Vol 9 No. 1 (2024) 100-109 ISSN (Online) : 2502-0943

Jurnal Katalisator

LACTIC ACID BACTERIES (LAB) OF YOGHURT ADDED WITH DAHLIA (*Dahlia pinnata* L) TUBER INULIN DECREASE

Widia Dara[1], Alya Misdhal Rini[2], Intan Dwi Permata Sari[3]

[1,2,3,] Fakultas Ilmu Kesehatan, Universitas Perintis Indonesia, Batipuh Panjang, Kec. Koto Tangah, Kota Padang, Sumatera Barat 25586

Email: widia.dara@upertis.ac.id

Detail Artikel

Diterima : 19 Desember 2023
Direvisi : 14 April 2024
Diterbitkan : 8 Mei 2024

Kata Kunci

Yogurt
Sinbiotik
Inulin Umbi Dahlia
Sifat Fisikokimia

Penulis Korespondensi

Name : Widia Dara
Affiliation : Universitas Perintis Indonesia
E-mail : widia.dara@upertis.ac.id

A B S T R A C T

Yogurt is a functional food product that contains probiotic bacteria. The functional value of yogurt can be enhanced by the addition of inulin from dahlia flower tubers, which has prebiotic content. Inulin is a water insoluble fiber. The purpose of this study was to analyze the organoleptic quality of yogurt added with dahlia flower tuber inulin and its physico-chemical properties. Experimental research type. There were three treatments in this study, namely the addition of dahlia flower inulin as much as 3, 5, and 7% and one control. Krusskall Wallis test was conducted to see the treatment differences in color, aroma, texture and taste of yoghurt. Objective observations included pH measurement, lactic acid content, LAB count and glucose test. Organoleptic test results showed that the most preferred yogurt in terms of color and texture was yogurt without the addition of inulin. The most preferred yogurt flavor and aroma was yogurt with 7% inulin added from dahlia flower tubers. The Krusskall Wallis test results showed no difference in all treatments on the color, aroma, texture, and taste of yogurt. There was no effect of adding inulin from dahlia flower tubers on organoleptic quality. Yoghurt added with 7% inulin at pH level, glucose test, lactic acid content, and lactic acid content increased. Total LAB decreased. Yogurt with 7% inulin added met SNI standards.

http://doi.org/10.22216/jk.v5i2.5717
Published by LLDIKTI Wilayah X

Jurnal Katalisator Vol 9 No. 1 (2024) 100-109

INTRODUCTION

Yogurt is a dairy product obtained from fermented milk using lactic acid bacteria *Lactobacillus bulgaricus* and *Streptococcus thermophilus*, other suitable bacteria can be added (BPOM, 2019). Yogurt is the oldest fermented milk product and is known in various parts of the world. Yogurt is fermented from two Lactic Acid Bacteria (LAB) as a starter, namely *Lactobacillus bulgaricus* and *Sterptococcus thermophillus* bacteria that live together. This yogurt is also known as plain yogurt (Jonathan et al, 2022). The fermentation process reduces the pH level in yogurt which results in a sour taste in yogurt, the sour taste is the hallmark of yogurt. In addition to decreasing pH levels, it can also produce acetic acid, acetal dehyde, and also other materials that evaporate. The general composition of yogurt is 4-6% protein, 0.1-1% fat, 2-3% lactose, 0.6-1.3% lactic acid, pH 3.8-4.6% (Prasetyo, 2017).

Fermentation is a microbial metabolic process that produces a product that has a high nutritional value, such as organic acids, single cell proteins, antibiotics and antibiopolymers. Yogurt fermented by Lactobacillus bulgaricus and Sterptococcus thermophillus bacteria are grouped into probiotic bacteria, which can help digest milk components and block the population of pathogenic bacteria (Sumarmono, 2016).

The amount of public interest in consuming yogurt needs to be balanced with an increase in the quality of yogurt making. One of them is by combining the starter culture of probiotic bacteria with the growth substrate of probiotic bacteria called prebiotics. The combination of probiotics and prebiotics is called synbiotics (Mukhoiyaroh et al., 2020).

Probiotics are microbes that are used to stimulate other microbes (Nursalam, 2013). Probiotics are also defined as indigestible food components that have a relationship with the benefits of their food source, which can encourage the growth or activity of bacteria in the colon (Antarini, 2011). Probiotics can improve the nature of microflora in the digestive tract and beneficial health effects for consumers associated with probiotic bacteria such as cholesterol levels, produce digestive enzymes and vitamins, can reduce intestinal pH, also have effects called anticarcinogenic and antagonistic activity to enteric pathogens (Mukhoiyaroh et al., 2020).

Prebiotics are materials that cannot be digested by the upper gastrointestinal tract, which results in stimulating the growth and activity of probiotics in the colon and also has a positive effect on improving body health. Prebiotics are able to stimulate the development of good bacteria in the gut, one of which is inulin (Mukhoiyaroh et al., 2020).

Inulin is a natural carbohydrate compound that is a polymer of fructose units. Inulin is also one of the food groups that are high in fiber (>90%), which is also used in functional foods. Inulin is water soluble, but it cannot be digested by digestive enzymes (Indriyanti et al., 2015). However, inulin can be fermented by a microflora that already exists in the human colon. According to the Balanced Nutrition Guidelines (PGS), about 35% of the fiber content is soluble dietary fiber and about 45% is insoluble fiber (Pratiwi, 2019). In general, inulin is also used as a substitute for sugar and fat which can produce quite low calories. Consuming inulin can also increase very beneficial bacteria, namely bifidobacteria (Indriyanti et al., 2015).

One plant that produces inulin is the dahlia flower. The dahlia flower can produce inulin in its roots or tubers. Inulin in dahlia flower tubers is used as a prebiotic. In addition to dahlia flower tubers, inulin is also found in various other foods such as bananas, bengkoang,

http://doi.org/10.22216/jk.v5i2.5717
Published by LLDIKTI Wilayah X

Jurnal Katalisator Vol 9 No. 1 (2024) 100-109

garlic, onions, wheat and asparagus (Oktavia, 2017). In fresh dahlia flower tubers, the water content is between 79.7-88.45%, while the dry matter weight contained in dahlia flower tubers is around 11.55-20.3%. Dahlia flower tubers have an inulin content of about 5.94-16.26%. The solubility and water absorption of dahlia tubers is a very important characteristic of inulin. Inulin will help bind water, thicken, and also improve the mouthfeel of various processed food products. As a prebiotic food ingredient, inulin provides several important benefits because it has the water-binding properties of some polysaccharides that are essential for retaining water in the stomach (Widowati, 2007).

Yogurt is known to have many health benefits, including helping people with lactose intolerance-a symptom of lactose malabsorption that is very common in some Asian and African countries, especially children. Yogurt also lowers blood cholesterol, keeps the stomach healthy, and prevents cancer of the digestive tract. These benefits are due to the bacteria used for yogurt fermentation. (Andayani, 2007).

Inulin can also be obtained from dried dahlia flower tubers. Pure inulin is made from dahlia flower tubers through buffered hot water extraction and pretreatment with diethylaminoethyl cellulose, activated charcoal, and acetone (Sunarti et al., 2022). The aim of the study was to analyze the effect of adding inulin from dahlia flower tubers (dahlia pinnata l) on the quality of organoleptic test and physicochemical properties of yogurt.

RESEARCH METHOD

Experimental research design. The ingredients for yogurt were: cow's milk (200 ml), probiotic starter (*Lactobacillus bulgaricus* and *Streptococcus thermophillus* bacteria) as much as 5% modified from Indriyani et al (2015). In this study, there were three treatments and one control. The treatments were the addition of inulin by 3%, 5% and 7% respectively. The control yogurt was without the addition of inulin. Fresh cow's milk was purchased directly from farmers in Padang city. The amount of probiotic yogurt starter used was at least 10^7.

The analysis conducted was the organoleptic quality (taste, aroma, color and texture) of yogurt. The hedonic scale used was: very much like = 5, very like = 4, like = 3, somewhat like = 2, dislike = 1. The organoleptic test was conducted at the organoleptic test laboratory of Universitas Perintis Indonesia. Objective observations on yogurt are physicochemical properties:

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http://doi.org/10.22216/jk.v5i2.5717
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Jurnal Katalisator Vol 9 No. 1 (2024) 100-109

Mann Whitney further test was conducted at the 5% level. Further test to see different treatments.

RESULTS AND DISCUSSION

Hedonic quality of yogurt color

The results of the hedonic test on the color of yogurt with the addition of dahlia flower tuber inulin (*Dahlia pinnata* L) there is no difference between treatments, can be seen in table 1. The hedonic test results of the addition of dahlia flower tuber inulin (*Dahlia pinnata* L) on the color of yogurt can be seen in Table 1

Table 1. Average acceptability of panelists' liking of yogurt color

Yogurt	average	criteria	P-Value
A (Milk: No dahlia tuber inulin)	4,28	Very like	0,062
B (Milk: 3% dahlia tuber inulin)	3,96	Very like	
C (Milk: Inulin dahlia tuber 5%)	4,22	Very like	
D (Milk: Inulin dahlia tuber 7%)	4,12	Very like	

The average value of liking for yogurt color given by panelists ranged from 3.96 to 4.28 (in the very like category). The color most preferred by panelists was white color, namely treatment A (without the addition of dahlia flower tuber inulin) with an average value of 4.28.

Based on the results of the data normality test, the pvalue (0.00) < (0.05) means that the data is not normally distributed. Then the non-parametric Kruskal Wallis test was carried out, the results obtained were pvalue (0.062) > (0.05). So it can be concluded that there is no significant difference from the addition of dahlia flower tuber inulin (Dahlia pinnata L) to the color of yogurt.

The results of this study are the same as (Indriyanti et al., 2015), the color appearance of all yogurts with the addition of 7% jombang root inulin can produce almost the same value from the panelists, this is because the color produced from each yogurt also has the same color, namely white.

The hedonic test results of the addition of dahlia flower tuber inulin (Dahlia pinnata L) on the aroma of yogurt are shown in Table 2 below.

Table 2. Average acceptability of panelists' favorite yogurt aroma

Yogurt	average	criteria	P-Value
A (Milk: No dahlia tuber inulin)	3,68	Very like	0,852
B (Milk: 3% dahlia flower tuber inulin)	3,78	Very like	
C (Milk: Inulin dahlia flower tuber 5%)	3,80	Very like	
D (Milk: Inulin dahlia flower tuber 7%)	3,86	Very like	

http://doi.org/10.22216/jk.v5i2.5717
Published by LLDIKTI Wilayah X

Jurnal Katalisator Vol 9 No. 1 (2024) 100-109

The mean score of the yogurt aroma given by the panelists ranged from 3.68 to 3.86 (in the very like category). The most preferred aroma by panelists was the aroma of yogurt treatment D, with the addition of 7% dahlia flower tuber inulin (Dahlia pinnata L) with an average value of 3.86. Based on the results of the data normality test, the pvalue (0.00) < (0.05) means that the data is not normally distributed. The next test using non-parametric Kruskal Wallis obtained a pvalue (0.852) > (0.05). The result was no significant difference from the addition of dahlia flower tuber inulin (Dahlia pinnata L) to the aroma of yogurt.

The hedonic test results of the addition of dahlia flower tuber inulin (Dahlia pinnata L) on the texture of yogurt can be seen in Table 3.

Table 3. Average acceptability of panelists' liking of yogurt texture

Yogurt	average	criteria	P-Value
A (Milk: No dahlia tuber inulin)	3,18	like	0,28
B (Milk: 3% dahlia tuber inulin)	2,98	like	
C (Milk: Inulin dahlia tuber 5%)	2,96	like	
D (Milk: Inulin dahlia tuber 7%)	2,70	like	

The average score of liking for yogurt texture given by panelists ranged from 2.70 to 3.18 (in the like category). The texture most favored by panelists was the texture of yogurt treatment A (without the addition of dahlia flower tuber inulin) with an average of 3.18.

Based on the results of the data normality test, the pvalue (0.00) < (0.05) means that the data is not normally distributed. The results of the difference test with non-parametric Kruskal Wallis obtained a pvalue (0.28) > (0.05), it was concluded that there was no significant difference from the addition of inulin from dahlia flower tubers (Dahlia pinnata L) to the texture of yogurt.

The organoleptic test results of the addition of dahlia flower tuber inulin (Dahlia pinnata L) on yogurt flavor can be seen in table 4 below.

Table 4. Average acceptability of panellists' liking for yogurt flavour

Yogurt	average	criteria	P-Value
A (Milk: No dahlia tuber inulin)	2,54	like	2,54
B (Milk: 3% dahlia flower tuber inulin)	2,66	like	2,66
C (Milk: Inulin dahlia flower tuber 5%)	2,70	like	2,70
D (Milk: Inulin dahlia flower tuber 7%)	2,94	like	2,94

The mean score of liking for the flavour of yogurt given by the panellists ranged from 2.54 to 2.94 (in the like category). The most preferred flavour by the panellists was the flavour of yogurt treatment D (7% dahlia tuber inulin addition) with an average value of 2.94 (in the like category). Based on the results of the data normality test, the pvalue (0.00) < (0.05) means that the data is not normally distributed. The next test using non-parametric Kruskal Wallis obtained a pvalue (0.387) > (0.05). The result stated that there was no

http://doi.org/10.22216/jk.v5i2.5717
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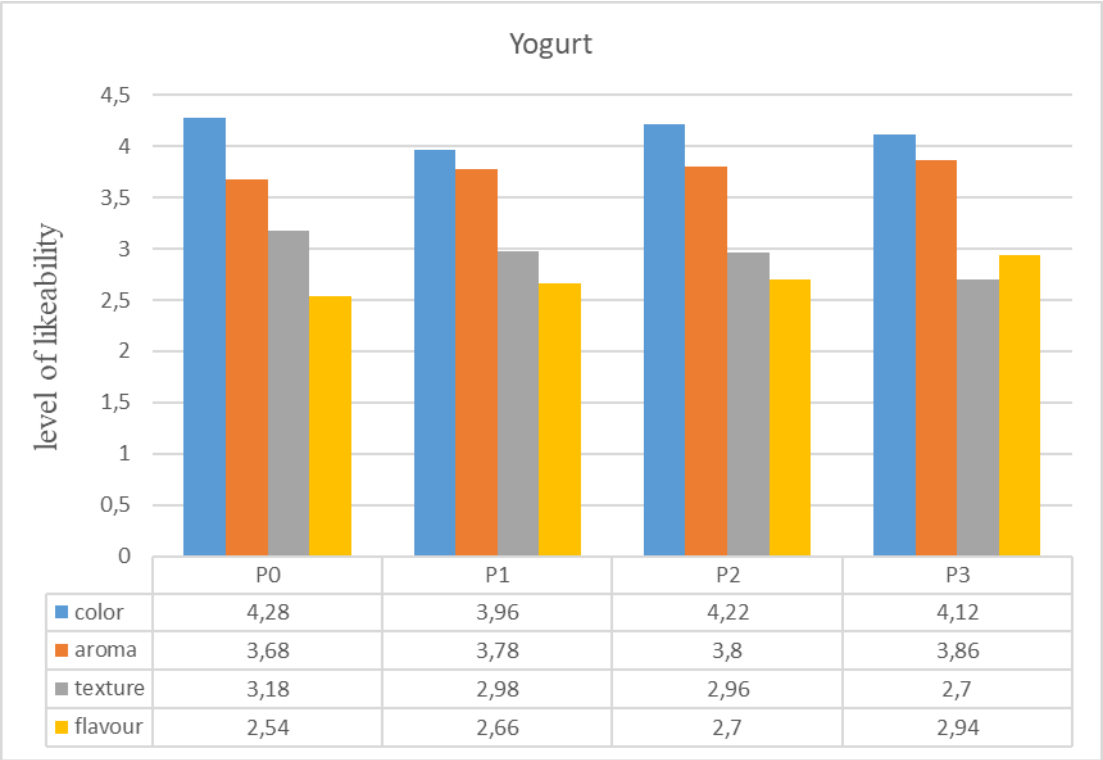
Jurnal Katalisator Vol 9 No. 1 (2024) 100-109

significant difference from the addition of dahlia flower tuber inulin (Dahlia pinnata L) to the flavour of yogurt.

Favoured Formulation from Overall Hedonic Assessment

Organoleptic assessment of yogurt with the addition of dahlia flower tuber inulin (Dahlia pinnata L) can be seen in the figure 1.



	P0	P1	P2	P3
color	4,28	3,96	4,22	4,12
aroma	3,68	3,78	3,8	3,86
texture	3,18	2,98	2,96	2,7
flavour	2,54	2,66	2,7	2,94

Figure 1. Organoleptic Assessment of Yogurt with Dahlia Tuber Inulin Addition

Yogurt treatment P3 (7% inulin addition) had a higher average liking in aroma and flavour indicators. Meanwhile, treatment A had higher liking in colour and texture indicators. In all difference tests with the Kruskal Wallis non-parametric test, the results were not significantly different, so the yogurt chosen was yogurt with treatment D (200 ml milk and 7% dahlia flower tuber inulin).

Observations of the yogurt produced were carried out objective quality tests. Table 5 is the result of the requirements and quality of yogurt according to SNI:

http://doi.org/10.22216/jk.v5i2.5717
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Jurnal Katalisator Vol 9 No. 1 (2024) 100-109

Table 5. Physico-chemical Properties of Yogurt

Test criteria	Yogurt P0 (control)	Yogurt P3 (addition of 7% inulin of dahlia tuber)	SNI	Data description
pH	4.2	4.5	4.1-4.5	Fulfilled P0 dan P3
glucose (level of sweetness) (^{o} Brix)	6.12	12.45	-	-
lactic acid level	0.467	0.524	0,5-2.0	Fulfilled P3
TPC lactic acid bacteria (cfu/g)	2.2 x 10^9	1.9 x 10^9	Min.10^7	Fulfilled P0 dan P3

In Table 5. The quality requirements of yogurt based on SNI (2009) limits the pH value of 4.1 - 4.5, from the research that has been done the pH value obtained from the treatment of control yogurt and yogurt adding 7% inulin dahlia tubers has met the requirements and quality of yogurt based on SNI. The pH level of cow yogurt in this study is almost the same as the results of research by Buchari et al, (2023) which is in the range of 4.40-4.65. In the fermentation process in yogurt, lactic acid bacteria will convert milk lactose into lactic acid which causes a decrease in pH levels. The pH value of yogurt is used to express the acidity of yogurt. The measurement results of lactic acid content of the control yogurt with a value of 0.467 and yogurt treatment D, the addition of 7% inulin dahlia tubers with a value of 0.524. Yogurt added with 7% inulin of dahlia tubers has met the requirements and quality of yogurt lactic acid content based on SNI.

In Table 5, the quality requirements of yogurt based on SNI (2009) limit the total lactic acid bacteria min 10^7. The total lactic acid bacteria of control yogurt and yogurt with the addition of 7% inulin have met the requirements and quality of yogurt based on SNI.

Inulin is a natural carbohydrate compound that is a polymer of fructose units. Inulin is also one of the food components with very high dietary fibre content (>90%), which is used in functional foods (Indriyanti et al., 2015). Inulin from dahlia tubers added to yogurt can meet SNI standards for yogurt. This can be seen from the physico-chemical properties of lactic acid content, pH value and LAB count of yogurt.

The addition of inulin to the yogurt was favoured by the panellists with high liking at the addition of 7%. The addition of inulin made no difference to the organoleptic quality of the yogurt in terms of aroma, colour texture and taste. The results of the research conducted can be concluded that the synbiotic yogurt with the addition of 7% inulin has a sharper aroma than the other concentrations. The 7% inulin concentration produced the smallest pH and the number of lactic acid bacteria produced was higher. It has a very thick texture. The water content was 87.05% (Indriyanti, at al, 2015). The results of this study are similar to Buchari (2023) that, the more inulin added to the manufacture of low-fat milk yogurt will increase the pH of the yogurt produced.

http://doi.org/10.22216/jk.v5i2.5717
Published by LLDIKTI Wilayah X

Jurnal Katalisator Vol 9 No. 1 (2024) 100-109

In this study with the treatment of inulin addition of dahlia flower tubers by 7%, the pH level increased. This can occur because inulin fermentation products by Bifidobacteria and Lactobacilli produce Short Chain Fatty Acid (SCFA) and lactate (Azhar, 2019). Milk fermentation is based on the breakdown of milk carbohydrates, namely lactose, into acidic organic compounds such as lactic acid, butyric acid and alcohol. The build-up of these compounds causes the pH of the milk to drop or become acidic. In the fermentation process, lactic acid bacteria utilise the sugar in milk as an energy source. Streptococcus thermophilus will grow first and produce lactic acid, the formation of lactic acid makes an acidic atmosphere with a pH of 4.2-4.4 which is a good atmosphere to stimulate the growth of Lactobacillus bulgaricus and a decrease in the number of Streptococcus thermophilus. (Sumarmono, 2016).

This can be explained that the growth of Lactobacillus bulgaricus will produce lactic acid which further lowers the pH between 3.5-3.8. The low pH denatures the casein in the milk so that it clumps to form curd and ferments lactose into lactic acid and gives yogurt a sour taste (Rahman, 2019).

The process of proteolysis by lactic acid bacteria will produce amino acids that are amphoteric (become basic in acidic solutions and become acidic in basic solutions) thus affecting the pH of yogurt. The pH change occurs due to the microbial activity of the starter that has been added, thus converting the lactose contained in milk into lactic acid (Buchari, 2023).

Bacteria growing on yogurt will lower the pH, causing the casein in the milk to denature, clumping, fermenting lactose into lactic acid, which gives it a sour flavour. Lactic acid bacteria can also improve the quality of yogurt because these bacteria produce protease enzymes that convert protein into amino acids, resulting in yogurt with high protein quality. (Purwantiningsih et al., 2022).

Inulin cannot be digested in the human digestive system, but it can be fermented by microflora in the human colon. This fermentation will become short-chain fatty acids that can affect the human immune system. According to the Balanced Nutrition Guidelines (PGS), the human body needs 35% soluble fibre and 45% insoluble fibre (Pratiwi, 2019). Inulin is a hot water-soluble dietary fibre.

CONCLUSIONS

There was no effect of inulin addition on organoleptic quality. Yogurt with 7% dahlia flower tuber inulin added was favoured. Yogurt added with 7% inulin can increase pH value, Brix degree and lactic acid content, while LAB content decreases. This yogurt fulfils the SNI standard for yogurt. It is recommended to use inulin from dahlia tubers to be added in making yogurt as much as 7%.

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