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The effect of fermented sweet potato flour supplementation on the characteristics of ambon banana yoghurt

Abstract

Starch can be added to yogurt to improve its body and texture, specially to increase viscosity and reduce syneresis. Starch utilization in a product can be done in the form of flour containing the main component of the starch. This study aims to determine the concentration of fermented sweet potato flour (FSPF) to produce the best quality characteristics of Ambon banana yogurt, significantly reducing syneresis and retain sensory yogurt. In this research, three levels of fermented sweet potato flour (0, 1, and 2 %) with three replicates were considered. The results showed that fermented sweet potato flour affects the quality characteristics of Ambon banana yogurt, and FSPF supplementation is proven to reduce syneresis. The best characteristics of yogurt are found in fermented sweet potato flour concentration of 2%, which produces a viscosity of 3400 cP, protein content of 3.72%, and fat content of 4.45%; syneresis 3.97%; total dissolved solids was 18.77%, and the sensory score was around four or like.

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Neti Yuliana, Ahmad Sapta Zuidar, Nadia Andina Putri Arpani
Department of Agro-industrial Product Technology, Faculty of Agriculture, University of Lampung, Indonesia

Correspondence: Neti Yuliana, Department of Agro-industrial Product Technology, Faculty of Agriculture, University of Lampung, Bandar Lampung 35145, Indonesia, Email neti.yuliana@fp.unila.ac.id

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Introduction

Yogurt is the refreshing drinks beneficial for health which is made by fermenting milk using lactic acid bacteria (LAB) such as *Lactobacillus bulgaricus* and *Streptococcus thermophillus*.[1] It can be combined with prebiotic sources to produce a product that benefits consumers since they encourage the growth of good bacteria in the intestine and result in low-calorie food.[2] Seydin et al.[3] research also showed that adding prebiotic sources to yogurt can produce a soft flavor and texture and is preferred by panelists. Bananas contain about 0.3% fructo-oligosaccharide, which can be used as a source of prebiotics, making them essential and influential in making yogurt.[4] Several studies on banana fruit yogurt have been carried out, including synbiotic yogurt based on Ambon banana puree and fruit yogurt extract from Ambon banana peel.[5–7] Research by Zulaikha & Fitria[5] shows that the addition of Ambon banana puree has a significant effect on sensory yogurt.

Consumer acceptance of banana yogurt is assessed in terms of taste, texture, color, distinctive aroma, and stability of the yogurt. So far, banana yogurt products often experience problems with their physical properties, namely syneresis. The cause of syneresis is due to the low level of viscosity and decreased ability to hold water during storage and transportation. Yogurt texture instability can be overcome by adding a stabilizer. The primary purpose of adding a stabilizer to yogurt is to increase and maintain the desirable characteristics of yogurt, such as improving texture, mouthfeel, and appearance, as well as to significantly reduce syneresis.[8–10] Starch, mainly corn starch, is one of the stabilizing groups besides pectin, guar gum, cellulose derivatives, sea wood extracts, and gelatin.[11] Starch addition to yogurt improve its body and texture, increase viscosity and firmness, improve mouthfeel, reduce syneresis, and generally make yogurt more appetizing.[11] So far, the use of starch in yogurt has been carried out, such as cassava starch sago starch in soy flour yogurt and sweet potato starch.[12–15] The composition, structure, arrangement, and crystallization of starch from different sources produce different functional and quality characteristics so when applied, it will produce differences in quality in the final product.[16]

Starch utilization in a product can be done in the form of starch directly or in the form of flour containing the main component of the starch. Application in the flour form is expected to get the benefits of starch, obtaining the benefits of prebiotic sources from the fiber contained in the flour. El-Attar et al.[17] reported that sweet potato flour (SPF) supplementation increased the rheological properties of yogurt. In this study, the application of sweet potato starch in the form of fermented sweet potato flour (FSPF) was carried out in the manufacture of Ambon banana yogurt. Fermentation cause SPF has better functional properties, such as increased viscosity and resistance to acids and heat, as well as increased water-holding capacity as a consequence of the modification of sweet potato starch by LAB during fermentation.[18,19] Fermented sweet potato flour (FSPF) can be applied to products that require a thickening agent, such as in making yogurt. In Ambon banana yogurt, the best results of fermented sweet potato starch supplementation are unknown; therefore, it is necessary to conduct this research to obtain the best quality characteristics of yogurt. This study aims to determine the concentration of fermented sweet potato flour, which produces the best characteristics of Ambon banana yogurt, significantly reducing syneresis and retain sensory yogurt.

Method and material

The main ingredients used in this study were Ambon bananas obtained from the local market, fermented yellow sweet potato flour obtained from the agricultural microbiology laboratory, University of Lampung, commercial pasteurized cow's milk, skimmed milk, granulated sugar, and yogurt starter from the new plain commercial yogurt.

Research methods

Making banana juice

Making banana juice follows Nita and Titik's[20] procedure with a few modifications. Ripe Ambon bananas, with a maturity color index of 3, were peeled and cut into several pieces, then blanched at 90ºC for 5 minutes. After that, the banana pieces were cooled to a temperature of 25ºC. Ambon banana pieces and water were mixed with a ratio of water: banana = 4: 1, was then crushed using a blender until smooth. Furthermore, a filter separates the banana slurry by dregs and juice. Ambon banana juice is ready to use in yogurt making.

Making yogurt

Eighty ml of fresh cow's milk was prepared in a 150 ml glass jar. To the glass jar, FSPF with concentrations according to the research

treatment (0%, 1%, and 2%) was added. Likewise, 8 % Ambon banana extract, 5% skimmed milk and 5% sugar. The milk mixture was then homogenized with the help of a vortex and then pasteurized in a water bath at 90ºC for 15 minutes, then cooled down to 43ºC. Furthermore, as much as 2.5% (v/v) (± 7.2 CFU/ml) of yogurt starter was aseptically added, and the mixture was again homogeneous by a vortex. Furthermore, the inoculated milk was incubated for 18 hours at 37ºC until Ambon banana yogurt was produced.

Observation of pH, syneresis and TSS

Measurement of the pH value used a pH meter pH-009i (China) which was previously calibrated using two buffer solutions representing low pH (4.00) and high pH (7.00).[21,22] Syneresis measurements using the centrifugation method followed the procedure by Rauf and Sarbini.[22] A total of 15 g of sample was centrifuged (3500 rpm, 10 minutes), and the supernatant was then separated from the gel and weighed. The ratio of the weight of the yogurt liquid and gel multiplied by one hundred is the percentage of syneresis. Measurement of total dissolved solids (TSS) using a Hand Refractometer (0-30ºBrix), following the procedures of SNI 01-3546, 2004.

Sensory test

A sensory test was carried out using a hedonic test. The sensory test was carried out by a group of 25 semi-skilled panelists, agricultural technology students from Lampung University's Faculty of Agriculture. Random samples in coded containers are given to subjects. A 5-like rating for hedonic acceptability were all taken into consideration during the scoring of color, aroma, taste, texture and overall acceptance.

Viscosity, protein content and fat content

Viscosity measurements, protein, and fat levels were tested on the best-treated samples. Yogurt viscosity or thickness using a Viscotester brand Rion VT-04F (Japan). Analysis of protein content using the Kjeldahl method while fat content was analyzed using the soxhlet method.

Result and discussion

Value of pH, syneresis, and TSS of ambon banana yogurt

The results showed that adding FSPF had no significant effect on pH before and after fermentation, slightly increasing TSS, but significantly reduce syneresis from 21.17% to 3.97% (Table 1).

Tabel 1 pH, syneresis and TSS of yoghurt as affected by FSPF addition

	pH			
Concentration of FSPF	**Initial**	**After fermentation**	**Syneresis (%)**	**TSS (ºBrix)**
0 %	6.49±0.08	4.55±0.00	21.17±0.0	17.08±0.00
1%	6.49±0.07	4.51±0.18	6.56±0.94	17.88±0.11
2%	6.46±0.12	4.47±0.09	3.97±0.69	18.77±0.76

The yogurt starter contains LAB *Lactobacillus bulgaricus* and *Streptococcus thermophillus*, commonly used in making yogurt. Fermentation of milk into Ambon banana yogurt by this starter has been going well, which is marked by a decrease in the pH of the yogurt as an effect of total acid production by LAB starter yogurt. The addition of FSPF has a lower pH tendency than yogurt without the addition of FSPF. The starch contained in FSPF is thought to increase the amount of LAB carbon source nutrients. Compared to plain yogurt, adding polysaccharides, primarily starches, can significantly increase its acidity.[23] The increase in acidity is due to the probiotic bacteria's rapid conversion of lactose into lactic acid due to their excessive proliferation and survival. In addition, FSPF contains fiber, which can act as a prebiotic for LAB. Good yogurt has a pH of 3.80-4.60 thus, the pH of Ambon banana yogurt produced in this study follows the pH of yogurt in general.

Adding FSPF reduced syneresis, where a concentration of 2% produced lower than concentration of 1%. The addition of FSPF reduced by as much as 17.27% compared to the control. This data shows that the FSPF, one of which contains starch, acts as a stabilizer in a product to increase the viscosity so that slight whey separation occurs. The research results by Purnamasari et al.[24] showed that adding 4% crosslinked sweet potato-modified starch could reduce syneresis by 18.40%. FSPF, besides containing starch, also contains crude fiber. Fibers have a high capacity to bind water, lowering the syneresis proportion by capturing the gel structure's free water. By delaying free water flow in the structure, dietary fiber can act as a stabilizer in yogurt. The concentration of fermented sweet potato flour slightly affected the TSS of Ambon banana yogurt. Yogurt with a concentration of 2% FSPF produced the highest TSS, 18.77ºBrix, compared to yogurt without fermented sweet potato flour, 17.083ºBrix. The increase in the TSS of yogurt, along with the amount of FSPF, is a contribution from the content of starch, sugar, fiber, and other constituents contained in the FSPF. Taufik et al.[15] reported that the addition of purple sweet potato flour had the effect of increasing the total yogurt solids by 10ºBrix. According to Lebot[25] sweet potatoes contain total sugars from 17.83 to 27.77% on a fresh-weight basis.

Sensory yoghurt

Sensory values heavily influence product quality evaluation as the most critical and significant factor influencing consumer perceptions. The sensory test on Ambon banana yogurt uses the hedonic method with attributes including color, aroma, taste, texture and overall acceptance. The sensory test results of Ambon banana yogurt supplemented with FSPF are presented in Table 2. The concentration of fermented sweet potato flour did not affect the sensory score for color, aroma, and overall acceptance of Ambon banana yogurt, which was still in the range of score 4 (liked). However, it affected decreasing the taste score and increased in Ambon banana yogurt texture score.

Table 2 The effect of adding FSPF on the Ambon banana yogurt sensory score

Concentration of SPF	Color	Aroma	Taste	Texture	Overall acceptance
0%	4.20±0.02	3.71±0.00	3.76±0.00	3.43±0.02	3.72±0.01
1%	3.98±0.06	3.58±0.05	3.59±0.08	3.49±0.08	3.61±0.07
2%	3.88±0.09	3.56±0.06	3.49±0.09	3.67±0.14	3.55±0.07

Color is the main factor that most often determines the acceptability of products, including yogurt. The addition of FSPF did not affect the color of the yogurt, and the score still being preferred. However, there was a tendency to decrease, as well as what happened to the aroma and taste attributes. Banana Ambon yogurt without fermented sweet potato flour produces a white color like yogurt in general or plain yogurt. Meanwhile, yogurt, adding 1% and 2% fermented sweet potato flour, produced a slightly yellowish-white color. The SPF flour used comes from yellow sweet potatoes, which contain carotene, which causes the color of the yogurt to be slightly yellowish so that the yogurt is slightly different from a commercial yogurt. On the aroma attribute, there was a tendency to decrease the aroma and taste scores as an effect of adding FSPF, which was a contribution from the flavor of FSPF that give a tart and tangy flavor. Comments from the panelists regarding the aroma of the Ambon banana yogurt included sourness (a typical yogurt aroma) and the aroma of bananas. Sweet potato volatile compounds were detected as families of alkenes (of which the majority were sesquiterpenes), alcohols, aldehydes, ketones, and esters. During fermentation, the concentrations of alkenes and ketone alcohols and esters were increased; while the concentrations of aldehydes decreased.[26] According to Schornburn[27]

yogurt has a distinctive flavor and taste due to the presence of lactic acid, acetaldehyde, and diacetyl. In terms of texture, the addition of FSPF increased the preference score for the texture of Ambon banana yogurt. The addition of 2% FSPF makes the texture of the yogurt more compact, so it is preferred. On the overall acceptance attribute, the addition of FSPF can still maintain the level of panelist preference in score 4 (liking). However, there is a tendency to a slightly decrease the value of the score with increasing concentration of FSPF added to Ambon banana yogurt.

Viscosity, protein, and fat content of selected yogurt

The best treatment of Ambon banana yogurt is determined based on the pH value based on the smallest syneresis value as a critical point of the quality of the yogurt product. Therefore, the treatment with a FSPF concentration of 2% was selected as the best banana yogurt, which was further tested for its viscosity, protein, and fat content, presented in Table 3.

Table 3 Viscosity, protein and fat content of banana yogurt with 2% SPF treatment

Parameter	Value
Viscosity	3400 cP
Protein content	3.72% (wb)
Fat content	4.45% (wb)

wb = wet basis

In yogurt production, starch is used as a stabilizer agent, which among other things, functions to bind water, thereby increasing the viscosity of yogurt.[28] Fennema[29] stated that the addition of stabilizers such as starch causes an increase in the hydrophilic properties of proteins so that their ability to bind water increases. Banana yogurt with an FSPF of 2% has a viscosity of 3400 cP. This value is comparable with the viscosity of yogurt (4852 mPas) reported by El-Attar et al.[17] and lower than the results of Jannah's research (2013) in whole fat yogurt with the addition of 2% sago starch stabilizer (viscosity of 7.05 P). The viscosity can be affected by temperature, the concentration of ingredients, stabilizers, carbohydrates, salt-colloidal salt, mixed protein, and the type of heating used.[30] The thickener concentration increases the water binding capacity so that the viscosity results will be higher. The protein content of Ambon banana yogurt supplemented with SPF is 3.72%. According to SNI 01-2981[31] this value meets the quality requirements. The protein content of yogurt is at least 2.7%. The yogurt protein content is determined by the quality of the essential ingredients of yogurt, namely cow's milk, which contains 3.5% protein.[32] In addition to protein, milk, as the primary raw material for yogurt, also contains fat, which contributes to the fat content of yogurt. The fat content of Ambon banana yogurt supplemented with FSPF is 4.45%. Based on SNI 01-2981 the fat content of yogurt is at least 3.0%, while in low-fat yogurt, it is 0.6-2.9%, and in nonfat yogurt, it is a maximum of 0.5%. Thus, Ambon banana yogurt's fat content has met SNI's requirements.

Conclusion

Ambon banana yogurt's qualitative attributes are influenced by the amount of FSPF, and supplementing with FSPF has been shown to lessen syneresis. The yogurt's best qualities are found in 2% FSPF supplementation. Thus, it has the potential to be recommended as a stabilizer for the production of yoghurt.

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Conflicts of interest

The authors declare that there is no conflicts of interest.

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