Comparison of Physicochemical, Microbiological, and Organoleptic Characteristics of Dali, Dangke, and Fresh Cheese from Goat Milk

Wahyuningtyas AN[1,2], Taufik E[2], Soenarno MS[2], Sulfiar AET[1,3], Atmoko BA[4], Nugroho T[5]

[1]*Sustainable Livestock Farming Extension, Politeknik Lingga, Kepulauan Riau 29871*
[2]*Department of Animal Production and Technology, Faculty of Animal Science, Bogor Agricultural University, Bogor 16680*
[3]*Animal Science Study Program, Faculty of Agriculture and Animal Science, Muslim University Buton, Bau-Bau, Southeast Sulawesi 93721*
[4]*Research Center for Animal Husbandry, National Research and Innovation Agency, Cibinong Science Center, Bogor 16911*
[5]*Faculty of Animal Science, Gadjah Mada University, Yogyakarta 55281*
E-mail: amalinanw2601@gmail.com epitaufik@gmail.com

(received 01-02-2023; revised 20-07-2023; accepted 24-07-2023)

ABSTRAK

Wahyuningtyas AN, Taufik E, Soenarno MS, Sulfiar AET, Atmoko BA, Nugroho T. 2023. Perbandingan karakteristik fisikokimia, mikrobiologi dan organoleptik dali, dangke, dan keju segar asal susu kambing. JITV 28(4):227-236. DOI: http://dx.doi.org/10.14334/jitv.v28i4.3254.

Masyarakat Indonesia memanfaatkan susu kambing untuk diolah menjadi produk pangan secara tradisional. Pengolahan susu kambing dalam produk olahan susu diharapkan dapat menjadi salah satu alternatif untuk meningkatkan nilai konsumsi susu kambing tanpa mengurangi manfaat yang dikandungnya. Produk pangan yang diolah dari susu tersebut diantaranya adalah keju segar, dali (Sumatera Utara), dan dangke (Sulawesi Selatan). Tujuan penelitian ini adalah untuk mengkaji perbandingan karakteristik fisikokimia, mikrobiologi dan organoleptik dali, dangke, dan keju segar. Rancangan percobaan pada penelitian ini adalah Rancangan Acak Kelompok dengan 3 taraf perlakuan koagulan yang berbeda yaitu rennet, getah pepaya, dan daun Agave angustifolia sebagai enzim penggumpal kasein pada dali, dangke, dan keju segar, kemudian dilakukan uji ragam dan data non parametrik menggunakan uji Kruskal Wallis, jika ada perbedaan nyata digunakan uji banding berganda Tukey. Hasil penelitian menunjukkan bahwa nilai a_w, pH, dan kadar lemak antara dali, dangke, serta keju segar tidak berbeda, namun berbeda ($P<0.05$) pada nilai rendemen, kadar air, abu, protein, dan karbohidrat. Hasil uji mikrobiologi pada angka lempeng total (TPC) dan angka kapang khamir tidak berbeda nyata antar perlakuan. Hasil uji hedonik berpengaruh nyata terhadap produk keju segar. Keju segar memiliki nilai organoleptik yang lebih baik dibandingkan produk dangke dan dali.

Kata Kunci: Dali, Dangke, Keju Segar, Susu Kambing

ABSTRACT

Wahyuningtyas AN, Taufik E, Soenarno MS, Sulfiar AET, Atmoko BA, Nugroho T. 2023. Comparison of physicochemical, microbiological and organoleptic characteristics of dali, dangke and fresh cheese from goat milk. JITV 28(4):227-236. DOI: http://dx.doi.org/10.14334/jitv.v28i4.3254.

Indonesian people utilize goat milk to be traditionally processed into food products. Goat milk processing into dairy products is expected to be an alternative way to increase the value of goat milk consumption without reducing the benefit. The traditional dairy products from goat milk are Dali from North Sumatra and Dangke from South Sulawesi. This study aimed to examine the physiochemical, microbiological, and organoleptic characteristics of dali with Agave angustifolia leaf extract coagulant (alo-alo leaf), dangke with papaya latex coagulant, and fresh cheese with rennet coagulant. The experimental design used a randomized block design with three different levels of coagulant treatment, namely Rennet, papaya latex, and Agave angustifolia leaves as casein coagulating enzymes for dali, dangke, and fresh cheese. The variance and non-parametric data test used the Kruskal-Wallis test, followed by Tukey's multiple comparison test. The results showed that the values of aw, pH, and fat between dali, dangke, and fresh cheese were not different. Meanwhile, there is a significant difference ($P<0.05$) for yield value, dry matter, ash, protein, and carbohydrate. The results showed that the total plate count, yeast, and mold count of fresh cheese, dali, and dangke were not significantly different. The results of the hedonic test showed that fresh cheese differs significantly from others ($P<0.05$). Fresh cheese had a better organoleptic value than dangke and dali.

Key Words: Dali, Dangke, Fresh Cheese, Goat Milk

INTRODUCTION

Goat milk is well known to have high nutritional value and good effects on human health. It contains highly conjugated linoleic acids essential in immune stimulation, growth, and disease prevention. Most of the goat milk protein component is similar to human milk. Thus, goat milk has more digestible nutrients than cow milk (Turkmen 2017). Moreover, goat milk has a lot of small-size fat globules and low lactose content

(Silanikove et al. 2010), which results in more digestible and can be consumed by an infant (Prosser 2021).

Goat milk processing was proposed to improve the shelf life, durability, and food variation without reducing the benefit (Van Leeuwen et al. 2020; Nayik et al. 2021). Goat milk cheese is one of the popular dairy goat products produced by several European countries. It is known to have distinctive textural, flavor, and aroma characteristics to cow milk (Medina & Nuñez 2017). In Indonesia, cheese consumption is very low (Susilawati & Wahyuningsih 2020). However, several cultures in Indonesia has dairy product, such as dadih (West Sumatra), dali ni horbo (North Sumatra), dangke (South Sulawesi), Cologanti, and Litsusu (Nusa Tenggara). Dali and dangke production concepts are similar to cheese processing because of the use of a coagulant (Surono 2015; Zakariah et al. 2022).

Dangke is one of the most popular dairy products in Sulawesi. Besides its distinctive taste, it has pretty high nutritional value because it is made from cow's or buffalo's milk, which is heated and then added papaya latex and then packaged using banana leaves (Zakariah et al. 2022). Dali is a traditional food for the people of North Sumatra, which is made by coagulating buffalo milk using pineapples (Pratiwi et al. 2019). In addition to pineapples, alo-alo leaf extract (*Agave angustifolia*) is a coagulant material for making dali with the hope that it will act as a milk coagulant and produce better curd. Therefore, this study aimed to examine the physiochemical, microbiological, and organoleptic characteristics of dali with *Agave angustifolia* leaf extract coagulant (alo-alo leaf), dangke with papaya latex coagulant, and fresh cheese with rennet coagulant.

MATERIALS AND METHODS

The research was conducted at the Animal Product Processing Laboratory, Faculty of Animal Husbandry, Division of Animal Product Technology, Bogor Agricultural University, and the Microbiology Laboratory, Faculty of Agricultural Technology, Bogor Agricultural University.

Experimental research

The materials used in the study were fresh cheese, dangke, and dali, which were then grown in an incubator at 37 °C for 48 hours for total plate count (TPC) and 25 °C for 72 hours for yeast mold numbers. The research method uses a randomized block design (RBD). The study was conducted using three different levels of coagulant treatment, namely Rennet, papaya latex, and *Agave angustifolia* leaves, each treatment having three replications.

Fresh cheese, dali, and Dangke processing

Fresh cheese processing carried out refers to the previous study (Permainy et al., 2013), which was modified, namely 1 liter of fresh goat's milk was pasteurized first at 70 °C, then cooled to 35 °C, then 0.2 g of Rennet was added while stirring evenly for 1 minute. During 30 minutes of standing, the coagulation results will separate the curd from the whey, then filtered, and the curd is taken. Dali processing from fresh goat milk, according to the previous study (Sirait, 1991) method, and formula, which is modified, namely Agave angustifolia leaves, are pounded and squeezed to obtain the juice. As much as 5.4% of the leaf extract is then put into 1 liter of goat's milk and heated at 70 °C until curd is formed. Dangke processing was based on a previous study (Mukhlisah et al., 2017) by heating 1 liter of fresh goat's milk to 70 ml and mixing 2% of papaya latex (papain enzyme). The milk and papaya latex solution is then allowed to stand until it forms curd.

Data collection

Fresh milk quality analysis

The milk quality tested was the total plate number (TPC) and the yeast mold number to determine the number of bacteria and yeast mold numbers (Maturin and Peeler, 2001) found in fresh goat's milk and pasteurized milk. Lactoscan is used for testing the quality of milk. The milk sample used for making curd is placed in a container, then quality levels are measured, including solid non-fat (SNF), density, fat content, lactose, salt, and protein.

Characteristics analysis of fresh chees, dali, and dangke

The characteristics of the samples tested in this study included physicochemical characteristics (aw, pH, yield, dry matter, ash, fat, protein, and carbohydrates) and organoleptic (taste, color, aroma, and texture), microbiological (Total et al. and yeast), and organoleptic (hedonic quality test and hedonic test).

Water activity analysis (a_w), pH, and yield

Water activity (aw) is the free water needed to grow microorganisms. Determination of the aw value of the product is measured using a measuring device, namely the aw meter. The instrument was calibrated before measuring the aw of the product with a saturated NaCl solution with an aw of around 0.7509. Several samples are placed into the aw meter. The start button is pressed

when the tool is in the ready position. The aw value can be read if the tool is in the completed position (AOAC 2005). The pH value is measured with a Schott pH meter that has been turned on and stabilized for 15 to 30 minutes. The pH electrode was standardized with a buffer solution. The electrode was rinsed and dried with a tissue and then dipped into the sample until the pH meter showed a stable number. The yield is calculated based on the percentage of the resulting sample weight to the weight of the milk used (Irmayanti, 2016). The yield value was calculated based on the formula:

$$Yeald\ (\%) = \frac{Curd\ weight}{Milk\ weight}\ x\ 100\%$$

Dry matter analysis

The sample was weighed (1 g) in a cup. Samples were put in an oven at 105 °C for 8 hours, then cooled in a desiccator and weighed (AOAC 2005). dry matter was calculated according to the formula:

$$Dry\ matter\ (\%) = \frac{First\ weight - Final\ weight}{first\ weight}\ x\ 100\%$$

Ash content analysis

The sample was weighed (1 g) in a porcelain cup. Samples were fired or ashed in a kiln at 600 °C for 2 hours or until they were not smoking. The sample is weighed after being cooled in a desiccator (AOAC 2005). Ash content was calculated according to the formula:

$$Ash\ content\ (\%) = \frac{Ash\ weight}{sample\ weight}\ x\ 100\%$$

Fat content analysis

The sample was weighed (2 g) and spread on cotton lined with filter paper. The filter paper is rolled up to form a thimble and placed in a Soxhlet flask. Samples were extracted for 6 hours with 150 mL hexane solvent. The extracted fat was dried in an oven at 100 °C for 1 hour (AOAC 2005). The formula calculates fat content:

$$Fat\ content\ (\%) = \frac{Fat\ extraction\ weight}{sample\ weight}\ x\ 100\%$$

Protein content analysis

The Kjeldahl method was used in the analysis of the protein content of the sample, which is an analysis of the total N content. A total of 0.1 g of the sample was placed in a 100 mL Kjeldahl flask, and selenium was added in a ratio of 1:1 to the sample and 3 mL of concentrated H2SO4. The sample is digested until the solution becomes clear for about 1 hour, then the digestion flask is cooled, 50 mL of distilled water and 20 mL of 40% NaOH are added, then distilled. The distillation results were collected in an Erlenmeyer containing 10 mL of 2% H3BO3 solution and two drops of pink Methyl Red. After the volume of the distillate becomes 10 mL and the color is bluish-green, the distillation is stopped, and then the distillate is titrated with 0.1 N HCl until it is pink. The same treatment was also applied to blanks (AOAC 2005). Protein levels can be calculated using the formula:

$$Protein\ content\ (bb\%) = 6.25\ x\ \%\ nitrogen$$

Carbohydrate content analysis (bb%)

otal carbohydrate content was determined by the method of carbohydrate by difference (AOAC 2005). The percentage of carbohydrates is calculated using the formula:

$$bb\% = 100\% - (dry\ matter + ash\ content + protein\ content + fat\ content)$$

Total Plate Count (TPC) and Yeast

Parameters observed, namely total plate count (TPC) and yeast mold number (Maturin and Peeler 2001), were also tested for organoleptic taste, aroma, color, and texture (Setyaningsih et al. 2010).

TPC and yeast samples were prepared according to the Bacteriological Analytical Manual (BAM) (Maturin and Peeler 2001). Samples were weighed as much as 25 g and put in sterile plastic wrap. 225 mL of BPW diluent was added to the sample. The mixture was homogenized, and a tenth dilution (P^{-1}) was obtained. Furthermore, 1 mL of P^{-1} was pipetted and dissolved in 9 mL of BPW diluent to obtain P^{-2}, and so on in the same way until P^{-4}.

Fertilization was carried out for each desired dilution (P^{-1} to P^{-4}) by pipetting 1 mL of the dilution into a petri dish and adding 10-12 mL of PCA medium for TPC and PDA media for yeast added with chloramphenicol as much as 0.01%. The mixture is homogenized by moving it to form a number 8 and left until the agar hardens. The Petri dishes were then incubated at 37°C in an inverted position. The growing colonies were counted after 48 hours of incubation. The interval between the number of colonies in the TPC calculation is 25-250 colonies. Colony count was carried out after 48 hours based on the BAM method in units of CFU mL^{-1} (Maturin and Peeler 2001). The data for mold and yeast numbers are combined, and the formula for calculating TPC and yeast molds is as follows:

$$TPC{:}N = \frac{\sum C}{((1xn1) + (0.1xn2))xd}$$

where N is number of colonies per mL or g of product, ∑C is the number of all colonies counted on all Petri dishes, n1is number of Petri dishes counted in the first dilution, n2 is number of Petri dishes counted in the second dilution, and d is the dilution in which the first petri dish was calculated.

Organoleptic

Organoleptic was carried out on hedonic test and hedonic quality test. Sample analysis was performed by 50 semi-trained panelists consisting of people who had studied organoleptic tests. Hedonic test attributes include color, taste, aroma, and texture, with a rating of very dislike (scale 7) to like very much (scale 1). Rating 1 = very like, 2 = like, 3 = somewhat like, 4 = neutral, 5 = somewhat dislike, 6 = do not like, and 7 = really dislike. The hedonic quality test attributes color (white to grayish white), bitter taste (very strong to very weak), milk aroma (very strong to very weak), and texture (hard to soft) (Setyaningsih et al. 2010).

Data analysis

ANOVA analyzed the data obtained to determine the effect of each treatment. Tukey's multiple comparison test is carried out if the treatment has a very significant effect. The data from the organoleptic test results were analyzed by non-parametric statistics using the Kruskall-Wallis test.

RESULTS AND DISCUSSION

Fresh goat milk quality

Milk quality is essential to pay attention to at the beginning of the production process. Milk is the main ingredient in cheese making, and milk components such as protein form texture and flavor. The quality of the milk tested is the total plate number (TPC) and the number of yeast molds to determine the number of bacteria and the number of yeast molds found in fresh goat's milk and pasteurized milk. Results of TPC and yeast in fresh goat's milk and milk pasteurization are presented in Table 1. Test results for the total plate number (TPC) and yeast mold count on fresh goat's milk, respectively 4.6x105 CFU mL-1 and <1.0x105 CFU mL-1. This value does not meet the standards set by the Thai Agricultural Standard for the total plate number (TPC) of fresh goat's milk, that is, a maximum of 2x105 CFU mL-1 (Thai Agricultural Standard 2008). The condition was presumably because of initial contamination during milking. Results from yeast mold numbers indicate that the value meets the specified standard value by the Thai Agricultural Standard for fresh goat's milk, i.e., none (Thai Agricultural Standard 2008). The condition was presumably because of initial contamination during milking. Results from yeast mold numbers indicate that the value meets the specified standard value by the Thai Agricultural Standard for fresh goat's milk, i.e., none (Torkar & Vengušt 2008).

According to the Indonesian Standard, milk is a liquid from the udder of cattle, healthy and clean milk obtained by the correct milking method by applicable regulations whose natural content is not reduced or added anything and has not received any treatment except the process cooling. Determination of the quality of milk must follow the quality standards determined by the National Standardization Agency for fresh milk (BSN 2011).

Chees processing using the pasteurization process. However, there is also cheese made without going through the process. Previous studies found that making processed food using pasteurized milk is better for food safety. Pasteurization is done by heating at 65 °C for 30 minutes (low-temperature long time/LTLT). This matter is required because it will kill bacteria that can affect quality cheese, such as coliform, which can spoil texture and taste prematurely (Fernandes 2009).

Test results for the total plate number (TPC) and yeast mold number of pasteurized milk, respectively, are 5.1x103 CFU mL-1 and 4.6x102 CFU mL-1. The value meets the requirements set by the Kenya Bureau of Standards for the total plate number (TPC) of pasteurized milk, which is <104 CFU mL-1 and does not meet the Kenya Bureau of Standards for pasteurized milk yeast mold numbers, namely 0 CFU mL-1. The quality of pasteurized goat milk meets the standards set by the Kenya Bureau of Standards so that goat's milk can be used for dairy products, especially soft cheese production (Kenya Bureau of Standards 2015).

Physical characteristics of fresh cheese, dali, dangke

The physical characteristics of fresh cheese, dali, and dangke, processed from goat milk, including water activity (aw), pH, and yield value, were presented in Table 2. The results of the analysis of variance showed that the water activity (aw) of dali, dangke, and fresh cheese was not significantly different (P>0.05). It was shown that the difference in coagulants does not affect the aw value of the resulting product. The aw values of dali, dangke, and fresh cheese were 0.82, 0.83, and 0.82, respectively. Water activity shows the amount of free water in food that microbes can use for growth (Walstra et al. 2005). The lower the aw value, the more bacterial growth decreases. At the lowest aw value, the bacteria will not grow (Walstra et al. 2005).

The analysis of variance showed that the pH between dali, dangke, and fresh cheese was not significantly different (P>0.05). Calculating the pH value of cheese is important because it affects the aroma

Table 1. TPC and yeast in fresh goat's milk and pasteurized milk

Milk type	P value (CFU mL^{-1})		Standard Value (CFU mL^{-1})	
	TPC	Yeast	TPC	Yeast
Fresh milk	$4.6x10^5$	$<1.0x10^5$	$2x10^{5a}$	-
Pasteurized milk	$5.1x10^3$	$4.6x10^2$	$<10^{4b}$	Nil[b]

[a] Source: Thai Agricultural Standard (2008).; [b] Kenya Bureau of Standard (2015)

Table 2. Physical characteristics of fresh cheese, dali, and dangke, which is processed from goat milk

Testing	Types of cheese		
	Fresh cheese	Dangke	Dali
a_w	0.82±0.01	0.83±0.01	0.82±0.03
pH	6.34±0.05	6.2±0.19	6.23±0.12
Yield value	$21.38±0.76^b$	$24.52±3.09^{ab}$	$27.40±1.87^a$

Difference of superscripts in the same row showed significant differences (P<0.05).

Table 3. Chemical characteristics of fresh cheese, dali, and dangke, which is processed from goat milk

Variable	Types of cheese		
	Fresh cheese	Dangke	Dali
Dry matter	$57.58±2.38^b$	$72.78±0.67^a$	$68.81±4.49^a$
Ash	$2.02±0.375^a$	$1.27±0.45^b$	$1.63±0.10^{ab}$
Fat content	18.73±1.39	13.17±2.40	13.87±3.56
Protein content	$14.28±2.89^b$	$8.11±1.49^b$	$11.28±1.58^{ab}$
Carbohydrate content	$7.39±0.80^b$	$4.66±1.58^b$	$4.41±0.27^b$

Difference of superscripts in the same row showed significant differences (P<0.05)

and ripening of cheese (Jamilatun 2009). The pH values of dali, dangke, and fresh cheese were 6.23, 6.2, and 6.34, respectively. Based on the data in Table 1, the higher the pH value of the product, the lower the yield. The relationship between pH and the yield shows that the pH in the coagulation process affects the curd yield in this study. Casein clumping can occur at a pH of 4.2 to 5. The lower the pH value, the faster the clumping process will occur (Walstra et al. 2006).

The analysis of variance showed that the yield of dali and fresh cheese was significantly different (P<0.05). The yield between dali, dangke, and fresh cheese is the same. The average yields of dali, dangke, and fresh cheese were 27.40%, 24.52%, and 21.38%, respectively. A previous study found that curd obtained from the coagulation process can reach 10% to 30% of milk volume (Walstra et al. 2006). Yield is the percentage ratio of the weight of the curd produced to the weight of the milk used. The higher yield value produced indicates that the weight of the curd produced is more and more (Irmayanti 2016). Factors that cause different yield values in this study are due to differences in the coagulants used. The curd formation occurs due to agglomeration and isoelectric activity (Walstra et al. 2006). Casein coagulates into the curd at its isoelectric point at pH 4.6.

Chemical characteristics of fresh cheese, dali, dangke

The chemical characteristics of fresh cheese, dali, and dangke, processed from goat milk, including dry matter, ash, fat, protein, and carbohydrate content, were presented in Table 3.

The analysis of variance showed that the water content of dali, dangke, and fresh cheese was significantly different (P<0.05). The water content between dali and dangke does not differ, but the two products have a different water content than fresh cheese. Fresh cheese in this study had the lowest water content based on the average value and the results of multiple comparison tests (Table 3). The high water content of dali and dangke is thought to be due to the coagulant used, which has weak enzyme activity, so the whey is

still bound in the curd. Compared to fresh cheese made with commercial Rennet, the whey separates more from the curd. It is shown that coagulation activity in fresh cheese is more optimal than in dali and dangke. According to Yuniwati et al. (2008), the optimal addition of enzymes will produce yield values that are not so high with low water content due to a better coagulation process so that the whey from the curd formed is easily separated. Low water content is considered good because the less water content, the longer it lasts (Pardede et al. 2013). Dali, dangke, and fresh cheese are classified as soft cheeses based on their water content. Soft cheese has a water content ranging from 50% -80% (Kongo and Malcata 2015).

The analysis of variance showed that the ash content of dali, dangke, and fresh cheese was significantly different ($P<0.05$). Intermediate ash content and dangke based on further test results are different. The ash content of fresh cheese is higher than that of dangke. The ash content in dali did not differ from that in dangke and fresh cheese (Table 3). The ash content indicates the mineral content contained in the food (Pardede et al., 2013). Milk minerals such as calcium, phosphorus, and magnesium are concentrated in the curd, forming during coagulation (Juniawati et al. 2015).

The analysis of variance showed that the fat content contained in dali, dangke, and fresh cheese was not significantly different ($P>0.05$). The fat content, which was not significantly different, was thought to be due to the absence of influence between the heating temperature of the milk and the coagulant used in each product manufactured on the resulting curd fat. The result was similar to the previous study in which there was no real interaction between the heating temperature and the concentration of papain (coagulant) in making dangke (Mukhlisah et al. 2017). Classification of cheese based on its fat content according to the general standard of Codex Cheese (1978) consists of high fat (>60%), full fat (40% to 60%), medium fat (25% to 45%), low fat (10% to 25%) %). Based on the fat content in Table 3, dali, dangke, and fresh cheese are classified as low-fat cheese.

This study's protein levels in dali, dangke, and fresh cheese were 11.28, 8.11, and 14.28%. The analysis of variance showed that the protein content of dali, dangke, and fresh cheese was significantly different ($P<0.05$). Fresh cheese's protein content in this study differed from that of dangke. Dali has a protein content that is not different from dangke and fresh cheese (Table 3). The protein levels in curd are influenced by water content. The higher the water content in the curd, the lower the protein content would be because the protein components were increasingly dissolved in water. The more protein dissolves in water, the lower the protein content (Mukhlisah et al. 2017). The results of this study follow the statement. Based on the average value, the protein content of dangke was the lowest, with the highest water content when compared to the average protein content and water content in dali and fresh cheese (Table 3). The protein and water content of dangke in this study (8.11% and 72.78%) differed from the results in the previous study (Mukhlisah et al. 2017), which were 16.03% and 59.60%. This significant difference is influenced by the concentration of papain in the papaya latex used in the two studies. Enzyme concentration affects the process of curd formation. The amount of enzyme that is insufficient in coagulation will reduce the activity of the enzyme for the coagulation reaction to occur; conversely, if the enzyme is added too much, it will allow the available media to be inadequate for the needs of the enzyme activity, so that the protein content in the product decreases when the enzyme is added excessively (Pardede et al. 2013).

The test results in Table 3 show that the carbohydrate content between dali and dangke is significantly different from that of fresh cheese ($P>0.05$). The carbohydrate content in fresh cheese was 7.39%, significantly higher than dali and dangke (Table 3). The carbohydrate content in this study was calculated using the carbohydrate by difference method (AOAC 2005): 100% - (moisture content + ash + protein + fat). The difference in carbohydrate content between dali and dangke and fresh cheese is thought to be influenced by the different coagulant agents used to manufacture these products. Based on Table 3, water content is the most significant chemical component in curd, so it is suspected that the water content in the product also affects the carbohydrate content in the three products. The water content between dali and dangke, significantly different from fresh cheese, was inversely proportional to the carbohydrate content. Fresh cheese has the lowest water content and the highest carbohydrate content compared to dali and dangke. The result was in line with another study, which states that the carbohydrate content is inversely proportional to the water content (Wulandari 2003).

Microbiological characteristics of fresh cheese, dangke, and dali

The microbiological characteristics tested on fresh cheese, dangke, and dali were the total plate count (TPC). to determine the number of bacteria and yeasts in fresh cheese, dangke, and dali. Sampling was done thrice (week 1, week 2, and week 3). Microbiological characteristics of fresh, dangke, and dali cheese are presented in Table 4.

The results of the variance analysis showed that the treatment of coagulant use did not have a difference in influence on the total plate count (TPC) of fresh cheese, dangke, and dali (Table 2). The test results of the total plate count (TPC) of fresh, dangke, and dali cheeses were $6.73x10^3$ CFU g^{-1}, $4.27x10^3$ CFU g^{-1}, and $6.80x10^3$ CFU g^{-1}, respectively. This figure tends to be high from the

Table 4. Microbiological characteristics of fresh cheese, dali, and dangke, which is processed from goat milk

Testing	Types of cheese (CFU g^{-1})			P value	Standard Value (CFU g^{-1})
	Fresh cheese	Dangke	Dali		
TPC	$6.73x10^3$	$4.27x10^3$	$6.80x10^3$	>0.05	<10 [a]
Yeast	$1.65x10^3$	$2.77x10^3$	$8.93x10^2$	>0.05	<50 [b]

[a] Source: Army Regulation Medical Services (USDA 2009); [b] USDA Foreign Agricultural Service (Baych 2021)

Table 5. The hedonic quality tests of fresh cheese, dali, and dangke, which is processed from goat milk

Testing	Cheese Type		
	Fresh cheese	Dangke	Dali
Color	1.26 ± 0.75^a	1.64 ± 0.85^b	3.92 ± 0.44^c
Milk aroma	3.50 ± 0.93^b	3.20 ± 0.90^b	2.60 ± 1.21^a
Bitter taste	3.88 ± 1.04^a	2.32 ± 1.27^b	3.36 ± 1.02^c
Texture	2.02 ± 0.79^a	2.38 ± 0.69^a	3.72 ± 0.92^b

Difference of superscripts in the same row showed significant differences (P<0.05). Hedonic quality (product quality based on panelist assessment); color: white (1), cloudy white (2), yellowish white (3), greenish-white (4), grayish white (5); cheese aroma: very strong (1), strong (2), moderately strong (3), weak (4), very weak (5); bitter taste: very strong (1), strong (2), slightly strong (3), weak (4), none (5); texture: hard (1), slightly hard (2), soft (3), slightly soft (4), very soft (5)

maximum limit of total bacteria in processed cheese set by the Army Regulation Medical Services regarding the maximum limit of contaminant fungi in dairy products (solid and semi-solid), which does not exceed 10 CFU g^{-1} (USDA 2009). The contamination was possible because the production process was not aseptic. The sources of bacterial contamination in dairy and processed products are due to the sanitation of processing equipment, workers, and raw materials used (Velázquez-Ordoñez et al. 2019).

The various analysis results showed that the coagulant treatment did not have a difference in the influence on the number of yeast in fresh cheeses (Table 4). The yeast molds from fresh cheese, dangke, and dali were $1.65x10^3$ CFU g^{-1}, $2.77x10^3$ CFU g^{-1}, and $8.93x10^2$ CFU g^{-1}. respectively. This result does not match the USDA Foreign Agricultural Service stipulates that it does not exceed 50 CFU g^{-1} (Baych 2021). The contamination was thought to be due to the pre-production process, such as the coagulants used were not sterilized first. The contamination of yeast found on canteen serving and dinner plates comes from the air around the canteen environment. Moreover, air conditioning and production chambers are the main sources of yeast (Damayanthi et al. 2008).

Organoleptic test

Organoleptic testing is divided into 2: the hedonic and the hedonic quality tests. Organoleptic testing collected data from 50 semi-trained panelists on color, aroma, taste, and texture. The samples used in the organoleptic test were fresh cheese, dangke, and dali.

Hedonic quality test

The hedonic quality test aims to see the good and bad impressions of the product being tested. Tests observed included color, milk aroma, bitter taste, and texture. Presentation of hedonic quality test data is presented in Table 5. Based on the hedonic quality test results, different coagulants showed very different results on the color of fresh cheese, dangke, and dali. The colors of fresh cheese, dangke, and dali are 1.26, 1.64, and 3.92, respectively, which are rounded off to 1 (white), 2 (turbid white), and 4 (greenish white), respectively. Fresh cheese, dangke, and dali are made with the basic ingredients of fresh goat's milk, so following Indonesian standards, the color of processed milk is white. The result was similar to the results of a study by Nasution and Marya, which stated that soft cheese made from the milk of the Peranakan Etawah, Saanen, and Crosses PE-Saanen goats has a whiter color than cheese made from slightly yellow cow's milk (Nasution and Marya 2021). Dali produces a greenish-white color because the coagulant in the manufacture of dali uses Agave angustifolia leaf extract.

The results of the hedonic quality test, using different coagulants, showed very different results for milk aroma. The milk aroma values of fresh cheese, dangke, and dali were 3.50, 3.20, and 2.60, respectively, which were rounded off to 4 (weak) and 3 (moderatly strong); this shows that the aroma of milk in fresh cheese and dangke produces a weak aroma of milk, while dali produces a moderatly strong aroma of milk. The aroma of milk is reduced due to the process of separating the curd from whey and the heating process in pasteurization.

Table 6. Results of hedonic tests on fresh cheese, dangke, and dali

Testing	Cheese type		
	Fresh Cheese	Dangke	Dali
Color	2.10±0.97a	2.28±0.88a	4.24±1.58b
Cheese aroma	3.20±1.19ab	3.06±1.15a	3.70±1.78b
Bitter taste	3.94±1.47a	4.72±1.65b	4.44±1.47ab
Texture	3.20±1.38	3.32±1.28	3.38±1.42

Numbers accompanied by different lowercase letters in the same row indicate significant differences (P<0.05). Hedonic test (liking power); Color: really like (1), like (2), like a bit (3), neutral (4), rather dislike (5), do not like (6), really do not like (7); Aroma: really like (1), like (2), like a bit (3), neutral (4), rather dislike (5), do not like (6), really do not like (7); Taste: really like (1), like (2), rather like (3), neutral (4), somewhat dislike (5), dislike (6), really dislike (7); Texture: really like (1), like (2), rather like (3), neutral (4), somewhat dislike (5), dislike (6), really dislike (7)

The assessment of bitter taste in fresh cheese, dangke, and dali products was significantly different statistically. The bitter taste of fresh cheese, dangke, and dali are 3.88, 2.32, and 3.36, respectively, which are rounded off to 4 (weak), 2 (strong), and 3 (rather strong); this shows that dangke products have a bitter taste, dali has a slightly bitter taste and fresh cheese does not have a bitter taste. The bitter taste produced in dangke and dali products is slightly bitter because the coagulant used comes from papaya latex for dangke and dali using *Agave angustifolia* leaf extract; this follows the previous study that the bitter taste produced bytaste is caused by the content of karpain alkaloid compounds (Dewa et al. 2018). Moreover, the bitter taste of dangke is closely related to its levels of nutrients; presumably, apart from the effect of papain, it is also due to the proteolysis process (Arini et al. 2016).

The results of the texture hedonic quality test were statistically very different. The textures of fresh cheese, dangke, and dali are 2.02, 2.38, and 3.72, respectively, which are rounded off to 2 (hard), 2 (hard), and 4 (soft). Fresh cheese and dangke produce a slightly firm texture, while dali produces a slightly softer texture. The soft consistency produced in dali is probably due to the low percentage of coagulant in *Agave angustifolia* leaf extract, so the resulting curd becomes less compact. This result was similar to the previous study that stated that administering enzymes at low concentrations causes imperfect clumping because the enzyme activity is not optimal while administering enzymes at high concentrations also allows low enzyme activity because the available substrate is insufficient for the enzymes needed to work (Musra et al. 2021).

Hedonic test

Hedonic tests also carried out organoleptic testing. The hedonic test determines the panelist's level of preference for the product. The tests observed included color, aroma, taste, and texture. The samples tested were fresh cheese, dangke, and dali. The hedonic test results can be seen in Table 6. Color is the primary determinant of whether consumers like a product because the physiological response and the objective stimulus of the sense of sight are more reflexive in judging (Schiano et al. 2017). Color ratings on products are statistically different. The panelists' acceptance of the colors on fresh, dangke, and dali cheeses were 2.10, 2.28, and 4.24, respectively, with scores of two preferred and four neutral. The colors of cheese and dangke were similar.

Meanwhile, both of them were different from Dali. The color difference was due to the coagulant used in dali, the juice of *Agave angustifolia* leaves. The leaves of *Agave angustifolia* are green with thin stripes of bright white color (Verloove et al. 2019), so the dali becomes greenish-white.

Fresh cheese, dangke, and dali flavors are 3.94, 4.72, and 4.44, respectively, rounded to 4 (neutral) and 5 (somewhat disliked). Taste assessments on products differ statistically. The results of the hedonic test showed that the panelists' difficulty level on the three products was neutral for fresh cheese and dali products, and the panelists somewhat disliked the taste of dangke products. The flavors of cheese and dangke are significantly different, while the flavors of the two with dali are not significantly different. The difference in flavor is because the dangke is made using papaya sap coagulant, so the resulting taste is bitter.

Volatile compounds found in the product were assessed using a sense of smell tool by capturing volatile compounds (Aprea 2020). The results of the scent hedonic test are statistically different. The hedonic test results showed that the aromas the panelists somewhat preferred were fresh cheese and dangke products, with average values of 3.20 and 3.06. The aroma of dali is neutral, with an average value of 3.70. The aromas of dangke and dali are noticeably different. The aroma resulted from the coagulants in dangke using papaya sap. While in Dali, using coagulant leaves of *Agave angustifolia* juice.

The textures of fresh, dangke, and dali cheeses are 3.20, 3.32, and 3.38, respectively (somewhat like). Results show that the textures of fresh, dangke, and dali cheese products are no different. The resulting texture in

fresh cheese, dangke, and dali products has the same level of liking, which is somewhat like.

CONCLUSION

It was concluded that fresh cheese, dali, and dangke have similar TPC and yeast. However, fresh cheese had a better organoleptic value than dangke and dali. Aw, pH, and fat values between dali, dangke, and fresh cheese were similar, meanwhile, there were significant differences in yield value, dry matter, ash, protein, and carbohydrate. The preference level for fresh cheese was preferable compared to dali and dangke.

REFERENCES

AOAC. 2005. Official methods of analysis of tAOAC International. 18th Ed. Horwitz W, Latimer Jr GW, Editor. Washington (USA): AOAC International.

Aprea E. 2020. Volatile Compounds and smell chemicals (Odor and aroma) of Food. Molecules. 25:1–4. DOI:10.3390/molecules25173811.

Arini N, Sudarwanto MB, Sudirman I, Indrawati A. 2016. Improvement efforts of sensory quality and preservation cow's milk dangke with addition cow's milk fat and *Lactobacillus plantarum* supernatant. Int J Dairy Sci. 11:20–27. DOI:10.3923/ijds.2016.20.27.

Baych A. 2021. China notifies cheese standard. Washington DC (USA) United States Department of Agriculture.

BSN. 2011. SNI 3141.1:2011 Susu segar-Bagian 1: Sapi. Jakarta (Indones): Badan Standardisasi Nasional.

Damayanthi E, Yuliati LN, Suprapti VY, Sari F. 2008. Aspek sanitasi dan higiene di kantin asrama tingkat persiapan bersama (TPB) Institut Pertanian Bogor. J Gizi dan Pangan. 3:22. DOI:10.25182/jgp.2008.3.1.22-29.

Dewa FAT, Sirajuddin S, Hendrayati. 2018. Pengaruh konsentrasi getah pepaya terhadap kualitas dangke dan daya terima masyarakat. J Teknol Pangan. 1:0–14.

Fernandes R. 2009. Microbiology handbook: Dairy products. Cambridge (UK): Leatherhead Food International Ltd.

Irmayanti. 2016. Nilai rendemen dan karakteristik organoleptik dangke berbahan dasar susu segar dan susu bubuk komersial (Thesis). Makassar (indones): Hasanuddin University.

Jamilatun M. 2009. Optimalisasi fermentasi pembentukan curd dan analisis kualitas keju mentah yang terbentuk (Thesis). Surakarta (Indones): Sebelas Maret University.

Juniawati, Usmiati S, Damayanthi E. 2015. Karakteristik Fisik Kimia Keju Rendah lemak dari berbagai Bahan Baku Susu Modifikasi. J Penelit Pascapanen Pertan. 12:28–36.

Kenya Bureau of Standard. 2015. Kenya Standard Pasteurized goat milk — Specification. Nairobi (KEN): Kenya Bureau of Standard.

Kongo JM, Malcata FX. 2015. Cheese: types of cheeses - soft. 1st Ed.: Elsevier Ltd. DOI:10.1016/B978-0-12-384947-2.00132-X.

Van Leeuwen SS, Te Poele EM, Chatziioannou AC, Benjamins E, Haandrikman A, Dijkhuizen L. 2020. Goat milk oligosaccharides: their diversity, quantity, and functional properties in comparison to human milk oligosaccharides. J Agric Food Chem. 68:13469–13485. DOI:10.1021/acs.jafc.0c03766.

Maturin L, Peeler JT. 2001. BAM Chapter 3: Aerobic plate count FDA. Maryland (USA): Food and Drug Administration.

Medina M, Nuñez M. 2017. Cheeses From Ewe and Goat Milk. Fourth Edi. Elsevier Ltd. DOI:10.1016/B978-0-12-417012-4.00041-7.

Mukhlisah AN, Arief II, Taufik E. 2017. Physical, microbial, and chemical qualities of dangke produced by different temperatures and papain concentrations. Media Peternak. 40:63–70. DOI:10.5398/medpet.2017.40.1.63.

Musra NI, Yasni S, Syamsir E. 2021. Karakterisasi keju dangke menggunakan enzim papain komersial dan perubahan fisik selama penyimpanan. J Teknol Indust Pangan. 32:27–35. DOI:10.6066/jtip.2021.32.1.27.

Nasution Z, Marya DT. 2021. Uji organoleptik terhadap keju lunak dari susu kambing Peranakan Etawah (PE) Saanen dan persilangannya (PESA). J Green Swarnadwipa. 10:337–341.

Nayik GA, Jagdale YD, Gaikwad SA, Devkatte AN, Dar AH, Dezmirean DS, Bobis O, Ranjha MMAN, Ansari MJ, Hemeg HA, Alotaibi SS. 2021. Recent insights into processing approaches and potential health benefits of goat milk and its products: A review. Front Nutr. 8:1–16. DOI:10.3389/fnut.2021.789117.

Pardede BE, Adhitiyawarman, Arreneuz S. 2013. Pemanfaatan enzim papain dari getah buah pepaya (*Carica papaya* L) dalam pembuatan keju cottage *Lactobacillus bulgaricus*. JKK. 2:163–168.

Permainy A, Wasito S, Widayaka K. 2013. Effect of Differences Rennet of protein and fat content in soft cheese of dairy milk. J Ilm Peternak. 1:208–213.

Pratiwi MB, Sinaga H, Julianti E. 2019. The influence of coagulants and cooking period on the quality of dali ni horbo. IOP Conf Ser Earth Environ Sci. 260:012098. DOI:10.1088/1755-1315/260/1/012098.

Prosser CG. 2021. Compositional and functional characteristics of goat milk and relevance as a base for infant formula. J Food Sci. 86:257–265. DOI:10.1111/1750-3841.15574.

Setyaningsih D, Apriyantono A, Sari MP. 2010. Analisis Sensori untuk industri pangan dan agro. Bogor (Indones): IPB Press.

Silanikove N, Leitner G, Merin U, Prosser CG. 2010. Recent advances in exploiting goat's milk: Quality, safety and production aspects. Small Rumin Res. 89:110–124. DOI:10.1016/j.smallrumres.2009.12.033.

Sirait CH. 1991. Penggunaan susu sapi Fries Holland Untuk pembuatan dali suatu produk susu olahan tradisional Sumatera Utara. Bogor (Indones): IPB University.

Surono IS. 2015. Traditional Indonesian dairy foods. Asia Pac J Clin Nutr. 24:S26–S30. DOI:10.6133/apjcn. 2015.24.s1.05.

Susilawati E, Wahyuningsih S. 2020. Statistics of Food Consumption 2020. Jakarta (Indones): Pusdatin Kementan RI.

Thai Agricultural Standard. 2008. Raw goat milk. Bangkok (THA): National Bureau of Agricultural Commodity and Food Standards.

Torkar KG, Vengušt A. 2008. The presence of yeasts, molds, and aflatoxin M1 in raw milk and cheese in Slovenia. Food Control. 19:570–577. DOI:10.1016/j.foodcont. 2007.06.008.

Turkmen N. 2017. The Nutritional Value and Health Benefits of Goat Milk Components. Elsevier Inc. DOI:10.1016/B978-0-12-809762-5.00035-8.

USDA. 2009. Appendix O of the Department of Defense food safety and quality assurance action level: dairy (other than cheese and milk products: solid and semi-solid dairy products). Washington DC (USA): United States Department of Agriculture.

Velázquez-Ordoñez V, Valladares-Carranza B, Tenorio-Borroto E, Talavera-Rojas M, Antonio Varela-Guerrero J, Acosta-Dibarrat J, Puigvert F, Grille L, González Revello Á, Pareja L. 2019. Microbial contamination in milk quality and health risk of the consumers of raw milk and dairy products. In: Mózsik G, Figler M, Editors. Nutr Heal Dis - Our Challenges Now Forthcom Time. Rijeka (CRO): IntechOpen; p. 1–25. DOI:10.5772/intech open.86182.

Verloove F, Thiede J, Rodríguez ÁM, Salas-Pascual M, Reyes-Betancort JA, Ojeda-Land E, Smith GF. 2019. A synopsis of feral agave and furcraea (agavaceae, asparagaceae s. lat.) in the Canary Islands (Spain). Plant Ecol Evol. 152:470–498. DOI:10.5091/plecevo. 2019.1634.

Walstra P, Wouters JTM, Geurts TJ. 2006. Dairy Science and Technology, 2nd Edition. Abingdon (UK): Taylor & Francis.

Wulandari BRD. 2003. Kombinasi penggunaan getah biduri (Calototropisgigantea) dan bakteri asam laktat pada pembuatan keju lunak (Thesis). Bogor (Indones): IPB University.

Zakariah MA, Malaka R, Laga A, Ako A, Zakariah M, Mauliah FU. 2022. Quality and storage time of traditional dangke cheese inoculated with indigenous lactic acid bacteria isolated from Enrekang District, South Sulawesi, Indonesia. Biodiversitas. 23:3270–3276. DOI:10.13057 /biodiv/d230656.