Properties and Microstructure of Dangke Fresh Cheese Made with Passion Fruits Juice as Coagulant

Ratmawati Malaka *, Wahniyathi Hatta and Sudirman Baco
Department of Animal Food Technology, Faculty of Animal Science, University of Hasanuddin.
*Corresponding author email id: malaka_ag39@yahoo.co.id

Abstract — Dangke, a natural cheese South Sulawesi is made through clotting boiled milk of buffalo, cow, goat or sheep using sap of papaya (carica papaya). Passion fruits (Passiflora edulis) juices can be used to coagulated milk in cheese making but have not been found information about the properties of product by using passion fruits juice as clotting agent of milk. The objective of this study was to investigate the properties of fresh Dangke by using passion fruits juice as coagulate of milk. Dangke was made by 10 lt of raw whole milk and heating in 73°C coagulated by addition of passion fruits juice (7.5% and 10%), and added 1% of salt. Curd was entered to dangke cheese template and pressed until compact. The cheese was packaging and was monitored during 28 d of ripening at approximately 5°C. Dangke was studied toward hardness, pH, level of fat and microstructure. Ripening times was increases the soft cheese hardness, but decreases the pH. Fat level of Soft cheese Dangke was average 21.4% and 30.5% by addition of passion fruit juice 7.5% and 10%, respectively. Hardness of Dangke was increase by increase the time of ripening (1.38 to 3.73 kg/cm), but pH of Dangke was decrease by increase of time of ripening storage (5.34 to 4.1). Microstructure of cheese from 10% of passion fruits was extremely more firm with full fat globular than 7.5%. The properties the Dangke modification making were similar with generally dangke properties. Manufacturing processes by addition passion fruits juice coagulant applied to Dangke had affect on hardness, pH, fat content and microstructure during cooling storage at 5°C for 1 – 28 d.

Keywords — Dangke, Passion Fruits, Microstructure, Cheese.

I. INTRODUCTION

Dangke, a natural semi solid and salty cheese that available in the traditionally market and traditionally manufactured by local people of Enrekang, South Sulawesi, Indonesia [1]. The composition of Dangke are 47.75% of water, 3.32% of ash, 3.89% of fat and 17.01% protein [2]; According to [3], cow milk dangke has a high nutrient content (water content of 55%, protein of 23.8%, fat of 14.8% and ash 2.1%) and its nearly normal pH value of 6.4. Its self life is generally two days at room temperature, while at the refrigerator temperature; it can reach five to seven days.

Recently, South of Sulawesi are being intensively to develop dairy cattle breed, therefore product of milk become increases. Passion fruits (Passiflora edulis) as a natural fruits have juices can be used to coagulated of milk in Dangke making. Natural cheeses are widely produced by homemade industry in the world. For many years, rennet was the most frequently used clotting enzyme for cheese making. A large number of known protease only a few were accepted to replace rennet.

One of natural fruits of South Sulawesi have potential for clotting protein of milk is Marquise (Passiflora edulis Sims) (markisa in Indonesian) juice. The juice of this fruits has high acidity that contains citric acid, malate acid, lactic acid, ascorbic acid and other organic acid [4]. Most of these acid show more evident coagulated activity than rennet to production acid-coagulated milk product such as fresh acid-coagulated cheese varieties. An excessive protein hydrolysis may negatively affect on curd formation and cheese-making yields. The susceptibility of the peptidic bond to the proteolytic activity depends on both, accessibility and specificity of the attack sites. External factors, such as pH, temperature, presence of non-protein substances like polysaccharide, as well as ionic strength of the medium may cause conformational modifications. Consumer acceptance of a cheese product depends directly on its appearance, flavor and texture that affect microstructure directly or indirectly [5]. Therefore, it is important to study conformational modifications as diversification of Dangke of the formation of milk curd during protein catalytic by passion fruits juice.

A number of factors, both compositional and process parameters, are known to influence texture of cheese [6]. In recent years, much attention has been given to the microstructure of cheese. Several techniques have been used for this purpose. In particularly, the use of scanning electron microscopy has become the method of choice in many investigations [7]-[8]-[9]-[10]-[11]. Acid coagulated milk products such as fresh-coagulated cheese varieties are important dairy products [12]. However, little is known regarding the mechanism involved in the gel formation, physical properties of acid gels, and the effect of processing varieties, gelation temperature on the important physical properties of acid-coagulated milk products [13]-[14]-[15]. The objective of this study was to evaluate microstructure of properties of soft cheese by using passion fruits juice as new coagulant.

II. MATERIALS AND METHOD

Cheese Making

Acid coagulated fresh cheese was accomplished using whole milk. This Dangke diversification product were manufactured by local people of Enrekang, South Sulawesi, Indonesia, by using sap of papaya (carica papaya). Passion fruits (Passiflora edulis) juices were coagulated milk at 73°C and then added 1% of salt. The cheese were stored at 5°C and monitored during 28 d.

Copyright © 2017 IJAIR, All right reserved

Malaka, R.*. Department of Animal Food Technology, Faculty of Animal Science, Hasanuddin University, Makassar, Indonesia, telp. 062-0411-583111, fax. 062-0411-587217, (e-mail: malaka_ag39@yahoo.co.id; ratihtamalag39@gmail.com). *corresponding author

602
manufactured by modification of normal procedures according to [16] as shown in Table 1. The acid coagulated fresh cheese kept at about 5°C until used for experiments. This research was conducted in the laboratory of biotechnology of milk processing, Faculty of Animal Science Hasanuddin University, from June to November 2013.

Table 1. Steps in manufacturing of acid coagulated fresh cheese as modification of Dangke

<table>
<thead>
<tr>
<th>Manufacturing steps</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasteurization</td>
<td>Whole milk was heating at 73°C, 15 s</td>
</tr>
<tr>
<td>Passion fruits juice</td>
<td>7.5 and 10.0%</td>
</tr>
<tr>
<td>Salt added</td>
<td>1% waiting until milk coagulated</td>
</tr>
<tr>
<td>Separation curd and whey</td>
<td>The whey was pouring on cheese template</td>
</tr>
<tr>
<td>Pressing</td>
<td>Curd was pressed by press tool</td>
</tr>
<tr>
<td>Filling and packaging</td>
<td>Hot-pack method</td>
</tr>
</tbody>
</table>

Sensory Evaluation

The sensory evaluation was performed according to a procedure of [17]-[18]. Sensory characteristics were determined by 20 untrained panelist for judging the quality of the cheese in term color, aroma, flavor and acceptability. Each panelist received a whole sample 2 cm edge and was requested to taste, carefully, each one. Sensory attributes were measured by using a 6-point hedonic scales: 1 is extremely like to 6 is extremely dislike. A two way analysis of variance (ANOVA) was used to test the sensory score data. Differences among the means were compared using Duncan’s Multiple Range Test.

Estimation of Physical Properties

Estimation of Hardness was evaluated by used CD-shear force modified by [19]. Cheese sample was cut one cm². The operating condition was use formulation as follow:

\[ A = \frac{A'}{\pi r^2} \]

Where:  
- \( A \) = The penetration plunger (kg/cm²)  
- \( A' \) = The power of plunger (kg)  
- \( \pi \) = 3.14  
- \( r \) = ½ diameter of plunger CD-shear Force (0,635 cm)

Level of fat was evaluated by Gerber Methods, and pH evaluator by Hanna-pH-meter [20].

Estimation of Microstructure

Microscopic analysis of acid coagulated fresh cheese was carried out by some modification of the techniques [21]-[10]. The one method was using histological method. Cheese samples approximately three mm cubes were fixed in 5% glutaraldehyde solution for 24 h and dehydrated in a series of ethanol-distilled water solutions (60, 70, 80, 90 and 100% (v/v) ethanol). Sample was cut by microtome knife and fixated in object glass then dyed by Hematoxylin Eosin, and then view by light microscope with 1000 x magnification [21]. The second methods by using the technique scanning Electron microscopic sample. The cheese sample was cut with 6 mm cubes. The cubes were fixed in 2.5% glutaraldehyde solution buffered at pH 7.0 with 0.1 M phosphate buffer, and post fixed in 1% osmium tetroxide solution. Samples were dehydrated in a graded alcohol, and then dried in a Hitachi HCP-2, ion type sputter coater (Hitachi Ltd. Tokyo), and viewed in a Hitachi S-4100 type SEM.

### III. RESULTS AND DISCUSSION

Sensory Evaluation

Results obtained from sensory evaluation by panelists are summarized in Table 2. The passion fruits juice are known as fruits with yellow color, so that showed significant differences (p<0.05) in color, aroma, flavor and acceptability. Passion fruits juice have specific flavor because of ester and non-ester component contains. Marquise have minor component that are carotenoid pigment, specially β-carotene, carotene and fitofluen [22]. This is to be expected, since it has been shown in model system that passion fruits juice with concentration 7.5% impart excellent in sensory parameter than concentration 10%. The average acceptability was near neither like or dislike indicating the cheese still need an introduction and dissemination of product on the consumer society.

<table>
<thead>
<tr>
<th>Sensory Evaluation</th>
<th>Clotted by 7.5% of passion fruits juice</th>
<th>Clotted by 10% of passion fruits juice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>3.53 ± 0.03 a</td>
<td>4.42 ± 0.06 b</td>
</tr>
<tr>
<td>Aroma</td>
<td>3.60 ± 0.04 a</td>
<td>4.43 ± 0.07 b</td>
</tr>
<tr>
<td>Flavor</td>
<td>3.74 ± 0.05 a</td>
<td>4.41 ± 0.05 b</td>
</tr>
<tr>
<td>Acceptability</td>
<td>3.01 ± 0.25 a</td>
<td>3.49 ± 0.04 b</td>
</tr>
</tbody>
</table>

Note: Each value is a means of 20 of 6-point hedonic scale: 1-like extremely 3-4- neither like nor dislike, 6-dislike extremely. Means in the same row bearing a different letter are significantly different (p>0.05).

Cheese properties may be defined as a composite of sensory attributes resulting from a combination of physical properties perceived by the sense of sight and touch [23]-[11]. The flavor, color and mouth feel of cheese affected by a few component of cheese especially fat and proteins [24]. The variation in characteristics of cheese could be attributed to the different basic material and to the age of cheese [25] also by the presence of lactic acid bacteria in cheese [26].

Physicochemical Properties (pH, Fat and Hardness)

The range pH value of fresh Dangke cheese from coagulated passion fruits were at range 6.12 – 6.45 indicating nearly of pH of normal milk. The less variation of pH of this Dangke cheese indicated less of microbial
and biological changes in the cheese network. The microstructural changes in casein micelles during the acidification of passion fruit juice were compared with the previous stage of fusion were extensively coalesced; thus forming a pseudo network with a very open structure; 3) pH 5.3 to 4.8, the network became more dense and fragmented into small units with new casein particles acting like individual characteristics; 4) pH 4.8 to 4.7, casein particles with the previous stage of fusion were followed by a stage of contraction and rearrangement, resulting in new casein particles with spherical shapes; 5) pH 4.6, the formation of acidified milk gels was completed with the casein particles aggregated into a true three-dimensional network of chains and clusters.

Level of clotting materials was very significant influence to hardness, pH, and fat level. Ripening times was increases the soft cheese hardness, but decreases the pH. Fat level of Soft cheese Dangke was average 21.4% and 30.5% by addition of passion fruit juice 7.5% and 10%, respectively. Hardness of Dangke was increase by increase the time of ripening (1.38 to 3.73 kg/cm), but pH of Dangke was decrease by increase of time of ripening storage (5.34 to 4.1). Microstructure of cheese from 10% of passion fruits juice coagulant applied to Dangke had affect on hardness, pH, fat content and microstructure during cooling storage at 5°C for 1 d – 28 d.

ACKNOWLEDGMENT

Authors gratefully acknowledge the financial assistance receiver from Ministry of Education and Research and Technology and Hasanuddin University, Indonesia.

REFERENCES


**AUTHORS’ PROFILES**

Ratnawati Malaka  
Professor of Animal Product Technology, Hasanuddin University  
Biotechnology of milk processing  
Verified email at unhas.ac.id - Homepage  
My profile is public  
email id: rathitamalag39@gmail.com; malaka@unhas.ac.id

Sudirman Baco  
Professor of Animal Production, Faculty of Animal Science, Hasanuddin University  
Animal Production, Animal Breeding, Management  
Verified email at unhas.ac.id - Homepage
Table 3. The changes in properties of Dangke clotting by Passion fruits juices during ripening

<table>
<thead>
<tr>
<th>Variable</th>
<th>0 d</th>
<th>14 d</th>
<th>21 d</th>
<th>28 d</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.45 ± 0.19</td>
<td>6.12 ± 0.54</td>
<td>5.34 ± 0.43</td>
<td>5.0 ± 0.19</td>
</tr>
<tr>
<td>Hardness</td>
<td>1.98 ± 0.90</td>
<td>1.63 ± 0.21</td>
<td>2.88 ± 0.20</td>
<td>2.57 ± 0.12</td>
</tr>
<tr>
<td>Fat</td>
<td>24.9 ± 1.29</td>
<td>21.4 ± 1.63</td>
<td>27.6 ± 1.89</td>
<td>25.2 ± 1.79</td>
</tr>
</tbody>
</table>

Notes: Hardness unit is kg/cm²; Fat level unit is %. This value is the average.

Fig. 1. Light micrographs by HE dye (1000 x magnification) of coagulated fresh cheese by passion fruits juice with a comparison of the two different techniques. Coagulated by 7.5% passion fruits juices: a) 14 days of ripening, c) 28 days of ripening. Coagulated by 10% marquise juice: c) 14 days of ripening, d) 28 days ripening.

Fig. 2. Scanning Electron Microscope (10,000 x magnification) of coagulated fresh cheese by passion fruits juice with a comparison of the two different techniques. Coagulated by 7.5% passion fruits juices: a) 14 days of ripening, c) 28 days of ripening. Coagulated by 10% marquise juice: c) 14 days of ripening, d) 28 days ripening.