PHYSICOCHEMICAL AND ORGANOLEPTIC PROPERTIES OF DRY FERMENTED MILK PRODUCTS WITH ADDITION OF PROBIOTIC BACTERIA \textit{Streptococcus lactis}, \textit{Lactobacillus casei} AND \textit{Bifidobacterium longum}

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ABSTRACT

Fermented milk is healthy product that has many benefits especially for human digestive tract. Manufacturing of probiotic fermented milk products with a viable long shelf life needs to be developed as a functional food. The aim of this study was to characterize the physical and organoleptic properties of dry fermented milk with the addition of probiotic bacteria \textit{Lactobacillus casei} and \textit{Bifidobacterium longum}. Experimental design employed in this study was complete random design with 4 treatments using different lactic acid bacteria (LAB): A1 (\textit{Streptococcus lactis}: 0.5%); A2 (\textit{Streptococcus lactis}: 0.25% and \textit{Lactobacillus casei}: 0.25%); A3 (\textit{Streptococcus lactis}: 0.25%, \textit{Lactobacillus bulgaricus}: 0.125%, \textit{Streptococcus thermophiles}: 0.125%); and A4 (\textit{Streptococcus lactis}: 0.25% and \textit{Bifidobacterium longum}: 0.25%). Physical analysis (hardness, tenderness, pH, and total acid), and organoleptic analysis were conducted to the milk products. Based on physical analysis, the highest level of hardness was A2 product, the highest level of tenderness was A1 product, and the lowest pH level was A1 product. Based on organoleptic test, A4 product with the treatment mixed starter bacteria \textit{Streptococcus lactis} and \textit{Bifidobacterium longum} was the best product for level of hardness, tenderness, pH and had properties yellowish white color, medium texture, smell of sour milk and typical characteristic of pure, tender hardness, and had good taste mixed between sweet and sour taste.

Key words: Dried Fermented Milk, Functional Food, Lactic Acid Bacteria (LAB), Physical and Organoleptic Properties

INTRODUCTION

Nowadays, people awareness of functional food is increased, they begin to choose food which really useful for health. Functional food is a kind of food or drink that contained materials for enhancing health and prevent from certain of diseases (Muchtadi, 2004). Fermented milk is healthy product that has many benefits especially for human digestive tract. Probiotics have emerged as the major nutritional factor influencing gastrointestinal physiology and function. This development introduces many challenges, but also creates new opportunities for food and nutrition scientists to improve food quality and develop new products with specific health benefits for different subpopulations (Diplock \textit{et al.}, 1999). Probiotic are live microbes that cause effects when consumed by people who have healthy balance of microflora in the digestive tract (Fueller, 1989).

Gastrointestinal microflora is a complex ecosystem consisting various types of bacteria and can lead to positive and negative effects on intestinal physiology. Good health is influenced by the most "good microbes" which are lactic acid bacteria (LAB). Its beneficial for health. To manufacture fermented dairy products, lactic acid bacteria are traditionally selected for their capacity to acidify milk and produce aroma compounds (Grattepanche \textit{et al.}, 2006). In general, a liquid fermented milks have no long shelf life. Method of drying fermented milk products can extend the shelf life of products to avoid damage to the sensory and chemical and the product was still suitable for consumption by humans. Manufacture of dry fermented milk products using probiotic bacteria is a relatively new technology in
International Conference on Livestock Production and Veterinary Technology 2012

Indonesia. Therefore we need research to develop functional food as a cow's milk-based health products today. The aim of this study was to characterize the physical and organoleptic properties of dry fermented milk with the addition of probiotic bacteria *Lactobacillus casei* and *Bifidobacterium longum*.

**MATERIALS AND METHODS**

**Materials and equipments**

The materials used in this research were consisted of the main ingredients and supporting materials. The main ingredient were cow's milk obtained from dairy farmers in the region Kunak, Ciampea, Bogor and LAB culture (*S. lactis*, *L. bulgaricus*, *S. thermophilus*, *L. casei* and *B. longum*). Supporting material used was sugar. Equipment used in the study include texture analyzer (USA brands CT3 4500 production), penetrometer (Precision Petroleum Analyzer brands, Company San Antonio Texas), oven (Imperial V brands Laboratory Oven, USA), pH meter, blower room, and colony counters, porcelain bowls, erlenmeyer, stoves, water bath, furnace, porcelain bowls, appliance titration, pumpkin drinks, a thermometer, the volume of glass, glass tools, and other equipment.

**Method/technique of processing dry fermented milk**

Processing of dry fermented products made from raw cow's milk with the addition of probiotic is based on the research conducted by Jandal (1996) and modified by Hidayatulloh (2011). The treatments were added to the addition of BAL culture (*S. lactis*, *L. bulgaricus*, *S. thermophilus*, *L. casei* and *B. longum*). Product making was presented ini Figure 1.

**Experimental design**

The experimental design study was complete random design with 4 treatments using different lactic acid bacteria (LAB): A1 (*S. lactis*: 0.5%); A2 (*S. lactis*: 0.25% and *L. casei*: 0.25%); A3 (*S. lactis*: 0.25%, *L. bulgaricus*: 0.125%, *S. thermophilus*: 0.125%); and A4 (*S. lactis*: 0.25% and *B. longum*: 0.25%).

**Statistical analysis**

The experimental design was a completely randomized design and the difference among treatments was tested using the Duncan multiple comparison test. Analysis of variance using software SPSS Statistics Duncan 17.0 was performed to determine the significant difference between flours. All correlations were performed at a 5% significance level. Data reported are the average of two replications.

**Product analysis**

Texture analysis using a texture analyzer and organoleptic test with hedonic product quality and test for panelists acceptance (Setyaningsih et al., 2010). Hedonic test using 15 – 25 untrained. Hedonic test parameters are color, flavor, taste, hardness and texture with the assessment scores used were 1: dislike extremely to 5: very like it.

**RESULTS AND DISCUSSION**

**Physical property of dry fermented milk**

**Hardness levels**

Hardness is one of the physical property assessments on product and it was measured by using hand or bitten with tooth. In this research, the hardness dry fermented milk products were measured using a texture analyzer. The physical properties of dry fermented milk levels of hardness showed in Figure 2. Based on Figure 1, A2 treatment had the highest levels of hardness about 1193.44 g, it was because the water content was least so that product was being driest and hardest. Less water content in food was make it becomes drier and more solid. Otherwise, A1 product had the lowest hardness level about 905.06 g due to very high levels of water content in the
The hardness level was indicated the water content contained in a product (De Man, 1997). The higher hardness level on products tend to occurred in products with addition of *L. casei*. Based on analysis of variance showed that the treatment did no significant affect the hardness level of dry fermented milk products (P > 0.05), it means that the treatments was not different in each others.

**Tenderness level**

The tenderness could perceive by chewing product. The tenderness level of dry fermented milk products was measured using a penetrometer. The physical property of
tenderness on dry fermented milk showed in Figure 3.

Based on Figure 3, A1 treatment had the highest levels of tenderness about 18 kg/s, while the A3 treatment had the lowest tenderness level about 13.28 kg/s. Higher tenderness on dry fermented milk products represented by fat content in milk. Higher fat content on dairy product will produce a tender texture of processed products (Banks, 2007). According to Matz (1978), fat can improve the physical structure, the tenderness, and aroma. Analysis of variance showed that the treatments did no significant affect the tenderness of dry fermented milk, it was indicate that tenderness levels were no significant different from each others (P > 0.05).

Acidity (pH) and Titratable Acidity

Measurement of acidity (pH) was carried out after milk products fermented for 24 hours and after drying process of fermented milk. Chart comparison of pH dry fermented milk before and after drying process showed in Figure 4.

Based on Figure 4, the pH value of dried fermented milk after fermentation process ranged from 5.03 to 5.39. The lowest pH value was A2, while the highest pH value of A4. pH value of fermented milk after drying process ranged from 5.74 to 6.14. The lowest pH value was A1, while the highest pH value was A4. pH value of the difference between dry fermented milk before and after the drying process was due to the addition of sugar. Sugar
could increase the pH value, thereby reducing the sour taste of fermented milk. According to Fellows (2000), the sugar fructose has a simpler compound that can cause a sweet taste and affect the acidity of the food products. Analysis of variance showed that the pH value in all treatments before and after drying process were no significant different from each other (P > 0.05).

Based on Figure 5, total acid in fermented milk dry before the drying process ranged from 1.12 to 1.43% with the highest total acid was A1. After the drying process, total acid decreased and ranged from 0.53 to 0.69 with the highest total acid in was A2. The acidity is directly proportional to pH value. pH value was opposite with the acidity level, according to Roissart and Luquet (1994), LAB lactate production in different levels was depend on the amount of nutrients, especially lactose and other components in milk during fermentation media. Analysis of variance showed that the treatments significantly effect the total acid products (P < 0.05). Total acid was different in each treatments.

**Organoleptic properties**

According to Setyaningsih et al. (2010), sensory assessment is a subjective test material using the five senses. Although the equipment has been growing rapidly, but the food assessment by using the senses remain important because there are some characteristics of the food can only be judged by the human senses. Sensory assessment is very important related to improved nutrition in development of food products. Organoleptic test also called sensory evaluation based on the senses of sight, smell, taste, and perhaps the sense listeners. Determination of acceptability of food products can be done through test hedonic or preference.

**Hedonic quality assessment**

**Color**

Analysis of variance showed that the treatments no significant effects the color product (P > 0.05) (Figure 6). A1 product had yellowish white same with others product. According to Fellows (2000), the color of products was affected by processing and storage. Drying process caused changes color from white to yellowish white. The presence of sugar in product tend to allowed the maillard reaction, but the temperature was not too high and the addition of sugar was only 10% of the weight of curd causes so it did not produce a brown color. The yellow color was caused by the compound of beta-carotene in milk. Color

![Figure 5. Total Acid comparison of fermented milk before and after drying process](image-url)
similarly of all formulation products was occurred because of the same time on drying process

**Texture**

Analysis of variance showed that the treatment significantly effect the texture attributes (P < 0.05). Product A1, A3, and A4 had harder texture then A2 (Figure 6). Contrast with physical analysis, product A2 was the hardest product (Figure 1). The texture of fermented milk products was influenced by moisture content, fat, and protein. Texture changing was caused by coagulation or protein hydrolized, creaming of milk emulsion, hydrolysis of carbohydrates, and fat loss (Fellows, 2000). Product texture influenced by many factors there were heating and drying process. According to Tomar and Prasad (1989), milk is heated to 70°C which produces a soft and had an open structure of casein. In addition, lactic acid fermentation by the BAL results changed to a softer texture (Widowati and Misgiyarta, 2009). The addition of powder sugar to the curd had an impact on the texture resulting product after drying (Manley, 2008). A2 product was assessed had fine granules, it was occur because of the granules softer so that when the curd was molded and dried produced soft texture in panelists mouth. Based on organoleptic assessment, A3 product had the hardest in texture attributes.

**Flavor**

Flavor is resulted from combination between taste and smell sense. Flavor can be detected by using the olfactory epithelium of the upper nasal cavity (Vaclavik and Christian, 2003). Humans use the nose as a tool to detect flavor and odor. Smell test was called long distance sense test because humans could be known a delicious food from distance (Setyaningsih et al., 2010). Based on analysis of variance showed no significant effect of treatments due to flavor attributes of dry fermented milk. A1 dry fermented milk had yogurt flavor same with A2, A3, and A4 products (Figure 6). Flavor in fermented milk products due to the number of components produced during fermentation such as diacetil, acetoin, and butadienol. The main component of the role is diacetil (Quintans et al., 2000). Based on the assessment of the image, A2 product had the highest value among other products. According Fonden et al. (2000) and Hutkins (2006), *L. casei* produced acid products with a distinctive aroma which often used in the cheese products flavor.

**Hardness**

Hardness is another factor which determines the consumer received the food product. Usually the food product was accepted by
consumers had medium hard level so that could be easy bitten. Dry fermented milk product was dried by oven, and therefore required an assessment of the hedonic quality attributes of violence. Analysis of variance showed that the treatment had significant effect to hardness attribute (P < 0.05). A1, A2, and A4 had higher hardness then A3 (Figure 6). Based on physical analysis of tenderness of A3 product had the lowest value (Figure 2). It was consistent with the panelist assessment. According Panesar (2011), yoghurt cultured with a symbiosis between bacteria S. thermophilus and L. bulgaricus produced soft texture, dense consistency, and accepted flavor. It was also supported by Paskov et al. (2010) that the combined culture of S. thermophilus and L. bulgaricus increased the gel viscosity of fermented milk products, so that when the A3 product was dried also had the hardernest texture.

Taste

Taste is a main factor for consumers to receive the food product. Vaclavik and Christian (2003) suggested that the taste of food is a combination of five basic tastes are salty, sweet, sour, bitter, and umami. Taste is very complex and difficult to describe. Taste of a food product could be influenced by several factors, for instance chemical compounds, temperature, consistency, and interaction with other flavor components and the type and duration of cooking. Analysis of variance showed that the treatment had significant effect on flavor attributes (P < 0.05). A1 and A2 product had dominant sour taste, while A3 and A4 had a sweet and sour taste (Figure 6). Based on measurements of pH and total acid value (Figure 3 and 4), A1 and A2 product had lower pH value and total acid higher than A3 and A4 (%).

Products A1 and A2 had dominant sour taste. According Foden et al. (2000) and Dahhan et al. (1984) that in yogurt manufacture, the utilization of S. lactis can produce good acidity in commercial yogurt products, and L. casei also produced a sour taste good as a commercial cheese flavor formation. According Tamime and Robinson (2007), Bifidobacteria did not produce a high acidity due to slow fermentation. It was also accordance with the National Standard (1992) for yogurt product had special sour taste. According to Fellows (2000) the utilization of sugar can affect the taste of a food product.

Hedonic test

According to Rahayu (1998), hedonic test was aimed to determine acceptance of the panelists to the general properties such as color quality, flavor, texture, and taste. Through the

![Figure 7](image_url)  
**Figure 7.** Average score of hedonic test for color, texture, flavor, and taste in dry fermentation milk.
hedonic test would be known the nature of the resulting good quality beverage flavor, aroma, color, and texture. Results of hedonic test of the product as a control treatment A1, A2, A3, and A4 can be seen in Figure 7.

Based on hedonic test, analysis of variance for color was no significant effects on products (P > 0.05). The color of dry fermented milk that was bright yellowish-white so the panelist accepted well. Based on analysis of variance conducted on the assessment of dry fermented milk preferences, can be seen that significantly different levels of texture preferences among formulations (P < 0.05). Acceptance of A1, A2, and A4 product was medium, while A3 tendo unlike by panelists because of the hardness. Flavor also one of factors that determined the acceptance of food products by panelists. Analysis of variance of flavor seems no significant different (P > 0.05), so all panelists judge the product had the same flavor. Based on analysis of variance for taste attribute, there were no significant different among the treatments due to taste (P > 0.05). All panelists judged the products Taste were ordinary as fermented milk and had a sour taste.

The hardness attribute also was judged by panelists beside the texture attribute. Based on analysis of variance the treatments had no significant different for hardness (P > 0.05). Acceptance of hardness attribute seems panelist to be preferred the product was softer than the harsh products. Organoleptic tests of dry fermented milk with the addition of probiotic were judged for overall acceptance by panelists. The test of overall preference test was determined whether the product was feasible to release in market. Based on analysis of various, it was known that the degree of overall acceptance were no significant different for all treatments (P > 0.05). Overall products acceptance were ordinary accepted, so these products could be launched in the market as a new development product of dairy.

CONCLUSION

The highest level of hardness was A2 product, the highest level of tenderness was A1 product, and the lowest pH level was A1 product. Based on organoleptic test, the product was A4 which had treatment mixed starter bacteria Streptococcus lactis and Bifidobacterium longum, and had properties medium level of hardness, tenderness, pH, yellowish white color, medium texture, smell of sour milk and typical characteristic of pure, tender hardness, and had good taste mixed between sweet and sour taste.

REFERENCES


