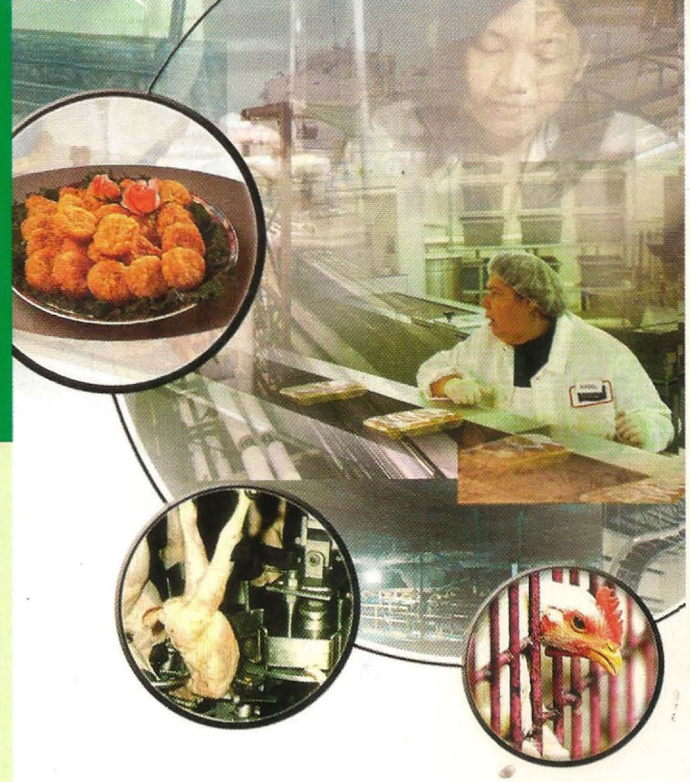
SEMARANG, JUNE 15, 2006
THOMAS AQUINAS BUILDING UNIKA SOEGIJAPRANATA

the 6th national student conference



ON FOOD SCIENCE AND TECHNOLOGY

ASSURING FOOD SAFETY AND FOOD QUALITY ALONG THE PRODUCTION CHAIN

PROCEEDING

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PREFACE

This is the proceeding of the 6th National Student Conference on Food Science and Technology held on June 15, 2006 and organized by Department of Food Technology Soegijapranata Catholic University, Semarang. The conference with theme "Assuring Food Safety and Food Quality along the Production Chain illustrated that safety and quality assessment need to be developed and implemented in vertically coordinated supply chains rather than on single divisions. In this conference we also were informed by experts from international food factories, which are PT. Firmenich Indonesia and PT. SMART about the newest trend on food and business issues.

The Conference was designed for students of food science and technology and other related fields to improve their presentation capability in English. Simultaneously, they could share their research findings, experiences, and knowledge in a scientific and professional setting. Participants of the conference included a wide national spectrum of audience (students, lecturers, researchers) from food related academic circles.

The platform presentations covered following topics:
1. Food Quality and Safety
2. Food Processing and Engineering
3. Nutrition and Functional Food
4. Food Microbiology and Biotechnology

The organizing committee is grateful to all honorable speakers, participants, sponsor companies and all parties that cannot be mentioned one by one for joining this gathering and their valuable contributions to the Conference.

Semarang, October 2006
Ir. Bernadetha Soedarini, MP
Dipl.-Ing. Fifi Sutanto-Darmadi
Dr. Ir. Lindayani, MP
Ir. Sumardi, MSc

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THE EFFECT OF PROTEIN/FAT RATIO AND CONCENTRATION OF *Streptococcus lactis* IN CHEDDAR CHEESE PRODUCTION

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ABSTRACT

Milk consist of mainly protein (caseins), fat, carbohydrate, vitamin and mineral, is one of the most valuable nutrients. Because of its lemited shelf life, a large of milk is marketed in the form of the keep-able diary products such as cheese. Cheddar cheese is one of the nutritious food and ready digestibility. It is made from milk concentrated trough fermentation with lactic acid bacteria ang milk clotting with protease enzyme. The research was aimed to learn the effect ofthe protein/fat ration from cow milk and the concentration of *Streptococcus lactis* in Cheddar cheese production. This research is expected to develop the cheese makin process with the use of lactic acid bacteria *Streptococcus lactis* and papain enzyme as an alternative non-*rennet* protease enzyme. The research consisted of preliminary research and main research. The preliminary research consisted of milk analysis, milk standarization, making satarter, counting the microbe in strarter and counting proteolytic activity of papain enzyme. The milk analysis was conducted by analyzing the protein content, lactose content, water content and pH. The main research of the cheese makin process were milk standarization, milk pasteurization, inoculating the culture, coagulation of milk, whey separation, curd cutting and pressing, salting, and ripening. In this research, the variation of protein/fat ratio is 0.7, 0.85, 1.0 and the concentration of *Streptococcus lactis* is 2 %, 3 %, and 4 % v/v. The result of the research showed that proteolitic activity of papain enzyme used was 120.6 MCU/g. The amount of the starter used was 3.2×10^6 microbe/mL. The Cheddar cheese made by Streptococcus lactis 4 % v/v and the protein/fat ration = 1 was the most appropriate to teh Cheddar cheese standard. The produced cheese having 43.25% moisture content, 32% fat, 20.27% protein, 5.40% w/w yield, and the pH was 5.2. The cheese color was white and the flavor was normal.

Keywords: protein/fat ratio, *Streptococcus lactis*, cheddar cheese, papain enzyme.

INTRODUCTION

Cows milk is highly nutritious beverage, but also a satisfactory growth media for decomposer microorganisms. Therefore, fresh milk should be immediately processed to various products that less-decayed. Cheese is one of milk derivativewhich has a potential market in Indonesia. Its production is supported by adequate supply of fresh milk, growing demand, and large market. In cheese production, milk is processed to be a solid food, more nutritious because more concentrated protein, and also its shelf life increases.

Cheddar cheese, as the most common cheese, is produced through lactic acid fermentationby mesophilic bacteria and coagulation of milk casein by protease enzyme. Acid produced by starter contributes aroma and texture of cheese. Coagulation process commonly conducted by rennet and supported by $CaCl_2$ to increase coagulation rate and yielding denser curd. But in this research papain enzyme is substituting the rennet because it is environmental acceptable, efficient in coagulating milk, and also inexpensive. The objectives of this research are to develop the production process of cheese as function of the concentration of *Streptococcus lactis*, papain, also interaction of them to the characteristic and yield of cheddar cheese.

METHODS

This study research is carried out into two parts, i.e. the start-up experiment and the main experiment.

Preliminary experiment

First, the fresh milk and skim milk used were analyzed their water, lactose, fat and protein content. It was needed for standardizing the cheese raw material. Standardization of raw material based on the P/F chosen. Multiply of *Streptococcus lactis* was conducted by taking 2 scratches of pure breed of *Streptococcus lactis* to the 100 mL sterile milk and incubated it for 24 hours on 37 ^{o}C. Counting of microorganisms in the starter was conducted by dissolve method or plate counting method. Determination of proteolitic activity of papain was carried out by milk clotting method.

Main experiment

Streptococcus lactis starter was added to the 1 L pasteurized milk, which had been heated to the 37^{o}C. It was stirred well during incubation for 45 minutes. The lactic acid in milk would increase during that process. After that, it was added 400 ppm papain and 0.2%-w/w $CaCl_2$ for coagulating milk casein into the curd. The mixture was incubated again at 37 ^{o}C until curd was formed completely. The coagulation process was take time about 5-6 hours. The coagulated milk (curd) was separated from the non-coagulated milk (whey) by passing the mixture through *mori* cloth. The curd gotten was cut into pieces and heated up to 42 ^{o}C for 30 minutes in oven. During the heating process, curd shrank. Then curd was passed again through *mori* cloth, kept still for an hour, and let dry. Curd then be cut, and poured with 2%-w/w salt to stop lactic acid fermentation and to raise cheese taste. Curd then reseed, castled, become raw cheese, then let dry. Cheese then ripened on 6-10 ^{o}C for a month. The final product of cheese then analyzed its lactic acid, water, fat, protein content, also yield, and pH.

RESULTS AND DISCUSSION

The composition of fresh milk used was water 87.71%, lactose 3.17%, fat 4% and protein 2.71% (w/w), whereas the starter was $3.2x10^6$ microorganisms/mL. Proteolitic activity of papain was 120.6 MCU/gram.

The result of this experiment was shown by the following graphics.

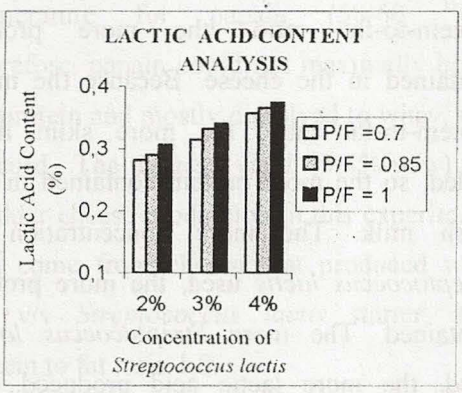

Figure 1. Lactic Acid Content of Cheese

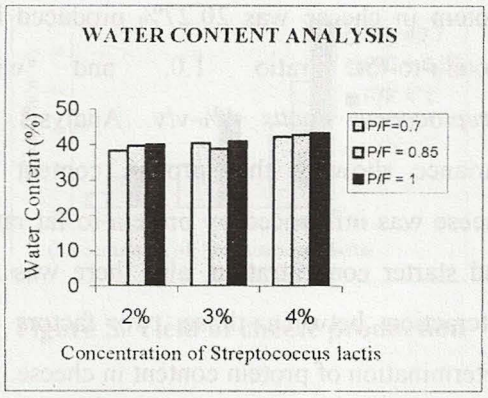

Figure 2. Water Content of Cheese

Figure 1, it is shown that the increasing concentration of *Streptococcus lactis* produced more lactic acid in curd. Since the *Streptococcus lactis* convert lactose into lactic acid. The higher P/F also gave a higher lactic acid. The milk with high P/F has more protein available for the growth of *Streptococcus lactis*. Since proteins contains nitrogen which needed for the metabolism of bacteria. So, more protein caused more bacteria could growth well and also more lactid acid were produced by them. Analysis of variance with 95% confidence level resulting that protein-to-fat ratio and concentration of starter were significant to lactic acid content but there was no interaction between those factors.

In Figure 2, it is shown that water content in cheese was various. Cheddar cheese is a quite solid cheese with 35-40% water content. The more the starter was used, the more water in the cheese. It was caused by the more acid produced by starter, pH was decreasing, more acid settled and bonded to the curd. The faster settling process, the more water contained in the curd and therefore the cheese will be more malleable. Beside that, water content could be various due to curd filtration process. While the more protein-to-fat ratio, the water content in curd was insignificantly increasing. Probably it was caused by manual cloth filtration. Analysis of variance showing that water content in cheese was only influenced by starter concentration and there was no interaction between protein-to-fat

ratio and starter concentration in determination of water content in cheese.

In Figure 3, it is shown that the more protein-to-fat ratio, the fatter cheddar cheese. Because the more protein-to-fat ratio, the more skim milk added, so the more milk protein was available as the food of bacteria acid lactic, so that protein stayed as an unbreakable chain, followed by the fat of milk which trapped into it. When the protein coagulated fat would join inside it. While the more concentration of *Streptococcus lactis* used, fat content in cheese was relatively constant. Analysis of variance showing that

fat content in cheese only influenced by protein –to-fat ratio and no interaction between protein-to-fat ratio and starter concentration in determination of fat content.

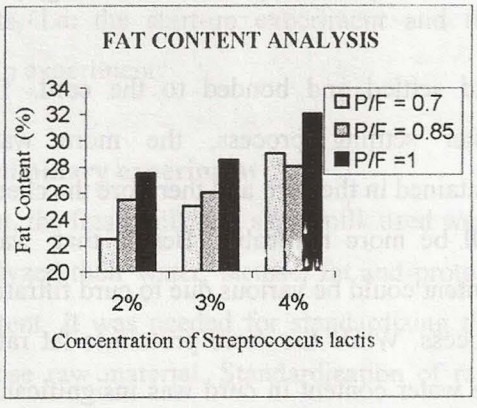

Figure 3. Fat Content of Cheese

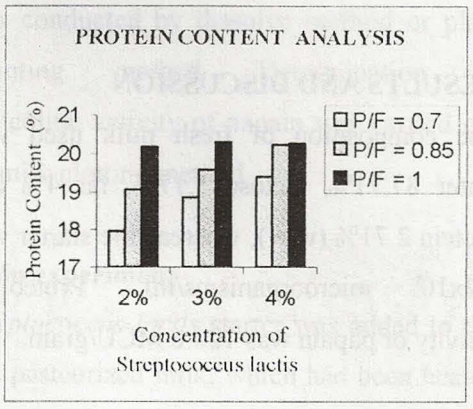

Figure 4. Protein Content of Cheese

From Figure 4, it is shown that the more protein-to-fat ratio, the more protein contained in the cheese. Because the more protein-to-fat ratio, the more skim milk added, so the more protein contained in the fresh milk. The more concentration of *Streptococcus lactis* used, the more protein contained. The more *Streptococcus lactis* used, the more lactic acid produced, pH decreased and more casein settled. Therefore, the more protein was in cheese. The most protein in cheese was 20.27% produced by protein-to-fat ratio 1.0, and with *Streptococcus lactis* 4%-v/v. Analysis of variance showing that protein content in cheese was influenced by protein-to-fat ratio and starter concentration, also there was no interaction between those two factors in determination of protein content in cheese.

From Figure 5, it is shown that the more protein-to-fat ratio and the more *Streptococcus lactis* used, then the bigger yield of cheddar cheese produced. The more protein-to-fat ratio, the more skim milk

added, the more casein coagulated which became the curd. While the more concentration of *Streptococcus lactis* used, the more lactic acid produced, resulting more casein coagulated to be the curd. Although the yield was increasing by bigger protein-to-fat ratio and more concentration of *Streptococcus lactis*, but it was still low in the range of 3.2-5.4%-w/w. This low yield was caused by coagulation temperature in this experiment (37 °C) still below optimum temperature for papain (50-60 °C). Therefore, papain could not maximally bond the protein and mostly dissolved to whey, not to curd. The largest yield (5.4%-w/w) of cheddar cheese production in this experiment was come from cheese that produced with 4% v/v *Streptococcus lactis* starter, and protein to fat ratio 1,0.

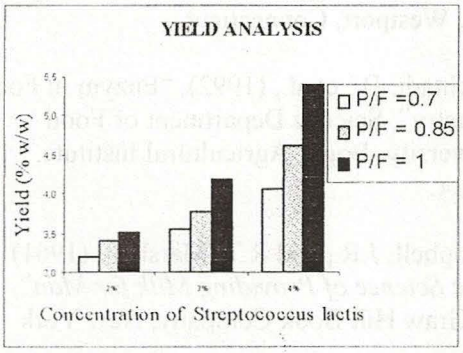

Figure 5. Yield of cheese production

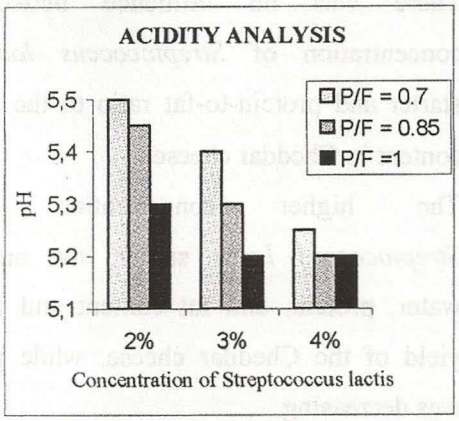

Figure 6. Acidity of cheese

From Figure 6, it is shown that the more protein-to-fat ratio, the pH of the cheese was lower. The more addition of skim milk, the more protein trapped by papain. Therefore the papain's proteolitic activity was increasing, trapping more lactic acid and lowering pH. The more concentration of *Streptococcus lactis* used, also the more acidic cheese produced. It was caused by the more microorganisms used, the more lactic acid produced. Similar trend was also shown in the using of papain. Analysis of variance showing that protein-to-fat ratio and starter concentration influenced yield and pH of cheese. There was also interaction between these two factors.

CONCLUSION

Conclusions that can be taken from this experiment are:

1. Water content, protein content, pH, and Cheddar cheese yield were influenced by concentration of *Streptococcus lactis* starter and protein-to-fat ratio.

2. There was no influence between concentration of *Streptococcus lactis* starter and protein-to-fat ratio to the fat content in Cheddar cheese.
3. The higher concentration of *Streptococcus lactis* starter, the more water, protein, and fat content and the yield of the Cheddar cheese, while pH was decreasing.
4. The more protein-to-fat ratio, the more water, protein, fat content, and yield of Cheddar cheese, while pH decreasing.
5. There was interaction between protein-to-fat ratio and concentration of *Streptococcus lactis* to the water content and pH of Cheddar cheese.
6. There was no interaction between protein-to-fat ratio and concentration of *Streptococcus lactis* used to the lactic acid, fat, protein content, and yield in cheddar cheese.
7. Papain enzyme could be used as substitution of rennet in cheddar cheese production.
8. Cheddar cheese that very nearly meet FAO Standard was produced by 1.0 protein/fat ratio and 4%-v/v *Streptococcus lactis* starter, 400 ppm papain, with 43.25% water content, 32% fat content, 20.27% protein content, 5.40%-w/w yield, pH 5.2 with white color and normal cheese aroma

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