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Acidification effects of starfruit (*Averrhoa Bilimbi* L.) on soy milk-based cottage cheese: A physicochemical and organoleptic assessment

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ABSTRACT

Using organic acids from citrus plants such as lemon and lime as a coagulant in soft cheese has been widely practiced. However, Wuluh starfruit (*Averrhoa Bilimbi* L.) is rarely used, especially in making cottage cheese from soy milk. Wuluh starfruit, which has a distinctive taste and aroma and is not shared by other citrus fruits, has the potential to be utilized in making cottage cheese. This study aimed to determine and study the effect of using a natural coagulating agent, Wuluh starfruit juice, as a coagulant in making cottage cheese from soy milk. A completely Randomized Design with six levels of treatment and three replications was used as the research design. The treatments were variations in the addition of Wuluh starfruit juice, namely as follows: SKA0 = control, citric acid 0.4%, SKA1 = 10%, SKA2 = 20%, SKA3 = 30%, SKA4 = 40%, and SKA5 = 50%. Cottage cheese from treatment SKA3 was the most preferred by the panelists based on the organoleptic evaluation with taste value (6.16 ±0.94%), aroma value (6.16 ±0.94%), texture value (5.24 ±1.20%), colour value (5.32 ± 0.85%), and acceptability value (5.72 ±0.51). SKA3 treatment was also the most preferred on the physicochemical properties of yield (26.43 ±1.13%), moisture (62.21 ±0.20%), ash (1.70 ±0.03%), protein (16.36 ±0.25%), fat (18.28 ±0.19%), pH (3.66 ±0.02), vitamin C (224.36 ±0.01 mg/kg), antioxidant activity (69.44 ±1.60%) and salt (50.33 ±0.58 ppm).

Keywords: starfruit, cheese, storage, viability, acidification

INTRODUCTION

Cheese is made through an enzyme addition to the milk **[1]**. Cheese is made most commonly from pasteurized cow milk, but the milk of other mammals may be used. Cheese production is common to households in many developing countries, which provides a helpful service in increasing the shelf-life of valuable human foodstuff like milk **[2]**. Cheese is widely known as a nutritious food that is an excellent source of calcium, vitamin A, riboflavin, and vitamin B12 **[3]**.

Cottage cheese is a low-calorie cheese with a minimal fraction of fat **[4]**. Cottage cheese is a highly regarded dairy product. There has been increased interest in specialty cheese, including additives like herbs, spices, or vegetables. The popularity of these cheese products is increasing due to their better biological value and improved flavour. Herbs and spices are used in different forms in food and traditional medicine because of their beneficial impact on health **[5]**.

One type of milk that can be used as the main ingredient for making cheese is soy milk. Milk can be extracted from soybeans and other legumes, which offer very cheap sources of vegetable milk, and could be used as substitutes for whole milk from animal sources in the production of cheese curds **[6]**. Soy milk, sometimes called soy drink or soy beverage, is a white emulsion resembling cow milk (conventional milk) in appearance and consistency. Soybean milk provides an alternative to malnourished infants and individuals who suffer from cow milk-associated allergies **[7]**. Soy milk, one type of milk, has gained economic prominence and worldwide popularity due to its use in the cheese industry. Fermented soy milk products, particularly yoghurt, buttermilk, and cheese, are trending in the world market because they are driven by medical needs and healthy food labels **[8]**.

Generally, cheese is divided into three types, namely hard cheese, semi-hard cheese, and soft cheese, with a moisture content of not more than 30-40% for hard cheeses, 35-45% for semi-hard cheese, and 45-75% for soft cheese **[9]**. Soft cheeses made without ripening are called fresh cheeses. Fresh cheese is cheese made from fresh milk coagulated with enzymes or acids. Cottage cheese is an example of soft cheese **[10]**. Cottage cheese is classified as cheese that is made in a short time because it does not undergo ripening and does not use renin as a coagulant so that it can be consumed immediately after production.

Coagulation of milk into cheese is not limited to using starter bacterial cultures that produce lactic acid but can also use several types of acids such as acetic acid, citric acid, and lactic acid **[10]**. Natural sources of citric acid, such as starfruit, can be an alternative as a coagulant in cheese making. Natural ingredients are increasingly preferred because they are considered safer and healthier as antioxidants that prevent cancer.

Wuluh starfruit (*Averrhoa bilimbi* L.) is a green fruit whose utilization is still limited. Wuluh starfruit has a reasonably sour taste and is usually used as a cooking spice or herbal medicine It contains a lot of citric acids, oxalic acid, tannins, saponins, glucose, sulfur, formic acid, peroxides, flavonoids, triterpenoids **[11]**. Previous studies used Wuluh starfruit juice to make cottage cheese from cow milk. However, the process still uses rennet, and the effect of adding Wuluh starfruit juice as a coagulant has yet to be studied **[12]**. Thus, we were interested in studying the effect of adding starfruit juice on the physicochemical and organoleptic properties of cottage cheese from soy milk.

Scientific Hypothesis

Using a natural coagulating agent, such as Wuluh starfruit juice, in making cottage cheese from soy milk can improve the physicochemical and organoleptic properties of cottage cheese from soy milk. We expect an increase in the physicochemical properties of cottage cheese on taste value, aroma, texture, colour, and acceptability values, and also in the organoleptic evaluation of cottage cheese in yield, moisture, ash, protein, fat, pH, vitamin C, antioxidant activity, and salt.

MATERIAL AND METHODOLOGY

Samples

The main raw material in this study was fresh soy milk obtained from Marapi Dairy Milk, Padang City, West Sumatra Province, Indonesia. Other raw materials used in the processing of cottage cheese are starfruit juice, citric acid (food grade), and salt (food grade) were purchased from the local market.

Chemicals

The chemicals used in the analysis consisted of aqua DM (Bratachem), selenium mix (Merck), boric acid (Pudak Scientific), sodium hydroxide (Merck), Tashiro indicator (Merck), hydrochloric acid (Merck), hexane (Bratachem), sulfuric acid (Smart Lab), DPPH (Sigma-Aldrich) and Methanol (Merck).

Instruments

The tools used in this research are a mixer, oven, digital scale, filter cloth, plastic utensils, knife, pH meter, and glassware. The instruments used for parameter testing are a UV-Vis spectrophotometer (Thermo scientific Genesys 150), Kjeldahl testing device, soxhlet extraction device, laboratory oven (Memmert UN 110), furnace (Carbolite AAF 1100), pH meter (Hanna Instrument HI 2211) and saltmeter (Lutron YK-31SA) and other tools.

Laboratory Methods

First, in coagulant solution preparation (Wuluh starfruit juice), Wuluh starfruit weighed as much as 1 kg and was washed with running water and mashed using a blender. Separation of pulp and juice was done using a sieve. According to the treatment variation, Wuluh starfruit juice can be added directly to milk. The 0.4% citric acid coagulant solution was prepared by dissolving synthetic citric acid in aqua DM (w/v) and stirring thoroughly.

Second, fresh soy milk was pasteurized at 72 °C for 20-30 seconds while stirring in the cottage cheese-making process. The pasteurized milk was then cooled to a temperature of 35 °C. Wuluh starfruit juice with five treatments was added gradually so the pH level would not drop too low. As a control, 0.4% citric acid solution was used as a coagulant to replace starfruit juice. The curd formation occurs for ±30 minutes after adding a coagulant **[13]**.

The curd is then filtered with a filter cloth consisting of 4 layers for 1 hour until the whey is no longer dripping. The curd that had been separated from the whey was then pressed for 15 minutes to remove the remaining water content. Cottage cheese is placed in packs and stored in a refrigerator at 7 °C. Then, pH measurements were carried out using a pH meter electrode to determine the acidity of starfruit at the five stages of adding wuluh juice to the cottage cheese.

Description of the Experiment

Sample preparation: In this study, cottage cheese from soy milk was produced by acidification method using juice extracted from Wuluh starfuit.

Figure 1 Wuluh starfruit (*Averrhoa Bilimbi* L.).

The treatments used were variations in the addition or concentration of Wuluh starfruit juice, namely as follows:

SKA0 : Control, citric acid 0.4%
SKA1 : Wuluh starfruit juice 10%
SKA2 : Wuluh starfruit juice 20%
SKA3 : Wuluh starfruit juice 30%
SKA4 : Wuluh starfruit juice 40%
SKA5 : Wuluh starfruit juice 50%

Pure citric acid was used as a comparison or control of citric acid, which is the dominant organic acid compound contained in Wuluh starfruit, which is 92.6-133.8 meq/100g of total solids, far exceeding the content of oxalic acid, acetic acid, and other organic acids **[14]**. The addition of starfruit juice and pure citric acid was based on the amount of milk used. The product of the six treatments can be seen in Figure 2.

Number of samples analyzed: We analyzed 6 samples.

Number of repeated analyses: All measurements of instrument readings were performed six times.

Number of experiment replication: The number of repetitions of each experiment to determine one value was three times.

Design of the experiment: In the physicochemical properties analysis, the proximate analysis included moisture content using the gravimetry method with a laboratory oven, ash content using the dry ashing method with the furnace, fat content using the soxhlet extraction method, and protein content using the micro-Kjeldahl method **[15]**.

The cheese pH was measured using an electrode pH meter. Vitamin C levels were measured using UV-VIS spectrophotometry by adjusting the wavelength range from 265 nm to 271 nm. The radical 1.1-diphenyl-2-picryl hydrazyl (DPPH) was used to determine the antioxidant activity of the cheese **[16]**. Samples from all treatments were put in equal volumes into DPPH, which had been dissolved in methanol (100 µM). After 15 min at room temperature, absorbance was measured at 517 nm by UV-Vis spectrophotometer. The cheese salt content was measured using a saltmeter/salinometer.

Then, in the organoleptic evaluation it is a method to determine panellists' response to cottage cheese products. The organoleptic evaluation was carried out with four parameters: colour, aroma, texture, and taste, because the level of consumer preference for a product is influenced by taste, aroma, texture, and colour **[16]**. The evaluation was identified using a 7-point hedonic scale: 1 = dislike extremely, 2 = dislike moderately, 3 = dislike slightly, 4 = neither like nor dislike, 5 = like slightly, 6 = like moderately, and 7 = like extremely.

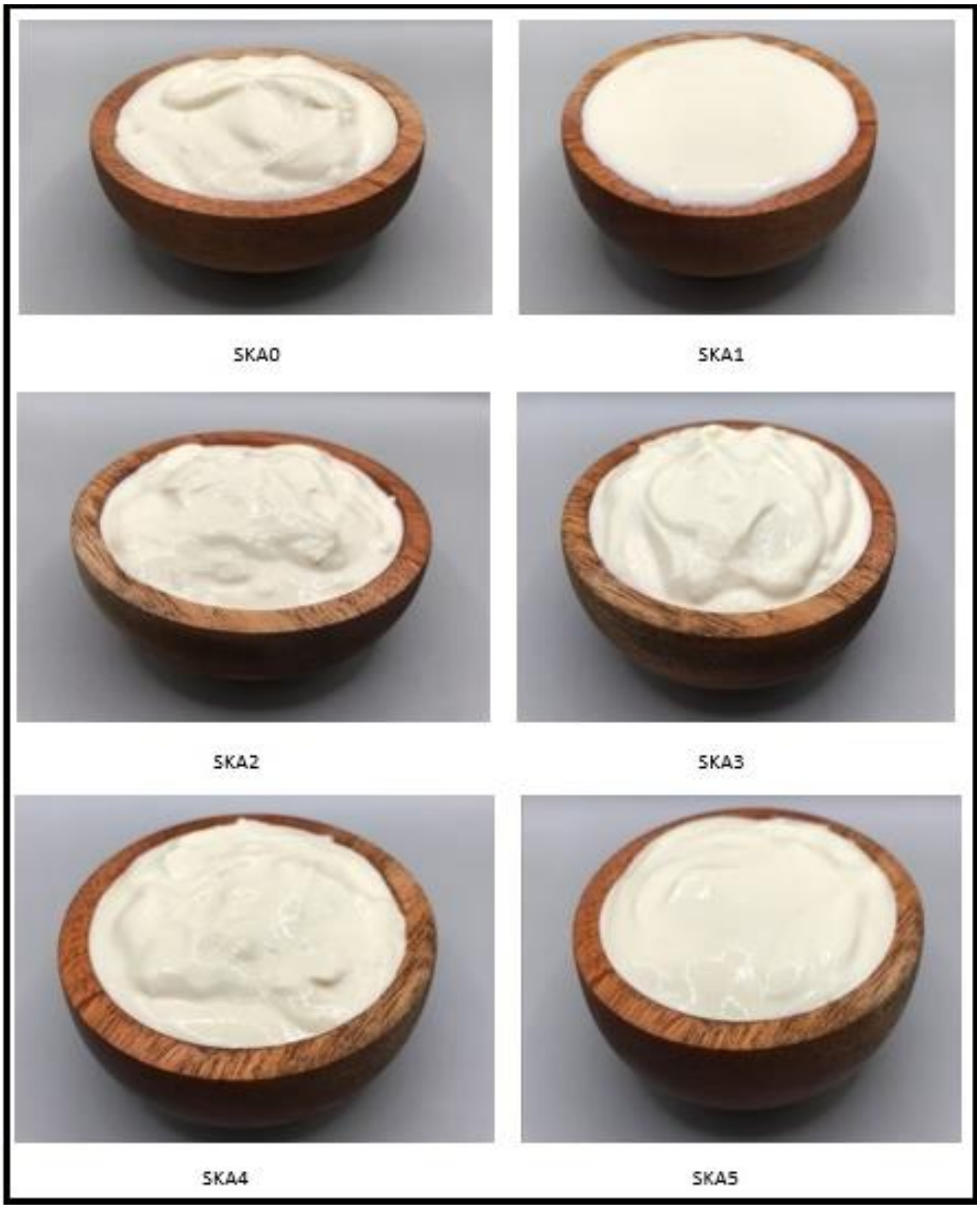

Figure 2 Cottage cheese from soy milk variations within the addition of Wuluh starfruit juice.

Statistical Analysis

Microsoft Excel and Statistica 15 produced the statistical data analysis. All experiments were carried out in triplicate, and the results reported are the results of those replicate determinations with standard deviations. The research design used was a one-level, Completely Randomized Design (CRD) with 6 levels of treatment and 3 replications. The data were analyzed using analysis of variance (ANOVA) with the F test and Duncan's New Multiple Range Test (DNMRT) advanced test at a 5% significance level. The ANOVA test is used because it can test differences in means of more than two groups and treatments, as this research wants to test whether there are significant differences between the treatments. Meanwhile, the Duncan test is used because it is more thorough and can be used to compare the effect of significantly different treatments with a large number of treatments.

RESULTS AND DISCUSSION

Physiochemical Properties

Regarding physicochemical properties, cottage cheese from soy milk was produced by acidification method using starfruit juice. The treatments used were variations in the addition or concentration of Wuluh starfruit juice: SKA0 (Control, citric acid 0.4%), SKA1 (Wuluh starfruit juice 10%), SKA2 (Wuluh starfruit juice 20%), SKA3 (Wuluh starfruit juice 30%), SKA4 (Wuluh starfruit juice 40%), and SKA5 (Wuluh starfruit juice 50%). The physicochemical properties of cheese produced from the six treatments are shown in Table 1.

Table 1 Physicochemical properties of cottage cheese from soy milk with variations in the addition of Wuluh starfruit juice.

Parameters	Treatments					
	SKA0	SKA1	SKA2	SKA3	SKA4	SKA5
Yield (%)	22.33 ±0.35	7.82 ±0.09	21.82 ±0.41	31.01 ±0.05	19.12 ±0.09	21.68 ±0.63
Moisture (%)	59.38^{a} ±0.43	61.77^{b} ±0.3	64.57^{c} ±0.34	65.24^{c} ±0.14	69.86^{d} ±0.06	75.41^{e} ±0.27
Ash (%)	2.21^{a} ±0.05	2.50^{ab} ±0.27	2.86^{bc} ±0.04	3.10^{cd} ±0.05	3.25^{cd} ±0.07	3.70^{d} ±0.22
Protein (%)	17.60^{f} ±0.13	16.35^{e} ±0.18	14.34^{d} ±0.21	12.51^{c} ±0.18	11.31^{b} ±0.22	10.22^{a} ±0.26
Fat (%)	17.67^{f} ±0.01	16.50^{e} ±0.39	14.73^{d} ±0.16	11.18^{c} ±0.12	8.38^{b} ±0.37	6.32^{a} ±0.30
pH	4.89^{d} ±0.01	5.62^{e} ±0.02	4.99^{d} ±0.02	4.79^{c} ±0.01	4.28^{b} ±0.00	3.11^{a} ±0.01
Vitamin C (mg/kg)	150.46^{a} ±0.00	153.12^{b} ±0.78	190.65^{c} ±0.25	243.50^{d} ±0.21	247.14^{e} ±0.11	268.57^{f} ±0.21
Antioxidant Activity (%)	4.05^{a} ±0.90	21.17^{b} ±0.78	27.33^{c} ±1.13	31.53^{d} ±0.78	44.44^{e} ±1.14	45.65^{e} ±0.69
Salt (ppm)	57.00^{d} ±0.00	39.00^{e} ±1.00	46.00^{c} ±1.15	50.33^{a} ±1.73	58.33^{d} ±1.15	68.00^{b} ±0.00

Note: a, b, c, d, e, f means within a row with different superscript letters are significantly different between treatments.

Yield is the ratio of the dry weight of the extract to the number of raw materials **[17]**. The cheese yield was obtained by weighing the weight of the resulting cheese and dividing it by the weight of the fresh milk used as a percentage **[18]**. It can be concluded that the more the addition of Wuluh starfruit juice, the higher the yield of cheese produced from soy milk.

The curd results from precipitation or coagulation of casein contained in milk. Protein coagulation and the decrease in pH are maximized, which is directly proportional to the increased concentration of added starfruit juice. Wuluh starfruit includes an organic acid (citric acid) with a low pH to precipitate casein in soy milk. Coagulation under optimum acid conditions will increase enzyme performance in forming a compact and sturdy curd **[19]**. Under these optimum acidic conditions, while the curd is filtered and chopped, less fat and casein are lost with the whey, so more fat can be retained for higher cheese yields **[20]**.

The cheese yield obtained from the control treatment, SKA0 (citric acid 0.4%), was 21.10%. This value is the average yield of cheese obtained by the acidification method for a pure citric acid coagulant agent. This value is under the treatment of SKA3, SKA4, and SKA5. The increase in the concentration of starfruit juice in each treatment was directly proportional to the yield of curd produced. The most curd obtained was with the addition of 50% starfruit juice (SKA5) because the acidity level was closer to the isoelectric point of milk casein **[21]**. The increase in cheese yield is also influenced by the moisture content bound to the casein network in the resulting product.

The moisture content is an important quality parameter that determines the water-holding capacity of the casein tissue to maintain a good cheese texture **[22]**. The moisture content of cottage cheese from soy milk is the addition of the Wuluh starfruit juice in the making of cottage cheese from soy milk, which influenced the increase of moisture content in each treatment. Each treatment increased with differences in adding Wuluh starfruit juice to soy milk. Wuluh starfruit is a fruit that contains a lot of moisture. Wuluh starfruit has a moisture content of 94.78% **[23]**. The high moisture content is influenced by the number of single water molecules or groups of water bound to the pectin surface through hydrogen bonds between -OH groups on pectin molecules and H atoms of water molecules.

Ash is a mineral element or inorganic substance that does not burn during combustion. An increase in water content accompanied the decrease in ash content. The higher the water content, the lower the ash content, and vice versa **[24]**. The more addition of Wuluh starfruit juice in soy milk, the lower the ash content produced in the cottage cheese. The more addition of Wuluh starfruit juice, the lower the ash content. The ash content value in the control (SKA0) was almost as high as the addition of starfruit juice in the SKA3 treatment.

Protein is a nutrient that is very important for the body because this substance functions as a building block and regulator. The more Wuluh starfruit juice was added to soy milk, the more the value of protein content in cottage cheese decreased **[25]**, **[26]**. The value of protein content decreased compared to the control (SKA0). The weak hydrogen bonds are broken when a protein is subjected to external stress, such as being heated or exposed to an acid (e.g., citric acid). This condition causes the protein to change. Proteins that are defective due to denaturation have a looser structure, are more random, and are mainly insoluble. The protein contained in cheese is easily digestible. This is because the protein breakdown process in cheese occurs appropriately **[27]**.

Fat content in cottage cheese decreased with the addition of Wuluh starfruit juice in soy milk. The value of fat content decreased in all treatments compared to the control (SKA0). An increase in the value of the moisture content accompanies the decrease in fat content in cottage cheese. This follows the statement that the factors that play a role in accelerating fat breakdown are air, light, temperature, and moisture content. The higher the moisture content of the cheese, the lower the fat content in the cheese.

The decreased quantity of fat was presumed to be due to heating, causing fat oxidation. This results in reduced fat content in cottage cheese **[28]**, **[29]**, **[30]**. The use of acid also affects the low fat because the acid can cause hydrolysis of fat. This can reduce the fat content in cheese. The proximate composition of cottage cheese from soy milk with six treatments can be observed in Figure 3.

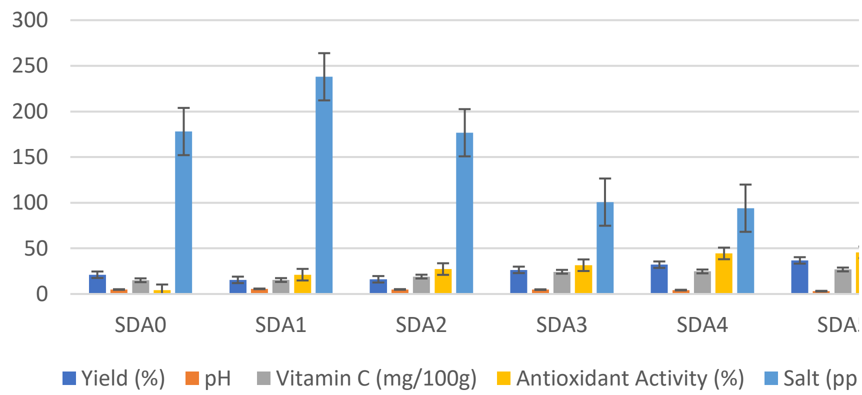

Figure 3 The proximate composition of cottage cheese from soy milk with six treatments of Wuluh starfruit juice addition.

Figure 3 shows the proximate composition of cottage cheese from soy milk from six treatments of Wuluh starfruit juice addition. pH is the highest in SKA1 (with 10% Wuluh starfruits), which was 5.62 and the lowest in SKA5 (with the addition of 50% Wuluh starfruits), which was 3.11. Vitamin C is the highest in SKA5 (with the addition of 50% Wuluh starfruits), which was 268.57 and the lowest in SKA0 (with the addition of 0.4% Wuluh starfruits), which was 150.46. Antioxidant Activity is the highest in SKA5 (with the addition of 50% Wuluh starfruits), which was 45.65, and the lowest in SKA0 (with the addition of 0.4% Wuluh starfruits) which was 4.05. Salt is the highest in SKA5 (with the addition of 50% Wuluh starfruits), 68.00, and the lowest in SKA1 (with 10% Wuluh starfruits), 39.00.

Organoleptic evaluation

Taste is the most important parameter in consumer acceptance of a product. Taste differs from the aroma and involves the five senses of the tongue. Tal factors can influence taste, such as chemical compounds, temperature, concentration, and interaction with other flavor components **[31]**, **[32]**. The taste of a product is a combination of aroma and taste, if the senses of taste detect food, panellists can distinguish one different type of food **[33]**. The resulting cottage cheese product had a characteristic sour taste of organic acids (citric acid). The increase in the concentration of Wuluh starfruit juice caused the cheese to become sourer. Adding salt can reduce the taste of too sour and create a savoury taste typical of cheese. The savoury taste was obtained by adding table salt to each treatment **[34]**.

The data showed that the higher the addition of Wuluh starfruit juice, the panellist acceptance rate. This is because Wuluh starfruit has a sour taste that affects the taste of the cheese. However, from the panellists' acceptance data, it can be concluded that the addition of Wuluh starfruit has been accepted by the panellists on a scale of 5.24 to 4.32, which means that the panellists already like the taste of the cheese.

The panellists' highest evaluation of the taste was found in the SKA3 treatment (with the addition of 30% Wuluh starfruits), which was 6.56 (moderately) with a balanced combination of sour and salty flavours. The panellists' lowest evaluation was the SKA5 treatment (adding 50% Wuluh starfruits), which was 4.32 (neither like nor dislike) with a taste that was too sour. For comparison, cottage cheese produced with 0.4% citric acid coagulant (SKA0) has a value of 5.24 (slightly).

The sense of smell influences aroma. In general, the nose can receive four types of odours can be received by the nose: fragrant, sour, rancid, and charred **[35]**, **[36]**. Aroma is also caused by chemical stimulation, which is responded to by the olfactory nerves in the nasal cavity. The aroma test was carried out by giving an assessment using the sense of smell; then the panellists gave a value to the aroma aspect of the questionnaire.

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The panellists' highest evaluation of the taste was found in the SKA3 treatment (with the addition of 30% Wuluh starfruits), which was 6.56 (like moderately) with a balanced combination of sour and salty flavours. The panellists' lowest evaluation was the SKA5 treatment (adding 50% Wuluh starfruits), which was 4.32 (neither like nor dislike) with a taste that was too sour. For comparison, cottage cheese produced with 0.4% citric acid coagulant (SKA0) has a value of 5.24 (slightly).

The sense of smell influences aroma. In general, the nose can receive four types of odours: fragrant, sour, rancid, and charred. Aroma is also caused by chemical stimulation, which is responded to by the olfactory nerves in the nasal cavity **[37]**. The aroma test was carried out by giving an assessment using the sense of smell. Then the panellists gave a value to the aroma aspect of the questionnaire.

The appearance of food is largely determined by moisture and fat content. The texture changes can be caused by loss of moisture or fat content, breaking of emulsions, and hydrolysis of proteins. The texture of the cheese was strongly influenced by the fat in soy milk, which was the main ingredient of this cottage cheese **[38]**. The high-fat content of milk will cause the cheese texture to become soft. So, the fat coagulated by organic acids in Wuluh starfruit juice determines the softness of the cheese texture. The higher the addition of Wuluh starfruit juice, the cottage cheese product produced is softer, and the impact on the higher level of panellist acceptance **[39]**, **[40]**.

The highest value of texture was found in the SKA5 treatment (addition of 50% Wuluh starfruits) with a value of 6.44 (like moderately). In comparison, the lowest texture value was found in the SKA1 treatment (addition of 10% starfruit Wuluh), which was 4.64 (like slightly). This means that the panellists' acceptance rate is normal to very like. As a comparison, the SKA0 treatment (addition of 0.4% citric acid) had a value of 5.08 (slightly).

Colour is an evaluation that uses the sense of sight. Colour factor determines whether food is delicious or nutritious because it is considered and affects the evaluation **[41]**. Variations in the concentration of Wuluh starfruit juice affected the colour of the cottage cheese. The colour of the cheese produced was dominated by the colour of the main ingredient, soy milk. In addition, adding Wuluh starfruit juice as a coagulant also affected the cheese **[42]**. The chlorophyll pigment in the fruit causes the resulting cheese product to be greenish-white (55.56).

The highest evaluation of the colour was found in the SKA1 treatment (addition of 30% Wuluh starfruit juice), which is 6.04 (like moderately) because the cheese had an almost pure white colour. The lowest value was found in the SKA5 treatment (addition of 50% Wuluh starfruit juice), which was 3.76 (neither like nor dislike) because the cottage cheese had a colour that was dominated by green. As a comparison, the SKA0 treatment (addition of 0.4% citric acid) had a higher value than the SKA1 treatment due to the absence of the addition of Wuluh starfruit, so there was no greenish colour in the resulting cottage cheese.

Overall organoleptic evaluation (colour, aroma, texture, and colour) of soy milk cheese was conducted by 25 semi-trained panellists. The highest value was found in the SKA3 treatment (addition of star fruit Wuluh 30%) with a scale of 5.66 (like moderately). Organoleptic properties of cottage cheese from soy milk with variations in the addition of Wuluh starfruit juice can be observed in Table 2.

In the Table 2, organoleptic evaluation is used to determine the response of panelists to cottage cheese products on the level of consumer preference for a product. In the taste preference, the higher the addition of Wuluh starfruit juice, the panelist acceptance rate decreased. The panelists' highest evaluation of the taste was found in the SKA3 treatment (6.56), while the panelists' lowest evaluation was the SKA5 treatment (4.32). In the aroma preference, the higher the addition of Wuluh starfruit juice, the panelist acceptance rate decreased. The panelists' highest evaluation of the taste was found in the SKA3 treatment (6.56), while the panelists' lowest evaluation was the SKA5 treatment (4.32).

Table 2 Organoleptic properties of cottage cheese from soy milk with variations in the addition of Wuluh starfruit juice.

Parameters	Parameters					
	SKA0	SKA1	SKA2	SKA3	SKA4	SKA5
Taste	4.68±0.75	4.84±1.28	5.44±0.92	6.16±0.94	6.76±0.44	4.48±0.77
Aroma	4.92±1.29	5.12±1.39	5.76±1.13	6.16±0.94	6.84±0.37	4.48±0.96
Texture	5.08±1.19	4.48±1.19	5.00±0.76	5.24±1.20	5.76±1.16	6.68±0.48
Color	4.24±1.23	4.36±1.44	5.28±0.94	5.32±0.85	6.68±0.48	3.84±0.80
Acceptability	4.73±0.37	4.70±0.35	5.37±0.32	5.72±0.51	6.51±0.50	4.96±1.22

Note: The evaluation was identified using a 7-point hedonic scale (1 = dislike extremely, 2 = dislike moderately, 3 = dislike slightly, 4 = neither like nor dislike, 5 = like slightly, 6 = like moderately, and 7 = like extremely).

In the texture preference, the higher the addition of Wuluh starfruit juice, the cottage cheese product produced is softer, and the impact on the higher level of panelist acceptance. The highest value of texture was found in the SKA5 treatment (6.44) while the lowest texture value was found in the SKA1 treatment (4.64). In the color preference, variations in the concentration of Wuluh starfruit juice affected the color of the cottage cheese. The highest evaluation of the color was found in the SKA1 treatment (6.04), while the lowest value was found in the SKA5 treatment (3.76). In the total of four preferences acceptability, overall organoleptic evaluation (color, aroma, texture, and color) of soy milk cheese was carried out by 25 semi-trained panelists. The highest value was found in the SKA3 treatment (addition of star fruit Wuluh 30%) with a scale of 5.66 (like moderately).

CONCLUSION

Using Wuluh starfruit juice as a coagulant showed effects on the physicochemical properties and organoleptic evaluation of cottage cheese from soy milk. It can be concluded that the cottage cheese product from the SKA3 treatment (the addition of 30% Wuluh starfruit juice) was the most preferred by the panellists from organoleptic properties on taste value (6.16 ±0.94%), aroma value (6.16 ±0.94%), texture value (5.24 ±1.20%), color value (5.32 ± 0.85%), and acceptability value (5.72 ±0.51). The cottage cheese product from the SKA3 treatment was also the most preferred by the panellists from physicochemical properties on yield (26.43 ±1.13%), moisture (62.21 ±0.20%), ash (1.70 ±0.03%), protein (16.36 ±0.25), fat (18.28 ±0.19%), pH (3.66 ±0.02), vitamin C (224.36d ±0.01 mg/kg), antioxidant activity (69.44 ±1,60%) and salt (50.33 ±0.58 ppm). This product's microbiological properties, heavy metals, and shelf life can be carried out for further research.

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