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PHYSICOCHEMICAL CHARACTERISTIC OF FERMENTED GOAT MILK ADDED WITH DIFFERENT STARTERS LACTIC ACID BACTERIA

Anif Mukaromah Wati[1,2)], Mei-Jen Lin[4)], Lilik Eka Radiati[3)]

[1)] Student of Master Post Graduate, Faculty of Animal Science, Brawijaya University, Veteran Street, Malang, East Java, Indonesia. 65145

[2)] Student of Double Degree Department of Animal Science, National Pingtung University of Science and Technology, Taiwan

[3)] Faculty of Animal Science, Brawijaya University, Veteran Street, Malang, East Java, Indonesia. 65145

[4)] Department of Animal Science, National Pingtung University of Science and Technology, Taiwan

Email : anifmukaromahwati@gmail.com

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ABSTRACT

Development of traditional food including dadih to be commercial fermented milk was needed to achieve efficiency and effective of products. Dadih with natural starter needs to be changed with starters because starters can be produced commercially. This study aims to evaluate physicochemical characteristic of fermented goat milk that added with different starters Lactic Acid Bacteria (LAB) isolated from dadih. The materials used for this research were starters LAB that isolated from dadih. In this experiment, treatments were used different starters that namely starter 11, starter 21, starter 25, starter 29, and starter 41 then analized about water content, ash content, fat content, syneresis, and viscosity. The experiment was carried out with three replications. The data were analyzed by ANOVA using the basic design of Completely Randomized Design (CRD) and continued by Duncan's Multiple Range Test (DMRT) if there was a significantly different. The results showed that different starters had influence on water content, ash content, fat content, syneresis, and viscosity. It could be concluded that starters 11 and 41 were the best starter that can be applied in fermented goat milk product based on physical quality with lower syneresis and higher viscosity. But based on chemical quality, starter 11 was the best starter with lower water content and higher ash content.

Keywords : *Starters LAB; dadih*

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ABSTRAK

Dadih merupakan produk susu fermentasi pengembangan makanan tradisional menjadi produk komersial yang efisien dan efektif. Dadih menggunakan starter natural dan saat ini starter yang digunakan diisolasi ditingkatkan untuk diproduksi secara komersial. Penelitian ini bertujuan untuk mengevaluasi Lactic Acid Bacteria (LAB) yang diisolasi dari dadih. Bahan yang digunakan untuk penelitian ini adalah LAB yang diisolasi dari dadih. Dalam percobaan ini menggunakan, starter 21, starter 25, starter 29, dan starter 41 kemudian dianalisa tentang kadar air, kadar abu, kadar lemak, sineresis, dan viskositas. Percobaan dilakukan dengan tiga ulangan. Data dianalisis menggunakan analisi ragam (Anova) dengan Uji Jarak Berganda Duncan (DMRT) jika ada perbedaan yang. Hasil penelitian menunjukkan bahwa starter yang diisolasi dari dadih yang berbeda memberikan pengaruh terhadap kadar air, kadar abu, kadar lemak, sineresis, dan viskositas. Dapat disimpulkan bahwa starter 11 dan 41 adalah starter terbaik yang dapat diterapkan dalam sineresis berbasis susu kambing fermentasi dan memiliki viskositas yang lebih tinggi. Namun berdasarkan kualitas kimia, starter 11 adalah starter terbaik dengan kandungan air yang lebih rendah dan kandungan abu yang lebih tinggi.

Kata kunci: Bakteri asam laktat; dadih

INTRODUCTION

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Dadih or dadiah, a traditional food from West Sumatra, Indonesia, is made from buffalo milk, then poured and fermented in bamboo tubes. Syukur *et al*. (2016) stated that the problem of dadih is still made with traditional way. In West Sumatera, dadih is not using starter and did't have any standard for nutrient and the making of dadih. The other problem of dadih that using traditional way (natural fermentation) can give variations in the characteristics, quality, and acceptability of dadih. Traditional way of dadih with natural starter needs to be changed with starter culture as starter culture make dadih more stable than using bamboo tube. Starters can use from LAB as they can convert carbohydrate into lactic acid (Nuraida, 2015). The parameter of industry to using LAB is capability to convert into lactic acid of raw materials because acidification can prevent growth of undesirable microorganisms and make the product with desirable aroma, texture, and flavor (Akabanda *et al.*, 2014). LAB utilized milk protein, then affected to enhance free amino and peptides. Moreover, LAB have market potential and claimed as probiotic because LAB are affecting to improve microbial balance in intestinal (Surono, 2003). Starters from LAB can obtain from dadih because dadih contain of LAB.

LAB of dadih are from raw material to make dadih that including buffalo milk, banana leaves, and bamboo tubes. Generally, LAB in

*Corresponding author:
Anif Mukaromah Wati
Email : anifmukaromahwati@gmail.com
Student of Master Post Graduate, Faculty of Animal Science, Brawijaya University, Veteran Street, Malang, East Java, Indonesia. 65145

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spontaneous lactic lactic acid fermentation including dadih were identified from *Lactobacillus plantarum* and *Lactobacillus fermentum*. Making dadih can use cow or goat milk because population of bufallo milk is decrease. Goat milk can be produced to ferment milk product (Yelnetty, *et al.,* 2014). Goat milk has LAB including *Lactobacillus* subsp. that potential to be antifungal (Widyastuti *et al*., 2014). Goat milk has functional components: proteins, vitamins (such as vitamins E and C), flavonoids, carotenoid, and antioxidant properties (Alyaqoubi *et al.,* 2015). In a previous experiment (Elida 2002), it was made dadih with yellow bamboo (*Bambusa vulgaris),* betung bamboo *(Dendrocalamus asper),* talang bamboo *(Schizoztachyum brachycladum),* and gombong bamboo *(Gigantochloa verticillata)*. Characteristic of dadih is affected by different bamboo as packaging. Taiwanhas thorny bamboo (*Bambusa stenostachya* Hackel) resources due to its environment which is suitable for bamboo growth. Thorny bamboo contains ash 2.66 ± 0.02%, hot water extractives 7.52 ± 0.05%, 1% NaoH extractives 25.62 ± 0.10%, alcohol–benzene extractives 75 ± 0.14%, lignin 25.21 ± 0.05%, holocellulose 68.53 ± 0.11%, and pentosans 17.55 ± 0.10% (Wang and Tsai, 2015).

This study aims to evaluate physicochemical characteristic of fermented goat milk that added with different starters isolated from dadih which packaging from Taiwan bamboo .

MATERIALS AND METHODS

Materials

Experiment was conducted from March until December, 2017 in Dairy Labolatory Department of Animal Science, National Pingtung University of Science and Technology (NPUST), Taiwan. The materials in this experiment were starters LAB and goat milk. Starters were obtained from Dairy Labolatory, Department of Animal Science, NPUST, Taiwan and goat milk was collected from dairy Alpine goat farm at Pingtung, Taiwan. Starters LAB that used in this experiment were isolated from dadih. Dadih was made with poured fresh goat milk to bamboo tube, which was special bamboo from taiwan: *Bambusa stenostachya* Hackel. After poured fresh goat milk to bamboo tube, bamboo tube was covered with banana leaves, and fermented in incubator 37ºC during 30 h. Then, dadih was isolated and identified the similar characteristic its starters with LAB. The identification was purposed to ensure the starters was from LAB, the identification including: microscopic identification, Gram stain, catalase test, motility test, and proteolytic activity test. The characteristic of starters were rod shape, Gram stain positive, and negative motility test and catalase test, and positive proteolytic activity. Moreover, starters had ability to decrease pH, increase TA (Titratable Acidity) and viability of LAB, and made a curd formation.

Methods

The methods of this research was experiment. Goat milk was homogenization, pasteurized at 85ºC for 30 min, added with 3.0% of starters, incubated at 37ºC for 48 h in incubator. In this experiment, treatment was used different starters that namely starter 11, starter 21, starter 25, starter 29, and starter 41 , then analized ash content, water content, fat content, syneresis, and viscosity. The study was conducted with three replications. The data were

analyzed by ANOVA using the basic design of Completely Randomized Design (CRD). Perform data analysis was used Statistical Analysis System (version 9.3, SAS) and continued by Duncan's Multiple Range Test (DMRT) if there was a significantly different. Parameters observed including ash content, water content, fat content, syneresis, and viscosity. Analysis of this experiment:

1. Analysis of water content: sample 1.0 g was weighed and placed in oven (WTC Binder, Tuttlingen, Germany) at 105^{o}C for 8 h (Modified from AOAC, 2000).
2. Analysis of ash content: sample 1.0 g was weighed and ignited with VULCAN A-550 (Ney Dental Inc (NDI), California, USA) for 12 h at 600^{o}C (Modified from AOAC, 2000).
3. Analysis of fat content: The bag paper XT4 Filter bags (Ankom Technology, New York, USA) was dried at oven (WTC Binder, Tuttlingen, Germany) at 105^{o}C for 18 h. Sample 1.0 g was weighed, transffered in bag paper and sealed to avoid loss of sample. The sample was extracted wih (Ankom Extractor model XT 10, New York, USA) that already poured with 350 mL Petroleum benzine (Merck, Taipei, Taiwan). After extraction, samples was dried in oven at 105^{o}C for 3 h. Directly, samples was transferrred in exsicator for 15 min and redried in oven for 20 min until the weight was constant (Modified from Aji *et al.,* 2015).
4. Anlalysis of viscosity: viscosity measurements were obtained using a Brookfield viscometer (Model DV-II+; Brookfield Engineering Labs, Inc., MA, USA) with spindle 2, rotating at 60 rpm and setting the temperature 4°C (Modified from Vareltzis *et al*., 2015).
5. Anlalysis of syneresis: syneresis was determined by Centrifuges universal 320 R (Sunway Scientific Corporation, New Taipei, Taiwan). Samples 20 g was rotated at 222 g for 10 min at 4^{o}C (Modified from Nouri *et al.,* 2011). The formula to determine syneresis used:

$$\frac{\text{Clear supernatant}}{\text{Initial weight}} \times 100$$

(Nouri *et al.,* 2011)

RESULTS AND DISCUSSION

Water content

Different starters had significant difference ($p<0.05$) on water content (Table 1). Starter 11 had lower of water content: 90.48 ± 0.33 and starter 21 had higher: 91.21 ± 0.08. Water content had negative correlation with ash content and fat content. Starter 11 had lower of water content while higher of ash content and fat content as part of total solid in milk. Higher of water content of starter 21 was caused by lower activity of starter 21 that effecting to lower curd formation or total solid. On the other hand, low water content on starter 11 because starter was higher to produce lactic acid, precipitated a milk protein, formed curd, and effected to decrease water content in the end of fermentation. Lawal and Adedeji (2013) stated that water content on fermented milk was affected by material (milk) and curd formation. The low values of water content with high activity of LAB were agreed with results from Bahobail *et al,* (2014), higher bacterial load effected to high produce acids in the medium attributed to lower water content values and

increased of total solids from 11.08% in fermented camel milk and 11.5% for fresh camel milk.

Ash content

Different starters have significant difference ($p<0.05$) on ash content (Table 1). The lower of water content was affecting to higher of ash content. Starter 11 had high of ash content 0.76 ± 0.04, and as Owiah *et al*. (2017) noted that high ash content indicated high inorganic content. Ash content was one of total solid that effected by activity of starters. According to the connection observed by Bibiana *et al.* (2014), ash content of yoghurt ranged from 0.41% to 1.02%, yoghurt with higher of ash content indicated that yoghurt was better source of minerals. Ladokun and Oni (2014) stated that mineral compositions of milk could be measure with ash content analysis.

Fat content

Different starters had significant difference ($p<0.05$) on fat content (Table 1). Fat content of starter 41 was higher (2.37 ± 0.18) and lower of starter 21 (1.03 ± 0.45). Fat content had negative correlation with water content. Starter 21 had lower of fat content while water content was higher. Higher of fat content of starter 41 because during fermentation, starter had ability to produce lipase, then lipase degrade fat to fatty acid and glycerol and effected to increase fat in fermented goat milk. LAB had metabolic activities such as breaking down lipids and other compounds. Different results were observed by Bahobail *et al.* (2014), fermented milk had fat 4.1%. Different results also reported by Widodo *et al.* (2013), fermented goat milk with collaboration between ST and LB was 5.40 ± 0.28, LA (4.50 ± 0.99), and LC 5.20 ± 0.00. Different results were caused difference in chemical composition of milk, starter cultures that used in fermentation, microbial population, and incubation period.

Fat content was included total solid on milk, as carried out in the study of Ehirim and Onyeneke (2013), improving the consistency of yoghurt was one important role of fat content. Kalyankar *et al*. (2016) noted that goat milk was higher fat content than cow milk because goat milk contained several hundred fatty acids that different with cow milk.

Syneresis

Whey separation (wheying-off) means the expulsion of whey from the network on products, then becomes visible as surface whey (Lee and Lucey, 2010). Different starters have significant difference ($p<0.05$) on syneresis (Table 1). Syneresis on starter 21 was higher (29.47 ± 1.75). Starters with low of syneresis were starter 11 (23.04 ± 0.77) and starter 41 (23.39 ± 2.39). The phenomenon of syneresis in this experiment was higher than that reported by Joon *et al.* (2017) who observed that yoghurts from goat milk had syneresis (9.92±0.02), different results between experiment and literature because in this experiment not used stabilizer that effected to increasing syneresis.

Syneresis had negative correlation with viscosity. When fermented goat milk had low syneresis, it had high viscosity. Starter 11 and 41 were lower of syneresis because higher activity of starters, then total solid was increased, increasing of total solid effected to decrease syneresis. The mecanism of starter to decrease syneresis was when starter was added

in fermented milk, starter can increase total solid that caused by higher density and lower pore size in the protein matrix of the fermented milk gel. Vareltzis *et al.* (2015) stated that this led to a reduction in syneresis and improvement of the water holding capacity of the gel. Lower syneresis of starters 11 and 41 showed acceptable product by consumers. Higher syneresis of fermented goat milk when adding with starter 21 because separation of liquid from shrinkage gel. Chye *et al.* (2012) noted that the gel interaction network is weakened and eventually ruptured which reduced the water holding capacity of fermented milk structure.

Viscosity

Different starters have significant difference ($p<0.05$) in viscosity (Table 1). Starters with high viscosity were starter 41 (158.67 ± 2.46) and starter 11 (154.33 ± 6.99). Additionally, lower viscosity was starter 21 (72.50 ± 0.58). Viscosity had correlation with water content and syneresis. Starter 21 had higher water content while lower viscosity and higher syneresis. Similar results were observed by Joon *et al.* (2017), they reported that yoghurt from goat milk had a softer consistency and lower viscosity than from cow milk. Viscosity was depended on dry matter (Dinkov *et al.*, 2008). Moyane and Afam (2013) noted that sample with lowest viscosity is recorded as lowest consumer acceptance on texture and smoothness sensory attributes.

Table 1. Physicochemical Fermented Goat Milk

Treatments (different starters)	Water content (%)	Ash content (%)	Fat content (%)	Viscosity (cP)	Syneresis (%)
Starter 11	90.48 ± 0.33^{b}	0.76 ± 0.04^{a}	1.92 ± 0.49^{ab}	154.33 ± 6.99^{a}	23.04 ± 0.77^{b2}
Starter 21	91.21 ± 0.08^{a}	0.70 ± 0.05^{ab}	1.03 ± 0.45^{b}	72.500 ± 0.58^{c}	29.47 ± 1.75^{a}
Starter 25	90.89 ± 0.09^{ab}	0.74 ± 0.03^{a}	1.06 ± 0.44^{b}	125.00 ± 4.04^{b}	26.52 ± 0.93^{ab}
Starter 29	91.05 ± 0.06^{ab}	0.71 ± 0.03^{ab}	1.12 ± 0.07^{b}	113.67 ± 1.20^{b}	27.21 ± 1.19^{ab}
Starter 41	90.72 ± 0.21^{ab}	0.59 ± 0.04^{b}	2.37 ± 0.18^{a}	158.67 ± 2.46^{a}	23.39 ± 2.39^{b}

Remarks : $^{a, b}$ Mean values within a same column followed by the different letters are significantly different at ($p<0.05$)

Conclusion

It could be concluded that starters 11 and 41 were the best starter that can be applied in fermented goat milk product based on physical quality with lower syneresis and higher viscosity. However, based on chemical quality, starter 11 was the best starter with lower water content and higher ash content.

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