

Effect of Skimmed-Milk and Starter Addition on Lactic Acid Formation in Soyghurt

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Abstract— Research on Effect of Skimmed-Milk and Starter Addition on Lactic Acid Formation in Soyghurt has been done. Soyghurt is a probiotic drinking product made from soy-milk produced by fermentation process using lactic acid bacteria. The bacteria used as starter was *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. The objective of this research was to evaluate the effect of skimmed-milk and starter addition on the formation of lactic acid. Variables used in this research was skimmed-milk concentration of 5, 10, and 15% and starter concentration of 3, 5, and 7%, based on volume of soy-milk used as raw material. The soy-milk used was analyzed for its carbohydrate and protein content, and the soyghurt produced was analyzed for its lactic acid, pH and syneresis. The result showed that carbohydrate and protein content in soy-milk was 122.39 mg/L and 2.75%, respectively. The best condition of this process was the addition of 15% skimmed-milk and 5% starter, which yielded the highest lactic acid of 15% with pH of 4.23 and syneresis of 15%. It can be concluded that increasing skimmed-milk concentration cause the increase in lactic acid formation and decrease pH and syneresis. While effect of starter concentration on product analysis was influenced by the amount of nutrition contain in soy-milk.

Keywords— Lactic Acid; Skimmed-Milk; Soyghurt; Starter

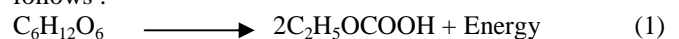
I. INTRODUCTION

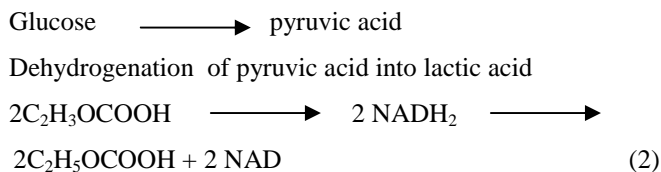
Lifestyle of people tends to realize the importance of health, the need for food to maintain health and fitness, commonly known as functional food, e.g. probiotic products. One of the probiotic products containing lactic acid bacteria is soyghurt. Soyghurt is the fermentation product of soy-milk by using lactic acid bacteria.

Soy-milk has a nutritional value similar to cow's milk and is best used as a substitute to children who suffer from lactose intolerance [4]. Soy-milk is a well-known protein enriched bio-functional food which has beany flavour. This flavour can be reduced through fermentation. Beside the flavour, more whey (separated water formed on the surface of soyghurt) formed in soyghurt shows that texture of soyghurt is less dense than that of yoghurt. The texture can be improved by adding skimmed-milk before fermentation process. Fermentation is the process of aerobic and anaerobic, both which produce various products involving microbial activity or the extract is controlled by microbial activity. Fermentation has many benefits, such as give a taste or flavour of a particular food product, give a certain texture in food products, and increase the nutritional value.

Fermentation in the manufacture of soyghurt is difficult, because of the type of carbohydrate in soy-milk is different from the one in cow's milk. Type of carbohydrate in soy-milk is oligosaccharides, while the carbohydrate in cow's milk is lactose [4]. Sugar content in soy-milk that can be utilized by the microorganism in making soyghurt is very limited, therefore it is necessary to add other sugar sources. When soy-milk was inoculated directly without the addition of sugar will not produce good quality soyghurt. It is characterized by high pH values [6]. Good soyghurt can be made from soy-milk contained 3.6 - 4.5% protein and by adding 5% sugar. Source of sugar that can be added are sucrose, glucose, lactose, fructose or skimmed-milk powder [5].

Soyghurt was made by fermentation process using lactic acid bacteria, such as *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. ↓Carbohydrate fermentation by *Lactobacillus bulgaricus* and *Streptococcus thermophilus* was done through the conversion of carbohydrates into glucose and then fermented glucose into pyruvic acid, then followed by dehydrogenation of pyruvic acid to produce lactic acid as the main product [1]. The reaction is as follows :





Lactic acid bacteria is defined as a group of bacteria that cause acidity in the milk (milk-souring organisms). The main role of these bacteria in the food industry is to marinate the raw material to produce the majority of lactic acid, acetic acid, ethanol and CO₂. *Lactobacillus bulgaricus* and *Streptococcus thermophilus* have different function. *Streptococcus thermophilus* play a major role in producing a sour taste, while *Lactobacillus bulgaricus* play a role more in producing lactic acid. The use of both types of bacteria is intended to accelerate the process of acid production, increase the amount of lactic acid, and improve the flavour [9].

The objectives of this research are to improve the benefit of soy-milk as a high nutrition bio-functional food by processing it into soyghurt, and to evaluate the effect of starter and skimmed-milk concentration on quality of soyghurt.

II. MATERIALS AND METHODS

Materials used in this research were soybeans, starters (*Lactobacillus bulgaricus* and *Streptococcus thermophilus*), low fat skimmed-milk merk HiLo, glucose, salt, and distilled water. The equipments used in this research were magnetic stirrer, autoclave, digital balance type FB-2000, centrifuge and several glass tools to support the research.

The research was divided into 4 steps, i.e. preparation of starter, manufacture of soy-milk, soyghurt formation and product analysis. Starters were obtained from Milk Processing Laboratorium, Animal Husbandry Department, Faculty of Agriculture, Syiah Kuala University.

Manufacture of soy-milk was started from soybeans sorting and cleaned under running water. Then, immersed in water for 8 hours and washed thoroughly. Soybeans were boiled in water with a ratio of 1 : 8 until a temperature of 80°C. Boiled soybeans was blended until it has turned into mush, then filtered to get soy-milk. Furthermore, soy-milk as raw material was analysed for carbohydrate and protein content.

Soyghurt was made from sterilized soy-milk. The sterilization process was done at 121°C for 15 minutes and cooled to room temperature. Then, added 5% glucose and 0.55% salt of the total volume of soy-milk. At the same time, added various concentration of skimmed-milk and inoculated various concentration of starter, then incubated for 14 hours at a temperature of 40°C. After that, cooled in the refrigerator with a temperature below 10°C. Furthermore, soyghurt product was analysed, in terms of lactic acid formed, acidity level, and texture (syneresis). Fig. 1 showed the flow diagram of soyghurt formation.

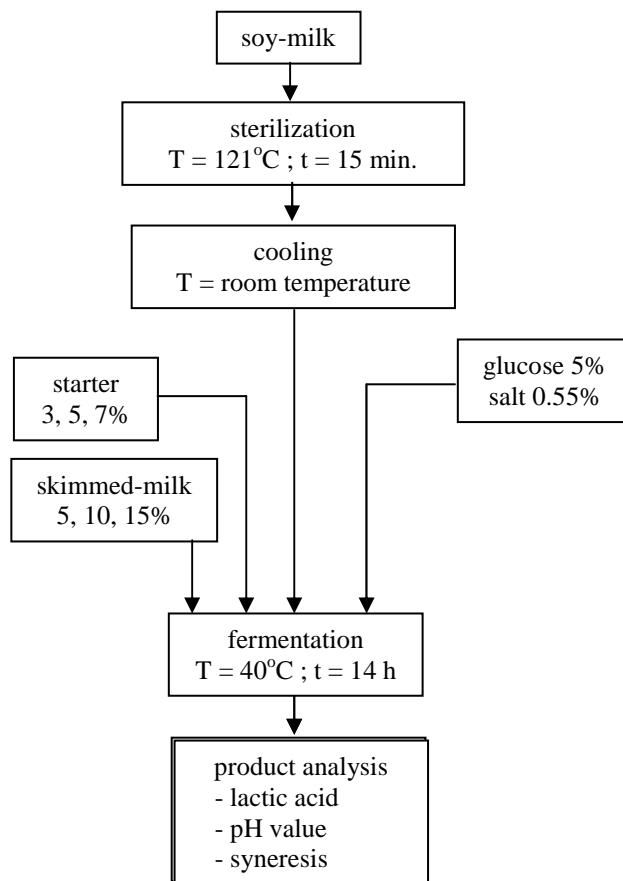


Fig. 1 Flow diagram of soyghurt formation

III. RESULTS AND DISCUSSION

Soyghurt was made by fermentation process of soy-milk using *L. bulgaricus* and *S. thermophilus* bacteria, and the variation of skimmed-milk concentration of 5, 10, and 15% and starter concentration of 3, 5, and 7% from total soy-milk volume. The experimental analysis included raw material and product analysis.

A. Raw Material Analysis

The analysis was done for its carbohydrate and protein content. Carbohydrate is to function as sugar source in soyghurt formation. Carbohydrate in soyghurt is in the form of oligosaccharide. The analysing result showed that carbohydrate content in soy-milk was 122.39 mg/L. Protein in soyghurt is to function as texture former, the higher the protein content, the better the soyghurt texture. Based on Indonesian standard, SNI 01-3930-1995, the minimum protein content in soy-milk is 2%. The analysing result showed that the protein content in soy-milk was 2.75%.

B. Product Analysis

1) *Effect of Skimmed-milk Concentration on Lactic Acid Formation*: Lactic acid is the major component in soyghurt. Skimmed-milk was to function as the additional sugar source to be decomposed into lactic acid by bacteria. The increase in skimmed-milk added, the increase in lactic acid production, as shown in Fig. 2.

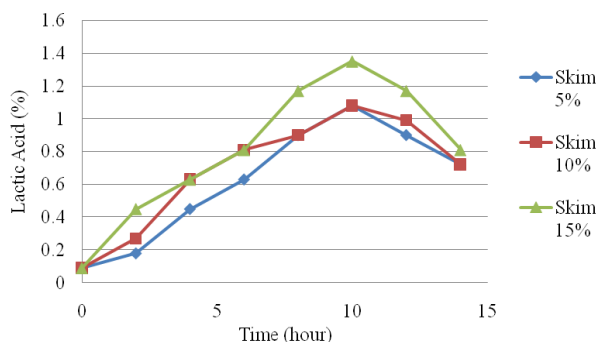


Fig. 2 Effect of skimmed-milk concentration on lactic acid formation (5% starter concentration)

Fig. 2 showed that skimmed-milk with concentration of 15% produce more lactic acid than that of 5 and 10%. It was caused by more sugar source in 15% skimmed-milk than in 5 and 10%. Sugar source gave effect on bacteria growth which directly improved formation of lactic acid. This was agree with the research's result of [2], the bigger skimmed-milk concentration, the higher lactic acid formation. The highest lactic acid produced was at the condition of 15% skimmed-milk and 10 hours incubation time. At longer time, the production of lactic acid was decrease. It was probably caused by the substrate was used up and the bacteria started to consume carbon in lactic acid.

2) *Effect of Starter Concentration on Lactic Acid Formation:* Starter is function to decompose sugar source into lactic acid. Starter used in this research are *Lactobacillus bulgaricus* and *Streptococcus thermophilus* in the same ratio with the variation of 3, 5, and 7% of soy-milk. The highest lactic acid production yielded from the process condition of 5% starter and 10 hours incubation time, as shown in Fig. 3. At this condition, the bacteria concentration is comparable with the available nutrition.

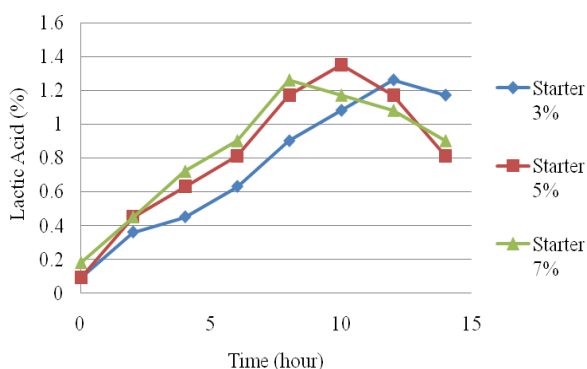


Fig.3 Effect of starter concentration on lactic acid formation (15% skimmed-milk)

Based on Indonesian standard, SNI 01-2981-2009, lactic acid production is in the range of 1.5 - 2%. It can be concluded that the soyghurt produced in this research contain lactic acid conform the standard.

3) *Effect of Skimmed-milk on pH of Soyghurt:* pH value of soyghurt has a close relationship with lactic acid, the highest the lactic acid formed, the lowest the pH value. Fig. 4

showed the effect of skimmed-milk concentration on pH of soyghurt.

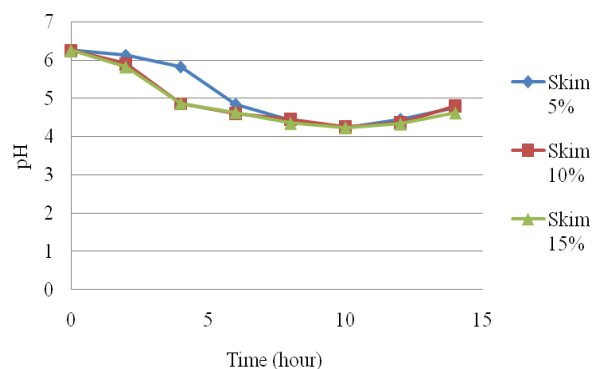


Fig. 4 Effect of skimmed-milk concentration of pH of soyghurt

In soyghurt production, skimmed-milk was function as additional sugar source which then decomposed into lactic acid by bacteria and lowering pH value. As shown in Fig. 4, the pH value was decreased until the incubation time of 10 hours, because the increase in lactic acid formation by bacteria activity. The lowest pH value was at the process condition of 15% skimmed-milk concentration, i.e. 4.23. After 10 hours incubation, pH value was increased. It was caused by the amount of nutrition become lower and the bacteria enter death phase.

In this research, variation in skimmed-milk concentration did not give significant effect on pH value. Range of pH for formation of lactic acid was in the range of 4 - 4.5, conform the Indonesian standard, SNI 01-2981-2009.

4) *Effect of Starter Concentration on pH of Soyghurt:* Fig. 5 showed the effect of starter concentration on pH of soyghurt.

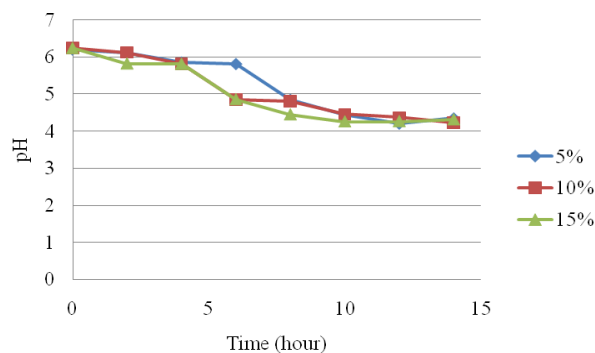


Fig. 5 Effect of starter concentration on pH of soyghurt

According to this figure, the lowest pH value was 4.23, yielded from the process condition of 5% starter concentration and 10 hours incubation time.

The experimental result showed that the most ideal condition was 5% starter concentration and 15% skimmed-milk concentration. Based on pH value, soyghurt produced from this research conform the Indonesian standard, SNI 01-2981-2009, i.e. $pH \leq 4.5$.

5) *Effect of Skimmed-milk Concentration on Syneresis:* syneresis is the process of whey separation induced by gel

contraction of the gel structure [3]. Syneresis was effected by pressure on water which exist between polysaccharide chain. The water evaporated and formed drops of water on the surface of soyghurt. Syneresis value depended on total solid concentration of raw material.

Fig. 6 showed the effect of skimmed-milk concentration on syneresis. The lowest syneresis was at the condition of 15% skimmed-milk concentration, compared to 5 and 10% skimmed-milk. Addition of skimmed-milk increased total solid concentration in soy-milk as well as in soyghurt.

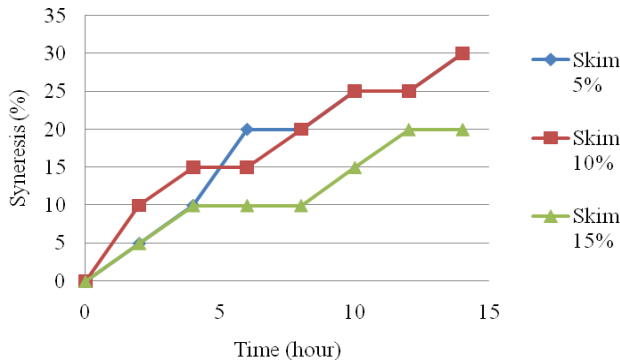


Fig. 6 Effect of skimmed-milk on syneresis

According to Indonesian standard, yoghurt (and soyghurt) had to have dense texture (homogenous). [10] found that the lowest syneresis of yoghurt was 4.3%. Syneresis for soyghurt was higher than for yoghurt, because total solid concentration in soy-milk is lower than in cow milk.

6) *Effect of Starter Concentration on Syneresis:* Texture of soyghurt was effected by total solid, while starter concentration affected only on concentration of bacteria and lactic acid formation. Thus, starter concentration did not have big effect of syneresis.

7) *Effect of Skimmed-milk and Starter Concentration on The Amount of Bacteria:* Lactic acid formation in soyghurt depended mostly on the activity of lactic acid bacteria. The amount and activity of bacteria depended on the availability of nutrition. Fig. 7 and 8 showed the effect of skimmed-milk and starter concentration on the amount of bacteria in soyghurt.

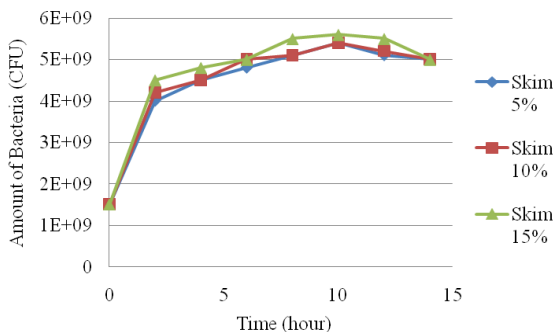


Fig. 7 Effect of skimmed-milk concentration on the amount of bacteria in soyghurt

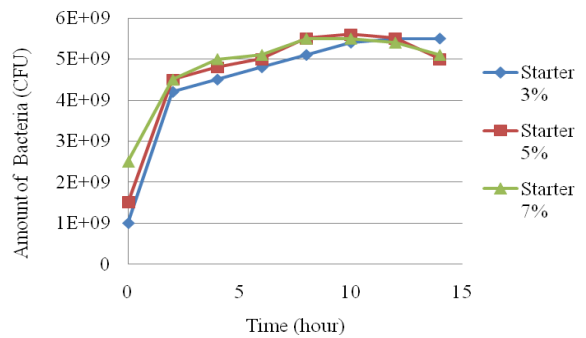


Fig. 8 Effect of starter concentration on the amount of bacteria in soyghurt

Both figures showed that starter concentration had significant effect on the amount of bacteria, and it was also comparable with sugar source availability. The highest amount of bacteria yielded from the process condition of 15% skimmed-milk and 5% starter concentration.

According to Indonesian standard, SNI 01-2981-2009, minimum amount of bacteria needed for soyghurt formation process is 10^7 CFU (Colony Forming Unit). In this research, the amount of bacteria at maximum lactic acid formation condition was 5.6×10^9 CFU. It was met the Indonesian standard.

IV. CONCLUSION

Skimmed-milk concentration gave effect on lactic acid production, pH value and syneresis of soyghurt. Lactic acid production increased as skimmed-milk concentration was increased, on the other way, pH value and syneresis decreased. The ideal starter concentration was 5%. Increasing starter concentration did not have significant effect on syneresis.

REFERENCES

- [1] Anonymous, <http://www.free.vlsm.org>, Reaksi Pembentukan Yoghurt, 2011.
- [2] Herawati, A.S. and Wibawa, Pengaruh Konsentrasi Susu Skim dan Waktu Fermentasi terhadap Hasil Pembuatan Soyghurt, <http://eprints.upnjatim.ac.id/id/eprint/1240>, 2009.
- [3] Jovanovic, S., O. Macej and J.D-Djurdjovic, Influence of Selected Factors in Induced Syneresis, Journal of Agricultural Sciences, Vol. 49, no. 2, 2004, p. 205-217.
- [4] Koswara, Teknologi Pengolahan Kedelai, Jakarta : Pustaka Sinar Harapan, 1995.
- [5] Koswara 1992.ebookpangan.com, Staf Pengajar Jurusan Teknologi Pangan dan Gizi, Fakultas Teknologi Pertanian IPB, 2006.
- [6] Renaldo, M. and D. Suhartandi, Antibacterial Activity Test of Soyghurt with Sugar Corn Addition Against Bacterium of Vibrio Cholera, IC-GWBT 2012, Ahmad Dahlan University : Yogyakarta, 2012.
- [7] SNI 01-3830-1995, sisni.bsn.go.id/index.php/sni_main/sni/detail_sni/4246.
- [8] SNI 01-2981-2009, pustan.bpkimi.kemenperin.go.id/id/files/SNI%20981-2009.pdf.
- [9] Susanto, A., Role of Lactic Acid Bacteria in Food Processing Fermentation Industry, Politeknik Ketapang, 2012.
- [10] Usmiati S. and Sudono, A., Pengaruh Starter Kombinasi Bakteri dan Khamir terhadap Sifat Fisikokimia dan Sensori Kefir, http://pascapanen.litbang.deptan.go.id/assets/media/publikasi/jurnal/j.Pascapanen.2004_1_2.pdf, 2004.