (%)	1.15±0.041
Total soluble solid (°Brix)	13.83±0.764
Inulin content (%)	0.54±0.010
Dietary fiber content (%)	1.51±0.437

Table 1. Showed that total lactic acid bacteria in accordance with the requirements of SNI yoghurt which requires a minimum of 10^7 CFU/ml starter or 7 logCFU/ml. Gustaw et al., (2011) stated that the activity of lactic acid bacteria will increase when added with prebiotics. The prebiotics found in water yam are able to stimulate the growth of probiotic bacteria found in yoghurt, it will increase the number of probiotic bacteria (Andriyani et al., 2013).

Characteristics of purple yam synbiotic yoghurt ice cream

Table 2. Showed that the average total LAB of yoghurt ice cream was not significantly different, which ranged from 8.54-8.63 logCFU/ml. This was because in the process of making ice cream there was no further fermentation, so that the treatment with different proportions produced almost the same total LAB. This was in accordance with the research of Pangga et al. (2018) and Baay et al. (2018), which stated that the addition of yoghurt in yoghurt ice cream production resulted in LAB populations that were not significantly different.

Table 2. The average value of the total lactic acid bacteria and ph of yoghurt ice cream from the treatment of the proportion of ice cream mix: yoghurt and xanthan gum concentration

Treatment		Total LAB (log CFU/ml)*	pH*
Ice cream mix : yoghurt	Xanthan gum (%)		
70:30	0.1	8.55 ±0.073	5.47 ±0.115
	0.2	8.55 ±0.069	5.53 ±0.115
	0.3	8.54 ±0.068	5.57 ±0.058
60:40	0.1	8.63 ±0.053	5.30 ±0.100
	0.2	8.56 ±0.004	5.33 ±0.058
	0.3	8.54 ±0.058	5.43 ±0.058
50:50	0.1	8.63 ±0.019	5.20 ±0.100
	0.2	8.61 ±0.068	5.23 ±0.115
	0.3	8.59 ±0.011	5.27 ±0.058

Note: *The average value in the same column showed no significant difference at $p \leq 0.05$

Table 2. Revealed that the lower the proportion of ice cream mix or the higher the proportion of yoghurt, the lower the pH of yoghurt ice cream. The yoghurt used in this study had a pH of 4.53. This was in accordance with Pangga et al. (2014) The pH of yoghurt ice cream was influenced by the proportion of yoghurt used as the main ingredient in making yoghurt ice cream.

Table 3. Showed that the lower the proportion of ice cream mix or the higher the proportion of yoghurt and the higher ice cream overrun, however the the higher xanthan gum concentration, the lower the yoghurt ice cream overrun. Mahdian et.al. (2012) stated that the lactic acid present in yoghurt lowered the pH of the yoghurt ice cream dough so that it clumps the protein contained in the yoghurt ice cream dough. The clumping increases the viscosity of the yoghurt ice cream dough, so that during the agitation process, the dough cannot expand optimally which results in low product overrun. Purwadi (2019) added that protein solubility decreases when the pH reaches 4.5-5.4 (isoelectric pH) then the protein would coagulate.

The higher the xanthan gum concentration, the lower the overrun and the longer the melting time of ice cream. This is because xanthan gum would bind to water thereby preventing the formation of large ice crystals and slowing down the melting

time. The increase in the concentration of xanthan gum caused the dough becomes thicker so that the binding power to water is stronger so that the yoghurt ice cream did not melt quickly. Goff and Hartel (2013) stated that the stabilizer would increase the viscosity of ice cream so that the

resulting ice cream had low overrun and soft texture due to the formation of small ice crystals and slow melting time. Goff and Hartel (2013) stated that good quality of melting time for ice cream ranges from 15- 20 minutes.

Table 3. The average of overrun, melting time, total dissolved solids and viscosity of yoghurt ice cream

Treatment		Overrun (%)	Melting time (min/10 g)	Total soluble solid (°Brix)	Viscosity (mPas)
Ice cream mix : yoghurt	Xanthan gum (%)				
70:30	0.1	27.69 ^a ±0.541	13.51 ⁱ ±0.060	31.00 ^d ±0.000	490.00 ⁱ ±2.598
	0.2	27.08 ^a ±0.541	14.23 ^h ±0.053	31.17 ^e ±0.289	512.83 ^h ±2.566
	0.3	26.81 ^b ±0.130	15.54 ^g ±0.127	33.00 ^f ±0.000	545.50 ^g ±1.803
60:40	0.1	25.33 ^c ±0.577	15.53 ^f ±0.032	26.67 ^c ±1.155	553.33 ^f ±1.041
	0.2	24.05 ^c ±0.820	16.33 ^e ±0.010	28.67 ^d ±0.577	566.67 ^e ±3.329
	0.3	23.34 ^c ±0.649	16.51 ^d ±0.020	30.17 ^d ±0.289	571.17 ^d ±0.289
50:50	0.1	22.51 ^d ±0.493	17.36 ^c ±0.021	23.33 ^a ±0.577	575.50 ^c ±0.500
	0.2	20.39 ^e ±0.907	19.22 ^b ±0.012	24.50 ^a ±0.500	579.17 ^b ±1.143
	0.3	18.88 ^f ±0.467	21.43 ^a ±0.115	25.00 ^b ±0.000	604.50 ^a ±4.093

Note: The average value in the same column followed by different notations showed a significant difference at $p \leq 0.05$

Table 3 showed the higher the proportion of ice cream mix or the lower the proportion of yoghurt and the higher the concentration of xanthan gum, the higher the melting time, viscosity and total dissolved solids of yoghurt ice cream. Mahdian et al. (2012) stated that yoghurt added to yoghurt ice cream dough has a low pH causing protein clumping so that the dough becomes thicker and difficult to trap air causing increased viscosity, decreased yoghurt ice cream overrun and ice cream did not melt easily. Goff and Hartel (2013) stated that high acidity in ice cream would increase the viscosity and the melting time of ice cream would be longer. Besides that, the addition of stabilizer would increase the viscosity and total dissolved solids. Agustina et al. (2019) stated the mechanism of xanthan gum as a stabilizer, namely the hydroxyl group on xanthan gum would absorb water thereby increasing viscosity. The study revealed that the best treatment is the proportion of ice cream mix:yoghurt 60:40 and xanthan gum concentration 0.2% because it had the highest overrun and total LAB 8.63 logCFU/ml which had met minimum LAB (7.0 logCFU/ml) in yoghurt standard (SNI 2981-2009)

CONCLUSION

The results showed that the best treatment, based on physicochemical properties of ice cream, was the proportion of ice cream mix:yoghurt treatment 70:30 with a concentration of 0.1% xanthan gum, that produced purple yam synbiotic yoghurt ice cream with total LAB of 8.55 logCFU/ml; overrun 27.69%; melting time 13.51 min/10gr; total dissolved solids 31.00°Brix; viscosity 517.00 mPas.

REFERENCES

- Agustina, M., Fahrizal dan Indarti, E. 2019. Penambahan CMC, Gum Xanthan, dan Pektin Sebagai Stabilizer Pada Sirup Air Kelapa. *Jurnal Ilmiah Mahasiswa Pertanian Unsyiah*. 4 (2), pp.266-273.
- Arbuckle, W.S. and Marshall, R.T. 2000. *Ice Cream*. 5th ed New York: Chapman And Hall
- Azhar, M. 2009. Inulin Sebagai Prebiotik. *SAINSTEK*. XII(1), pp.1-8.

- Baay, M.G. Ramirez, M.A.J.R. and Gorne, A.S.C. 2018. Product Optimization of Yoghurt Ice Cream Flavored With Fermented Cacao Butter (*Theobroma cacao* L.). *Journal of Science, Engineering and Technology* 6, pp.137-148.
- Budhiarto, S. 2003. Pengaruh Lama Pengukusan dan Sistem Pengeringan (Kabinet dan Vakum) Terhadap Kualitas Tepung Ubi Ungu Jepang. Skripsi. Malang: Universitas Brawijaya.
- Chotimah, S.C. 2009. Peranan *Streptococcus thermophilus* dan *Lactobacillus bulgaricus* Dalam Proses Pembuatan Yoghurt. Review. *Jurnal Ilmu Peternakan*. 4(2), pp.47-52.
- Ezeocha, V.C. and Ojmelukwe, P.C. 2012. The impact of cooking on the proximate composition and anti-nutritional factors of water yam (*Dioscorea alata*). *Journal of Stored Products and Postharvest Research*. 3(13), pp.172–176.
- Fardiaz, S. 1992. *Mikrobiologi Pangan I*. Jakarta: Gramedia Pustaka Utama.
- Franck, A. and De Leenher, L. 2005. *Polysaccharides and Polyamides in The Food Industry*. 1st ed. Weinherim: Wiley-Vch.
- Goff, H.D. and Hartel, R.W. 2013. *Ice Cream*. 7th ed. New York: Springer.
- Gustiani, S., Helmy, Q., Kasipah, C. and Novarini, E. 2017. Produksi dan Karakterisasi Gum Xanthan dari Ampas Tahu Sebagai Pengental Pada Proses Tekstil. *Arena Tekstil*. 32(2), pp.51-58.
- Jannah, A. M., Legowo, A. M., Pramono, Y.B., Al-Baari, A.N., dan Abduh, S.B.M. 2014. Total Bakteri Asam Laktat, Ph, Keasaman, Citarasa dan Kesukaan Yoghurt Drink dengan Penambahan Ekstrak Buah Belimbing. *Jurnal Aplikasi Teknologi Pangan*. 3(2), pp.7-11.
- Kailasapathy, K. 2002. Microencapsulation of Technology and Potential Applications. *Curr. Issues Intest. Microbiol*. 3, pp.39-48.
- Korengkeng, A.C., Yelnetty, A., Hadju, R. dan Tamasoleng, M. 2020. Kualitas Fisikokimia dan Mikrobial Yoghurt Sinbiotik yang Diberi Pati Termodifikasi Umbi Ungu (*Dioscorea alata*) dengan Level Berbeda. *Zootec*. 40(1), pp.124-133.
- Mahdian, E., Tehrani, M.M. and Nobahari, M. 2012. Optimizing Yoghurt-Ice Cream Mix Blend in Soy Based Frozen Yoghurt. *J. Agr. Sci. Tech*. 14, pp.1275-1284.
- Maryati, Y., Nuraida, L. dan Hariyadi, R. D. 2016. Kajian Isolat Bakteri Asam Laktat Dalam Menurunkan Kolesterol Secara *in vitro* dengan Keberadaan Oligosakarida. *AGRITECH*, 36(2), pp.196-205.
- Mudannayake, D.C., Wimalasiri, K.M.S., Silva, K.F.S.T. and Ajlouni, S. 2015. Selected Sri Lankan Food Plants and Other Herbs as Potential Sources of Inulin-Type Fructans. *J. Natn. Sci. Foundation Srilanka*. 43(1), pp.35-43.
- Mulyani, T., Sudaryati dan Susanto, A. 2013. Kajian Peran Susu Skim dan Bakteri Asam Laktat Pada Minuman Sinbiotik Umbi Bengkuang (*Pachyrrhizus erosus*). *Jurnal Teknologi Pangan*. 5(1), pp.76-100.
- Mustika, S., Yasni, S. dan Suliantari. 2019. Pembuatan Yoghurt Susu Sapi Segar dengan Penambahan Puree Ubi Jalar Ungu. *Jurnal Pendidikan Teknologi Kejuruan*. 2(3), pp.97-101.
- Ochoa, F.G., Santos, V.E., Casas, J.A. and Goamez, E. 2000. Research Review Paper Xanthan Gum: Production, Recovery, and Properties. *Biotechnology Advances*. 18, pp.549-579.
- Padaga, M. dan Sawitri, M.E. 2015. *Es Krim Yang Sehat*. Surabaya: Trubus Agrisarana.
- Pangga, N. R., Rossi, E. dan Rahmayuni. 2014. Penggunaan Whipping Cream Es Krim . *JOMFAPERTA*. 1 (1).

- Purwadi. 2019. *Ilmu Dan Teknologi Pengolahan Keju*. Malang : UB Press.
- Puspitasari, D., Radiati, L.E. dan Thohari, I. 2015. Pengaruh Lama Simpan Es Krim Yoghurt Sinbiotik dengan Penambahan Pati Ubi Cilembu Terhadap Viskositas, Ekspolisakarida, dan Total Padatan. Malang : Universitas Brawijaya.
- Ramadhan, K., Atmaka, W. dan Widowati, E. 2015. Kajian Pengaruh Variasi Penambahan Xanthan Gum Terhadap Sifat Fisik dan Kimia Serta Organoleptik Fruit Leather Kulit Buah Naga Daging Super Merah (*Hylocereus costaricensis*). *Jurnal Teknologi Hasil Pertanian*. 8(2), pp.115-122.
- Rini, A.S. 2019. Pasar Indonesia Menjanjikan Produsen Es Krim Bermunculan. [diakses tanggal 5 Maret 2020]. <https://ekonomi.bisnis.com/read/20190411/9/910680/pasar-indonesia-menjanjikan-produsen-eskrim-bermunculan>.
- Rosida dan Santi, S.S. 2019. Pengembangan produk yoghurt dan es krim sinbiotik uwi ungu (*Dioscorea alata* var *purpurea*) sebagai pangan fungsional. *Laporan Penelitian Riset Inovasi dan Penerapan Ipteks*. Surabaya : LPPM UPN Veteran Jawa Timur.
- Sawitri, M.E. dan Sari, E.P. 2020. Prospek Frozen Yoghurt Sinbiotik Fortifikasi Dengan Ekstrak Kulit Buah Naga Merah (*Hylocereus polyrhizus*) dan Fruktosa, Mendukung Gaya Hidup Sehat Pasca Pandemi Covid-19. *Prosiding Seminar Teknologi Dan Agribisnis Peternakan VII, Purwokerto*.
- SNI. 1995. SNI 01-3713-1995. Es Krim . Jakarta : Badan Standarisasi Nasional.
- SNI. 2009. SNI 2981-2009. Yoghurt. Jakarta : Badan Standarisasi Nasional.
- Soukolis, C. and Tzia, C. 2008. Impact of the Acidification Process. Hydrocolloids and Protein Fortifiers on the Physical and Sensory Properties of Frozen Yoghurt. *International Journal of Dairy Technology*, 61 (2):17-177.
- Widodo, W. 2002. Bioteknologi Fermentasi Susu. Pusat Pengembangan Bioteknologi. Universitas Muhammadiyah, Malang.
- Widowati, S., Sunarti, T.C. dan Zaharani, A. 2005. Ekstraksi. Karakterisasi. dan Kajian Potensi Prebiotik Inulin dari umbi Dahlia (*Dahlia pinnata* L.). *Prosiding Seminar Rutin Puslitbang Tanaman Pangan, Bogor*.
- Winarti, S. 2010. Makanan Fungsional. Surabaya: PT. Graha Ilmu.
- Venkateshaiah, B.V., Atmarara, K., and Gireesh, T. 1997. Development of a Frozen Yoghurt Dessert of Sensory Acceptability. *Tropical Agricultural Research*. 9, pp.62-68.
- Zahro, C., dan Fithri, C.N. 2015. Pengaruh Penambahan Sari Anggur (*Vitis vinifera* L.) Terhadap Karakteristik Fisik, Kimia Dan Organoleptik Es Krim. *Jurnal Pangan dan Agroindustri*. 3(4), pp.1481-1491