ON FOOD SCIENCE AND TECHNOLOGY

ASSURING FOOD SAFETY AND FOOD QUALITY ALONG THE PRODUCTION CHAIN

PROCEEDING

ISBN: 979-8366-92-1
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. Firmenheim 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
# TABLE OF CONTENT

Preface .................................................................................................................. i

Table of content .................................................................................................. ii

## PLENARY SESSION

PS-01. Strategic Role of Quality Assurance in Food Manufacturing ............... 1
  Antoinette Suwita (PT. Smart Tbk)
PS-02. A Non-Technical Look at Some Aspects of Quality for a Food Flavour Manufacturer ................................................................. 7
  Martin John Shaw (PT. Fermenich Indonesia)
PS-03. Life Cycle Approach in Food Safety Assurance ................................. 11
  Budi Widianarko (Soegijapranata Chatholic University)

## FOOD QUALITY AND SAFETY

FQS-01. The Effect of Different Storage Duration and Salt Concentration Toward the Quality of Smoked Catfish (Clarias batrurus) Using Corn Cob Liquid Smoke ......................................................... 16
  Fronthea Swastawati, Mahmud Mudayani, Herda Bolly, Erlifa Rahma
  Priska Ani Setyawati, Fifi Sutanto-Darmadi, Ita Sulistyawati
FQS-03. Development of HACCP Implementation Concept at “Lapis Legit” Industry in Semarang .............................................................. 33
  Felicia Febbianti Cahyani, Fifi Sutanto-Darmadi, Laksmi Hartayanie
FQS-04. Safety Assurance of Probiotics as Novel Good ................................ 39
  Dwianto Wibowo, Rosalia Simone, Rosalia Devi Budi Anggraeni, Budi Widianarko
FQS-05. Mapping of Perception on Safety and Naturalness of Beverage Products among Students of Catholic University of Soegijapranata Semarang ......................................................... 44
  Samuel Kristianto, Budi Widianarko, Ita Sulistyawati
FQS-06. Prevention of Enzymatic Browning in Sliced Apple with Onion Extract ......................................................... 48
  Meliana Gandhi Kusumo

## FOOD PROCESSING AND ENGINEERING

FPE-01. The Effect of the Protein / Fat Ratio And the Concentration of *Streptococcus lactis* in Cheddar Cheese Production ....................... 54
  Vania Hermanto, Juddy Retno Wito, Arry Miryanti

National Student Conference on Food Science & Technology
“Assuring Food Safety & Quality Along The Production Chain”
Department of Food Technology, Soegijapranata Catholic University, June 15, 2006
FPE-02. Improving Characteristics of Gelamai Snack ........................................... 61
Andi Sulistio, Zakiah Penny Widaryani, Putri Nurani Atikasari, Yohan Kaleb, Setiadi
FPE-03. Substituting Glutinous Rice Flour to Improve Crispiness Characteristic of Chocolate Stick Crackers ....................................................... 63
Ricky Satyadharma, Rosalia Estining Rahayu, Wahyu Arianto
FPE-04. The Application of Konjac Gum (Amorphophalus konjac K. Koch) and Fructo-Oligosaccharides in Prebiotic Levitation Drink Product......................................................... 65
Any Wulansari, Kristina Ananingsih, Laksmi Hartayanie

NUTRITION AND FUNCTIONAL FOOD
NFF-01. Characterization and Antioxidant Activity from Extracts of Salak Fruit (Salacca edulis Reinw.) variety of Bongkok ........................................ 73
Leni Herlian, Afrianti Priyatno, Elin Yulina Sukandar, Slamet Ibrahim, Ketut Andryana
NFF-02. The Application of Red Bean (Vigna unguiculata L. Walp) Powder as Wheat Flour Replacer and Its Effects on Sensory, Physical, and Chemical Characteristics of Biscuit ........................................ 84
Brigitta Ratna Yuliana, Laksmi Hartayanie, Ita Sulistyawati
NFF-03. Functional Biscuit: Reconciling Health Benefits and Taste .......... 92
Ambar Ayuningtyas, Dian Kristianto, Melia
NFF-04. Potential Used of Combination Whey Protein Isolate-Xanthan Gum as Fat Replacer in Low Sausages Products ........................................... 101
Shinta Kumala Dewi Poedjiono

FOOD MICROBIOLOGY AND BIOTECHNOLOGY
FMB-01. The Improvement of Conventional Method for Detection of Enterobacter sakazakii in Powdered Infant Formula ................................ 107
Noni Sukmawati, Dhira Satwika, Tri Yahya Budiarsro
FMB-02. Fermented Acetic Acid and Lactic Acid as Alternative Coagulant Applied to Tofu ................................................................. 113
Elvira Melisa, Theresia Christiani, Ivone Wibowo, Lindayani, Bernadetha Soedarini
FMB-03. The Effectiveness of Antimicrobia Angkak in Inhibiting Molds and Yeasts Growth in Guava Fruit Juice .............................................. 121
Kartika Pusp Dyani, Bernadetha Soedarini, Kristina Ananingsih
FMB-04. The Influence of Inoculum Variation for Yogurt Fermentation from Peanut ................................................................. 130
Christine Natalia Wijaya, Dhira Satwika

The Committee of the 6th National Student Conference ........................................ 137

National Student Conference on Food Science & Technology
"Assuring Food Safety & Quality Along The Production Chain"
Department of Food Technology, Soegijapranata Catholic University, June 15, 2006
FERMENTED ACETIC ACID AND LACTIC ACID AS ALTERNATIVE COAGULANT APPLIED TO TOFU

Elvira Melisa¹, Theresia Christiani¹, Ivone Wibowo¹, Lindayani², B. Soedarini², Laksni Hartayani²

¹Students of Food Technology Department, Agricultural Technology Faculty, Soegijapranata Catholic University Semarang
²Lecturers of Food Technology Department, Agricultural Technology Faculty, Soegijapranata Catholic University Semarang

ABSTRACT

Recently, the use of formalin, a substance used as corpse preservative in the food industry had aroused to national food issue. One of given food materials type addition of formalin is tofu. Tofu is food type made of soybean and the most consumed by societies. In addition of acetic acid and lactic acid are result of fermentation of microorganism as coagulant is one of the alternatives it is also potential to replace formalin as preservative in making tofu. Fermented media which will be used in this research “tajin”, and the microorganism will instant yeast to yield acetic acid, and Lactobacillus bulgaricus to yield lactic acid. The treatment was made by adding acetic acid and lactic acid in a range of concentrations. This research aimed to determine the influence of acetic acid and lactic acid usage, as the result of fermentation of microorganism, as coagulant in making non formalin tofu. The evaluation was made to the aspects of physical, chemical, microbiological, and sensory characteristics. The parameters employed in physical analysis that would be texture analysis, in chemical analysis would be water content analysis, using the method of thermogravimetry, in microbial analysis would be shelf life analysis using the method of TPC (Total Plate Count), and in sensory analysis would be texture, flavor, and color and liking.

Keywords: tofu, formalin, coagulant, acetic acid, lactic acid, fermentation

INTRODUCTION

Containing 35% protein and being faction of Leguminosa (Moehy, 1992), soybean is one of the food-stuff types which has highest vegetative protein from all legume types. The soybean (Glycine max) is an important source of edible vegetable oil (20%) and high-quality vegetable protein (48-50%). The protein from soybean is complete and has all eight essential amino acids. The major proteins in soybean are globulins (glycinin and β- and γ-conglycinin), which represent 80% of total proteins. It constants at pH 7.6 and 0.5 ionic strength (Prestamo et al., 2000) on the basis of their sedimentation

Tofu is a food product made by soybean milk coagulating, and rich in protein content. It has high water content that give good condition for spoilage

National Student Conference on Food Science & Technology
“Assuring Food Safety & Quality Along The Production Chain”
Department of Food Technology, Soegijapranata Catholic University, June 15, 2006
microbe to grow. To extend the shelf life, many tofu industries add formalin as preservative to the processing. That addition can improve end product texture and shelf life, but it is indicated to be hazardous to human's health if it is consumed (Mudjajanto, 2005).

Lactic acid bacteria are being used in probiotic preparations currently, either singly or in combination. Lactobacillus, Streptococcus, and Bifidobacterium are the most commonly used in fermented dairy products since these bacteria comprise a portion of the desirable intestinal microflora and have beneficial effects, including stimulation of the immune response, anticarcinogenic activity and inhibition of the growth of pathogens (Lin et al., 2004).

Homofermentative of Lactobacillus bulgaricus is lactic acid bacteria, its yielding lactic acid and aldehyde from anaerobic fermentation with sugar substrat. Lactobacillus bulgaricus is positive gram bacterium which is not dangerous (non pathogen) and is used much for the fermentation of food products. Optimal growth temperature for the Lactobacillus bulgaricus is 43-45° C (Rehm et al., 1995). Lactic acids are naturally produced by lactic acid bacteria, such as Lactobacillus bulgaricus and several other bacteria strains such as Streptococcus thermophilus. Generally, lactic acid bacteria will alter sugar into alcohol during the fermentation process, which it happens under anaerobic condition. Because they produce alcohol in the presence of sugar naturally, lactic acid bacteria are survival under low pH condition. The optimum growing condition of lactic acid bacteria is under pH of 5.5, while their lowest tolerable pH is 3. Lactic acid bacteria may also survive under a great range of temperature (Just, 2004).

Dry yeast is a live inactive microorganism. It consists of dried yeasts mixed with substrate. Yeast's optimum growth temperature range ranges from 32 to 40°C when the relative humidity is about 86 - 90%. Like lactic acid bacteria, yeast will also break down anaerobically complex sugar into such as polysaccharides in its simpler form, such as glucose if inoculated into carbohydrate rich media. Broken down sugar form, i.e. glucose will then be used to produce carbon dioxide as well as ethanol. The following is the fermentation reaction using yeast as the culture:

\[ C_6H_{12}O_6 \rightarrow CO_2 + 2C_2H_5OH + \text{Energy} \] (Widiastuti, 1997).
Yeast is capable of deriving many types of substrates. Generally, yeasts grow optimally when the pH ranges from 3.5 - 6 and temperature ranges at 25 - 30°C. *Acetobacter aceti* is a microorganism that produces acetic acid. *Acetobacter aceti* grows optimally when the pH ranges from 3.5 to 4.5. Yeast and *Acetobacter aceti* are proven to be able to work synergically. The use of a mixed culture of these two microorganisms is expected to improve results obtained from the fermentation process. When mixed culture is used, first yeast will degrade the substrate into ethanol, carbon dioxide, and energy. Afterwards, the ethanol produced by the yeasts will be used as a substrate by *Acetobacter aceti* to produce acetic acid (Peppler & Perlman, 1979); (Rehm & Reed, 1995).

In this research, tain is used as the medium (substrate) for growing the cultures. Tajin itself is defined as thick water from cooked rice. Tajin that is made from 150 gr of rice and 3 litres of water contains 9.5 ml of reducing sugar per 100 ml. Tajin majorly contains amilose type of starch. This amilose will then be broken down into glucose, maltose and alcohol or other acids by microorganisms during the fermentation process (Nugerahani et al., 2000). So the aim of this research was expected to produce tofu with similar texture and shelf life using of mixed natural lactic and acetic acid as coagulant to the ones made with formalin addition.

**MATERIALS AND METHODS**

**Materials**

For the experiment would be used rice; water; starter inoculums which are *Lactobacillus bulgaricus*, *Streptococcus thermophilus*, *Acetobacter aceti*, and baker’s yeast.

**Methods**

Because the research is still in the phase of preliminary study, this chapter will cover the process just till fermentation. The process is first, mixing rice with a certain amount of water then it is boiled and then the liquid is separated from solid material then it is cooled for about 25 minutes. The obtained liquid is called tain. The tain is sterilized. Sterile tain is inoculated with the starter inoculums which are *L. bulgaricus*, *S. thermophilus*, baker’s yeast, and *A. aceti*. Then it is fermented using batch and fed batch method for 5 days. It is analyzed until pH 4.

**RESULTS AND DISCUSSION**

Based on the pH analyzing is to see that fed batch fermentation method is more effective than batch fermentation. It is
showed that the pH in fed batch fermentation decreased faster. This was due to the nutrition from the medium, in this case was tajin, especially when the nutrition started to run out. This describes the term of fed batch fermentation, in which the cultures were fed continuously or sequentially with the medium without removal of culture fluid (Figure 1 and Figure 2). This shows that fed batch fermentation was more effective than simple batch fermentation in order to decrease pH (as seen in Table 1 and 2).

Table 1. pH value during fermentation of Tajin using L. bulgaricus with batch and fed batch fermentation

<table>
<thead>
<tr>
<th>Day</th>
<th>Batch Fermentation</th>
<th>Fed Batch Fermentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>8.97</td>
<td>8.97</td>
</tr>
<tr>
<td>1</td>
<td>7.34</td>
<td>7.13</td>
</tr>
<tr>
<td>2</td>
<td>5.78</td>
<td>5.5</td>
</tr>
<tr>
<td>3</td>
<td>5.16</td>
<td>4.96</td>
</tr>
<tr>
<td>4</td>
<td>4.78</td>
<td>4.63</td>
</tr>
<tr>
<td>5</td>
<td>4.65</td>
<td>4.52</td>
</tr>
</tbody>
</table>

![Graph showing pH decrease over days for batch and fed batch fermentation](chart)

Figure 1. Profile of “tajin” fermentation by L. bulgaricus using batch and fed batch fermentation based on pH and time of fermentation (day)

Table 2. pH value during fermentation of Tajin using bakers yeast with batch and fed batch fermentation

<table>
<thead>
<tr>
<th>Day</th>
<th>Batch Fermentation</th>
<th>Fed Batch Fermentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>8.97</td>
<td>8.97</td>
</tr>
<tr>
<td>1</td>
<td>7.32</td>
<td>7.16</td>
</tr>
<tr>
<td>2</td>
<td>5.96</td>
<td>5.72</td>
</tr>
<tr>
<td>3</td>
<td>5.43</td>
<td>5.28</td>
</tr>
<tr>
<td>4</td>
<td>4.91</td>
<td>4.75</td>
</tr>
<tr>
<td>5</td>
<td>4.67</td>
<td>4.55</td>
</tr>
</tbody>
</table>
The use of mixed culture had proven to be more effective than the use of single culture to reduce pH in a 5 days fermentation (as seen in table 3,4 and figure 3,4). As shown in the tables and figures, the use of mixed culture of L. bulgaricus and S. thermophilus and the mixed culture of bakers yeast and A. aceti reduced pH more effectively than the use of single culture of L. bulgaricus or bakers yeast alone. The following figures and tables also show that fed batch fermentation was more effective than simple batch fermentation in reducing pH.

Table 3. pH value during fermentation of Tajin using L. bulgaricus and S. thermophilus with batch and fed batch fermentation

<table>
<thead>
<tr>
<th>Day</th>
<th>Batch fermentation</th>
<th>Fed Batch Fermentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>8.95</td>
<td>8.95</td>
</tr>
<tr>
<td>1</td>
<td>7.06</td>
<td>6.85</td>
</tr>
<tr>
<td>2</td>
<td>5.41</td>
<td>5.27</td>
</tr>
<tr>
<td>3</td>
<td>4.74</td>
<td>4.55</td>
</tr>
<tr>
<td>4</td>
<td>4.52</td>
<td>4.4</td>
</tr>
<tr>
<td>5</td>
<td>4.45</td>
<td>4.31</td>
</tr>
</tbody>
</table>
Figure 3. Profile of “tajin” fermentation by L. bulgaricus and S. thermophilus using batch and fed batch fermentation based on pH and time of fermentation (day)

Table 4. pH value during fermentation of Tajin using bakers yeast and A. acetii with batch and fed batch fermentation

<table>
<thead>
<tr>
<th>Day</th>
<th>Batch fermentation</th>
<th>Fed Batch Fermentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>8.98</td>
<td>8.98</td>
</tr>
<tr>
<td>1</td>
<td>7.05</td>
<td>6.89</td>
</tr>
<tr>
<td>2</td>
<td>5.68</td>
<td>5.46</td>
</tr>
<tr>
<td>3</td>
<td>5.17</td>
<td>4.92</td>
</tr>
<tr>
<td>4</td>
<td>4.73</td>
<td>4.56</td>
</tr>
<tr>
<td>5</td>
<td>4.54</td>
<td>4.35</td>
</tr>
</tbody>
</table>

Figure 4. Profile of “tajin” fermentation by baker’s yeast and A. acetii using batch and fed batch fermentation based on pH and time of fermentation (day)
During fermentation, inoculated microorganisms grow and degraded further the medium used as the substrate, the tajin. The tajin was derived into many substrates, one of which was acid substance. The presence of acid during the fermentation process resulted the reduction of pH. The acid substance resulted in the fermentation process then was used as a coagulant to coagulate soybean protein in tofu making process (Rehm & Reed, 1995).

The reduction of pH during the fermentation process was mainly due to the production of acids by the microorganism(s) used in the fermentation. The use of mixed culture of _L. bulgaricus_ and _S. thermophilus_ was more effective to reduce pH in the fermentation than using the _L. bulgaricus_ alone. This could mean that more acid was produced by the mixed culture of _L. bulgaricus_ and _S. thermophilus_ than the single culture of _L. bulgaricus_ alone. In the use of mixed culture, _S. thermophilus_ first worked by deriving several substances and produces acid. The acid produced caused decreasing of environment’s pH, thus inhibiting the growth of _S. thermophilus_ itself. Meanwhile, the produced acid promoted the growth of _L. bulgaricus_. _L. bulgaricus_ then replaced _S. thermophilus_ to derive substances in the substrate to produce lactic acid. In the use of _L. bulgaricus_ alone, the growth of _L. bulgaricus_ was slower because of the alkaline environment, thus decreased the effectivity of the fermentation (Rehm & Reed, 1995).

The use of bakers yeast in tajin fermentation cause the substances within the tajin to be derived into ethanol, carbon dioxide, and energy. When a single culture of bakers yeast was used in the fermentation, the end result would include ethanol. When a mixed culture of bakers yeast and _A. aceti_ was used, the ethanol produced by bakers yeast would then be used by _A. aceti_ to produce acetic acid. Both acetic acid and ethanol were acids, however acetic acid had lower pH and higher acidity than ethanol, and therefore it made the use of mixed culture be more effective than the use of bakers yeast alone (Rehm & Reed, 1995).

**CONCLUSIONS**

- Fed batch fermentation method is more effective than batch fermentation method
- The use of mixed culture (_Lactobacillus bulgaricus_ and _Streptococcus thermophilus_) may increase the effectiveness of the fermentation process to produce
lactic acid. And mixed culture
(baker’s yeast and A. aceti)
effective to produce acetic acid.

ACKNOWLEDGEMENTS

(2004). Fermentation of a Milk–Soymilk
and Lycium Chinense Miller Mixture
Using a New Isolate of Lactobacillus
paracasei subsp. paracasei NTU101 and
Bifidobacterium longum. J. Ind.
Microbiol Biotechnol. 31:559-564.

Makanan Institusi dan Jasa Boga.
Bharata. Jakarta.

Mudjajanto, E. S. (2005). Tahu,
Makanan Favorit yang Keamanannya
Perlu Diwaspada. Departemen Gizi
Masyarakat dan Sumber Daya Keluarga.
IPB. Bogor.

Nugerahani, I.; T. I. P. Suseno dan I.
Fransisca. (2000). Pengaruh
Perbandingan Air dan Beras Pada
Pembuatan Air Tajin Terhadap Sifat
Fisikokimia dan Organoleptik Sayur
Vol 1: 45-51.

Microbila Technology Second Edition
Volume II. Academic Press, Inc.
London.

Prestamo, G.; M. Lesmes; L. Otero and
Protein (Tofu) Preserved With High
Pressure. J. Agric. Food Chem. 48:
2943-2947.

Rehm, H. J.; G. Reed; A. Puhler and P.
Stadler. (1995). Biotechnology Second,
Completely Revised Edition. VCH
Verlagsgesellschaft mbH, D-69451.
New York.

Sederhana Penentuan Kualitas Yeast
Roti. Sainteks Vol. 4, No.2.