Kecombrang Flowers Can Increase the Nutritional Content of Yogurt Which Is Supplemented by Kecombrang Flower Juice with Different Percentages

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Abstract. Kecombrang flower juice yogurt is a fermented beverage made by the addition of kecombrang flower juice to milk. In addition to being a probiotic drink, kecombrang flower juice yogurt has many benefits for human health. This study aims to determine the effect of adding kecombrang flower juice to yogurt, which includes flavonoids, acidity, pH, fat content, protein content, viscosity, and organoleptic tests (aroma, taste, and color). The study used a complete randomized design (RAL) with variations in the treatment given, including the addition of kecombrang flower juice in amounts of 2.5%, 5%, and 7.5%. All data obtained were analyzed using the analysis of variance (ANOVA) test. The results showed that the addition of kecombrang flower juice had an effect on flavonoids, acidity, pH, fat content, protein content, viscosity, aroma, and the organoleptic test of kecombrang flower juice yogurt. But it does not have an effect on the organoleptic tests of taste and color. Based on this, it is concluded that the addition of kecombrang flower juice can increase nutritional value. The higher the percentage of kecombrang flower juice added, the more the flavonoid content, acidity, pH, fat content, and protein content in kecombrang flower juice yogurt increase.

Keywords: yogurt, kecombrang flower juice, nutritional, organoleptic.

1 Introduction

Milk is one of the beverages with a high nutritional value for humans.In addition, milk is also easy to obtain and affordable. Milk has a variety of nutritional contents, such as proteins, fats, carbohydrates, vitamins, and minerals [1]. Fresh milk is a beneficial medium for microorganisms because the pH value of milk is close to neutral pH, so it is good for the growth and development of bacteria [2]. The growth and development of microorganisms can adversely affect the quality of milk. Therefore, if not handled appropriately, the milk will suffer damage. The way to overcome milk so that there is no physical and chemical damage is by fermenting milk into yogurt. Yogurt is a fermented drink formed from good bacteria, such as Streptococus thermopillus, Lactobacillus bulgaricus, and Lactobacillus acidopillus [3]. The milk fermentation process aims to improve the quality and nutrition of milk and extend its shelf life. Yogurt is proven to improve the digestive process by providing the needed microflora and can inhibit the growth of pathogenic bacteria in the digestive tract because it contains probiotic bacteria [4].

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One of the innovations in making yogurt is to add kecombrang flower juice. Kecombrang (Etlingera elatior) is an Indonesian spice plant in the Zingiberaceae family that has long been used as medicine and flavoring for dishes [5].Public consumption of processed kecombrang flowers is still low. This is because kecombrang flowers are rarely processed into a product on a large scale that can be consumed directly [6]. Therefore, kecombrang flower juice yogurt is an innovation in yogurt processing that utilizes and increases the value of kecombrang flowers.

Kecombrang flowers have antioxidant, anticancer, anti-microbial, larvicide, and repellent activities [7]. Antioxidants are molecules that can neutralize free radicals by receiving one electron to eliminate the condition of unpaired electrons [8]. Because free radicals have taken electrons from the human body, they cause changes in the structure of DNA (deoxynucleic acid), resulting in mutant cells [9].Kecombrang flowers can inhibit the growth of breast cancer cells because they contain phenolics and flavonoids such as gallic acid, caffeine acid, quercetin, luteolin, and myricetin [10]. Yogurt with the addition of kecombrang flower juice has the potential to be a functional drink because it contains antioxidant compounds.

This study aims to analyze the physical, chemical, and organoleptic tests of yogurt with the addition of kecombrang flower juice. The addition of kecombrang flower juice uses a concentration of 2.5%, 5%, and 7.5%, and the fermentation time of yogurt is 8 hours. Physical and chemical analyses in this study were of flavonoids, acidity, pH, fat content, protein content, and viscosity. Meanwhile, the organoleptic test analysis in this study was a test of the liking of aroma, taste, and color. It is hoped that this research can create food diversification products that take advantage of kecombrang flowers.

2 Research Method

2.1 Method and Analyzed

Yogurt research with the addition of Kecombrang flower juice using experimental methods A complete randomized design (RAL) was used in this study, with free variables of adding kecombrang flower juice in amounts of 2.5%, 5%, and 7.5%, which was repeated twice. The data collection technique in this study uses physical, chemical, and organoleptic tests, which include flavonoids, acidity, pH, fat content, protein content, viscosity, aroma organoleptic tests, taste organoleptic tests, and color organoleptic tests. The methods used in this study are flavonoids using the spectrophotometric method, acidity using the titrimetric method, pH using a pH meter, fat content using the Soxhlet method, protein content using the Kjeldahl method, and viscosity using a viscometer. The organoleptic test used 25 semi-trained panelists. The research data were analyzed using the Analysis of Variant (ANOVA) method, which was followed by the DMRT test with a confidence level of 5% if there was an influence.

2.2 Tools and Materials

The tools used in this study were scales, bowls, knives, cutting boards, stoves, pots, thermometers, wood stirrers, blenders, sieves, incubators, and glass cups. The materials used in this study were cow's milk, skim milk, granulated sugar, starter Lactobacillus bulgaricus and Streptococus thermopillus, and kecombrang flower juice. The yogurt formula with the addition of kecombrang flower juice can be seen in Table 1.

Table 1. Yogurt formula with the addition of kecombrang flower juice

No.	Materials	X1 (2,5%)	X2 (5%)	X3 (7,5%)
1.	Cow's milk	250 ml	250 ml	250 ml
2.	Skimmed milk	12,5 g	12,5 g	12,5 g
3.	Sugar	25 g	25 g	25 g
4.	Starter (pure bacterial culture)	10 ml	10 ml	10 ml
5.	Kecombrang flower juice*	6,25 ml	12,5 ml	18,75 ml

Information: *) the volume of kecombrang flower juice = (2.5%/5%/7.5%) x vol of cow's milk.

3 Results and Discussion

The results of physical and chemical analysis laboratory test data can be seen in Table 2. while the results of the organoleptic test analysis can be seen in Table 3.

3.1 Physical and Chemical Analysis

Table 2. The results of physical and chemical analysis of yogurt with the addition of kecombrang flower juice

Addition of kecombrang flower juice	**Flavonoid (mg/kg)**	**Acidity (%)**	**pH**	**Fat Content (%)**	**Protein Conten (%)**	**Viscosity (cP) 25^0C**
2,5%	139,269	1,237	4,22	1,471	3,112	5675
5%	171,663	1,372	4,18	1,308	3,379	6025
7,5%	187,860	1,551	4,12	1,183	3,816	6175

3.1.1 Flavonoids

Flavonoids are antioxidant substances. Antioxidants are molecules that can neutralize free radicals by receiving one electron to eliminate the condition of non-paired electrons [8]. Because free radicals have taken electrons from the human body, they can cause changes in the structure of DNA (Deoxy Nucleic Acid), resulting in mutant cells [9]. Yogurt with the addition of Kecombrang flower juice at different concentrations contains flavonoids. The treatment of adding different kecombrang flower juices to each yogurt is responsible for the data diversity. The results of the average data on flavonoid yogurt with the addition of kecombrang flower juice were 2.5% by 139,269 mg/kg, 5% by 171,663 mg/kg, and 7.5% by 187,860 mg/kg. The addition of kecombrang flower juice causes the flavonoids in yogurt to increase. This is because kecombrang flowers contain flavonoids. The flavonoid content in Kecombrang flowers is 14,914 mg QE/g [11]. Flavonoids in Kecombrang flowers contain phenolic compounds, so they have an anti-cancer activity that can inhibit the growth of breast cancer cell lines. [10]. In kecombrang flowers, flavonoids are identified as kaemferol and quercetin [12, 13]. Thermodynamically, flavonoids can reduce most oxidizing free radicals related to biological systems, such as superoxide, peroxyl, coccyx, and hydroxyl radicals, because they have a low reduction potential (0.2 E0 0.8) [14].

3.1.2 Acidity

Yogurt with the addition of kecombrang flower juice at different concentrations affects the acidity. The results of the data on the average acidity in yogurt with the addition of kecombrang flower juice were 2.5% by 1.237%, 5% by 1.372%, and 7.5% by 1.551%. The

acidity in yogurt is produced by lowering the pH value and exposing it to an acidic environment [15]. During the fermentation process, lactic acid bacteria and kecombrang flowers produce organic acids, so the acidity increases due to the acid accumulation process. The addition of kecombrang flower juice causes the acidity to increase. The increase in acidity is because kecombrang flowers contain flavonoids. Flavonoids are made up of phenolic acidic compounds. The acid content in phenolic compounds includes gallic acid, caffeine acid, tannic acid, and chlorogenic acid [10]. The addition of kecombrang flower juice makes the environment acidic, so the amount of acid formed increases. Acidic conditions in yogurt cause lactic acid bacteria to develop properly and produce lactic acid. The large growth of lactic acid bacteria causes the acid content to be higher [16]. The flavonoid content in kecombrang flowers functions as an anti-microbial [7]. In this study, a blanching process was carried out on the juice of kecombrang flowers first before being added to the yogurt. The blanching process results in increased flavonoid compounds. The longer the blanching process, the higher the flavonoids produced [17]. The blanching process for the juice of kecombrang flowers uses a temperature of 900 °C for 3 minutes. This results in low antimicrobial activity, which does not interfere with the activity of lactic acid bacteria. Therefore, the addition of kecombrang flower juice causes the acidity produced to increase. Based on the results of the study, yogurt with the addition of kecombrang flower juice at 2.5%, 5%, and 7.5% is included in the "good" category compared to the Indonesian National Standard (SNI), which is 0.5% to 2.0% [18].

3.1.3 pH

Yogurt, with the addition of different kecombrang flower juices, affects the pH. The results of the data on the average pH of yogurt with added kecombrang flower juice were 2.5% at 4.22, 5% at 4.18, and 7.5% at 4.12. The results showed that yogurt is in an acidic state. The addition of kecombrang flower juice causes the pH value in yogurt to decrease. The more kecombrang flower juice added, the higher the acidity, and thus the lower the pH value. This is because kecombrang flowers have flavonoid compounds. Flavonoids are made up of phenolic acidic compounds. The acid content in phenolic compounds includes gallic acid, caffeine acid, tannic acid, and chlorogenic acid [10]. The pH value is related to the acidity of yogurt. The low pH value is due to the activity of lactic acid bacteria that produce lactic acid. The higher the acidity in yogurt, the lower the pH value. This happens because the high growth of lactic acid bacteria causes the acidity to increase so that the pH value decreases [19]. Thus, the addition of kecombrang flower juice causes a decrease in the pH value.

3.1.4 Fat Content

Yogurt with the addition of kecombrang flower juice at different concentrations affects its fat content. The results of the data on the average fat content of yogurt with the addition of kecombrang flower juice were 2.5% by 1.471%, 5% by 1.308%, and 7.5% by 1.183%. The addition of as much as 2.5% of kecombrang flower juice has a higher fat content of 1.471% compared to the additions of kecombrang flower juice of 5% and 7.5%. The fat content of kecombrang flower juice yogurt is getting lower along with the addition of kecombrang flower juice. The more kecombrang flower juice added, the higher the acidity, and thus the lower the fat content of the yogurt. Acidity is related to the growth of lactic acid bacteria. The decrease in fat contents occurs due to the large growth of lactic acid bacteria, so that the activity of the lipase enzyme increases in the process of hydrolyzing fat [20]. In the lipase enzyme, there is an increase in lipolytic activity, which causes lactic acid bacteria to reduce milk fat so that fat

contents decrease due to lipolysis activity [21]. Lipolysis activity is the process of breaking down fats and triglycerides by the lipase enzyme into smaller molecules, namely fatty acids and glycerol. In the process, the lipase enzyme serves to break down the fatty substances in the yogurt to make it easier to digest and be absorbed by the body. Based on the results of the study, yogurt with the addition of kecombrang flower juice at 2.5%, 5%, and 7.5% is classified as low-fat yogurt and is in a good category compared to the Indonesian National Standard (SNI), which is 0.6% to 2.9%. [18].

3.1.5 Protein Content

Yogurt with the addition of kecombrang flower juice at different concentrations affects the protein content. The results of the data on the average protein content of yogurt with the addition of kecombrang flower juice were 2.5% by 3.112%, 5% by 3.379%, and 7.5% by 3.816%. The addition of as much as 7.5% of kecombrang flower juice has a higher protein content of 3.816% compared to the additions of kecombrang flower juice of 5% and 7.5%. Protein contents increase along with the addition of the concentrated kecombrang flower juice. The more kecombrang flower juice added, the higher the protein content of the yogurt. The addition of kecombrang flower juice makes the growth environment of lactic acid bacteria more acidic, so that the acidity increases. This causes the growth of lactic acid bacteria to develop properly, so that protein contents increase. The increase in protein contents is due to the large number of lactic acid bacteria in yogurt because most of the constituent components of lactic acid bacteria are proteins [22]. Based on the results of the study, yogurt with the addition of kecombrang flower juice at 2.5%, 5%, and 7.5% is included in the "good" category compared to the Indonesian National Standard (SNI), which is at least 2.7% [18].

3.1.6 Viscosity

Yogurt with the addition of kecombrang flower juice at different concentrations has different viscosities. The results of the data on the average fat content of yogurt with the addition of kecombrang flower juice were 2.5% at 5675 cP, 5% at 6025 cP, and 7.5% at 6175 cP. When compared to the additions of 2.5% and 5% kecombrang flower juice, the addition of 7.5% kecombrang flower juice has a higher fat content of 6175 cP. The viscosity of kecombrang flower juice yogurt has increased along with the increase in the concentration of kecombrang flower juice. Viscosity is closely related to acidity, pH, and protein content. The milk fermentation process produces organic acids derived from the breakdown of sugars. This causes the acidity to increase and the pH to decrease, so that an isoelectric point occurs. The isoelectric point is a condition where the protein in the yogurt undergoes clumping so that the yogurt becomes viscous. At a pH below 5.3, milk experiences an increase in viscosity due to a decrease in casein solubility [23]. At pH 4.8–4.7, the casein will be perfectly motivated [24]. The decrease in pH in yogurt causes the milk protein-casein balance to be disturbed, resulting in casein coagulation and the formation of a semi-solid textured gel. The addition of more kecombrang flower juice causes the acidity and protein content to increase, so that the viscosity becomes viscous or semi-solid. The activity of lactic acid bacteria in yogurt causes the milk protein casein to coagulate well. In the process, clumping occurs in the milk so that it produces a thick or semi-dense consistency of yogurt.

3.2 Organoleptic Test

Table 3. The results of the organoleptic test analysis of yogurt with the addition of kecombrang flower juice

Addition of Kecombrang Flower Juice	Aroma	Taste	Color
2,5%	4,72	4,40	4,66
5%	4,04	4,24	4,38
7,5%	4,34	4,26	4,66

3.2.1 Aroma organoleptic tests

Based on the results of the aroma organoleptic test analysis, yogurt with the addition of kecombrang flower juice affected the panelists' favorite value. The treatment of adding different kecombrang flower juices to each yogurt is responsible for the data diversity. The results of the average data of the aroma organoleptic test on yogurt with the addition of kecombrang flower juice were 2.5% by 4.72 (like), a concentration of 5% by 4.04 (like), and a concentration of 7.5% by 4.34 (like). Yogurt with the addition of 2.5% Kecombrang flower juice had the highest value in the aroma organoleptic test. Kecombrang flower juice yogurt has a distinctive aroma derived from kecombrang flowers and fermented milk. The more kecombrang flower juice is added to the yogurt, the stronger the distinctive aroma of kecombrang flowers becomes. The aroma comes from the essential oil content of kecombrang flowers [25]. while the characteristic aroma of yogurt is produced by lactic acid bacteria. Lactic acid bacteria are microorganisms that produce lactic acid, which is responsible for the distinctive aroma of yogurt. Lactobacillus bulgaricus bacteria play a role in the formation of aromas rather than probiotic drinks [19]. The bacteria Streptococcus thermopillus grow faster to produce acid, whereas Lactobacillus bulgaricus produces glycine and histidine, which stimulate Streptococcus thermopillus to produce acid [15].

3.2.2 Taste organoleptic tests

Based on the results of the organoleptic test analysis of taste, yogurt with the addition of kecombang flower juice did not affect the panelists' favorite value. The results of the average data of the organoleptic test of taste in yogurt with the addition of kecombrang flower juice were 2.5% by 4.4 (like), a concentration of 5% by 4.24 (like), and a concentration of 7.5% by 4.26 (like). Yogurt with the addition of 2.5% Kecombrang flower juice has the highest value in the organoleptic test of taste. In the organoleptic test of taste, the panelists preferred the addition of a not-so-high kecombrang flower juice. This is because kecombrang flowers have a slightly spicy, sour taste. Kecombrang flowers have a distinctive taste that sticks to the tongue after consumption because they contain polyphenolic compounds [26]. In addition, the distinctive taste of kecombrang flowers is due to the content of essential oils [25]. The sour taste in kecombrang flowers comes from tannin compounds, saponins, and flavonoids [27] [15]. The level of liking of the panelists varies because they have sensory characteristics that are not the same, so they are relative [28]. The addition of 2.5% kecombrang flower juice produces the characteristic sour taste of yogurt and the characteristic taste of kecombrang flowers, which is slightly spicy. Meanwhile, the addition of 7.5% kecombrang flower juice produces a sour taste typical of yogurt and a distinctive taste of kecombrang flowers that is quite spicy.

3.2.3 Color organoleptic test

Based on the results of the color organoleptic test analysis, yogurt with the addition of kecombang flower juice did not affect the panelists' favorite value. The results of the average data of the color organoleptic test on yogurt with the addition of kecombrang flower juice were 2.5% at 4.66 (like), a concentration of 5% at 4.38 (like), and a concentration of 7.5% at 4.66 (like). Yogurt with the addition of 2.5% and 7.5% kecombrang flower juice has the highest value in the color organoleptic test. Yogurt has a white color, while kecombrang flowers have a red color. This is because kecombrang flowers have anthocyanin pigments, which are classified as flavonoid compounds that can be used as natural dyes [29]. The difference in the addition of kecombrang flower juice gives a color that does not differ markedly, so it does not have a real effect on the panelist's favorability value.

4 Conclussions

The results showed that the addition of kecombrang flower juice affected flavonoids, acidity, pH, fat content, protein content, viscosity, and aroma in the organoleptic tests. But it does not affect the organoleptic tests of taste and color. Yogurt with the addition of 7.5% Kecombrang flower essence has the highest physical and chemical value, namely flavonoids at 187,860 mg/kg, acidity at 1.551%, pH at 4.12, fat content at 1.183%, protein content at 3.816%, and viscosity at 6175 cP. Meanwhile, yogurt with the addition of 2.5% kecombrang flower juice has the highest value against organoleptic tests, namely aroma 4.72 (like), taste 4.40 (like), and color 4.66 (like). Based on this, it is concluded that the addition of kecombrang flower juice can increase nutritional value. The higher the percentage of kecombrang flower juice added, the more the flavonoid content, acidity, pH, fat content, and protein content in kecombrang flower juice yogurt increase.

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