PROCEEDING

Food Globalization:
New Technology in An Era of Change

The 10th National Student Conference on food science & technology

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Unika SOEGIJAPRANATA

Proceedings

The 10th National Student Conference

Food Globalization : New Technology in An Era of Change

Penerbit Universitas Katolik Soegijapranata
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ISBN 978-602-8011-22-8

PLENARY SESSION

FOOD PRODUCT DEVELOPMENT

FOOD QUALITY AND SAFETY

FOOD MARKETING AND BUSINESS

FOOD ENGINEERING

Preface 10th NSC – "Food Globalization: New Technology in An Era of Change"

This is a proceeding of the 10th National Student Conference on Food Science and Technology done by Food Technology Department, Soegijapranata Catholic University. Seeing that this conference is organized by only the students of the faculty, ten consecutive years of performance deserves quite praise. Thanks to their powerful motivation and energy, this event can be held in routine without skipping a single year.

In this year conference we focused on the development of food in globalization era. As we know it, since globalization has begun there has been lots of changes in many sectors of life including food. On the bright side, it can be seen that globalization has made food become highly varied, more "functional", and somewhat safer by using new material, more sophisticated technology, or even change the food source's genetic structure. Although there are a lot of advantages in the era of food globalization, there will be many risks that make people have to be aware in consuming the foods.

The conference was specifically designed to discuss all of these matters, where students of food technology department can share their research and opinion. This proceeding covers two sections of paper that are papers of the keynote speakers and also from the presenters. There are six platform themes that were used: *Food Product Development*, *Food Quality and Safety, Food Management and Business, Food Engineering. Food Microbiology & Biotechnology* and *Functional Food.* With the ongoing changes in food related to the current globalization, I am quite sure there will be more topics that can be discussed in other student's conferences or academic communities.

Semarang, January 7, 2010

Alberta Rika Pratiwi
Chairman of the Steering Committee

FORGET THE DREAM ON TEMPEH KORO BENGUK, LET'S THINK ABOUT THE TOFU

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ABSTRACT

In Indonesia , demand of soybeans is extremely high. It can reach 2,2 million tons per year. From those huge amounts, 50 % is used for tempeh production, 40 % is used for tofu production, and the rest is used for soysauce production. Wholly, Indonesia still unable to complete it all. Koro benguk can be used as good substituent for soybean because koro benguk can grow well in dry land. Besides, koro benguk can grow along a year. But unfortunately, research during the last 30 or 40 years indicates that koro banguk contains some undesirable compounds in it. One example is cyanide acid. The problem is some cheap methods such as submersion, heat, and addition of certain compounds like salt still not effective to clear up all of cyanide acid in it. Cyanide acid is trapped on vacuoles so it is hard to clear up it. Thus, better to grind the koro benguk so it can be flour. After that the flour can be reprocessed into flour-based food products such as tofu.

Keywords: *Mucuna pruriens,,cyanide acid, tofu, soybean crisis*

INTRODUCTION

Indonesia is the world biggest tempeh producer and becoming the biggest soybean producer in Asia. In Indonesia , demand of soybeans is 2,2 million ton per year but Indonesia can produce 0,8 million ton only. Around 50% of soybean consumption in Indonesia is for tempe production, 40% for tofu production, and 10% for the other products (tauco, soysauce, etc.). Because of the lack of soybean, Indonesia need material substance tu substitute the use of soybean for manufacturing many kinds of food products with the right one. And the right substituent is lentils because lentils is family of legumes that has most similarities of taxonomy with soybean. Besides, lentils can grow well in dry land and can grow along a year, so not too difficult to get it. BPS report said that production of soybean in Indonesia until 2008 is still low and fluctuative. In 2003 production reach 672 miliion tons, 2004 reach 723 million ton, 2005 reach 808 million tons, 2006 reach 748 million ton 2007 reach 593 million tons and 2008 reach 776 million tons.

Lentils is a kind of local legumes which is commonly used as the substituent of soybean as the basic material of tempeh production. The nutrition content of lentils is pretty similar with soybean. Furthermore, the fat content of lentils is lower than soybean. But, lentils is also contain several harmful substances, such as glucosianide phytic acid. Glucosianide can be toxic for human health, whereas phytic acid is an antinutritional compound. In the other hand, lentils can be classified into functional food because of its polyphenol content. Several varieties of local lentils are koro benguk (*Mucuna pruriens*), koro pedang (*Cannavalia ensiformis*), koro glinding (*Phaseolus lunatus*).

Processing of lentils commonly started by submersion to remove the high value of cyanide acid contents inside it. After submersion, processing followed by cooking to soften it because lentils has a hard texture. So far, there still unknown about effect of processing for chemical compound of some kinds of lentils. But research about the last 30-40 years said that some treatment like submersion, drying and addition of certain compounds can't remove the undesirable compound completely because there are trapped inside the vacuole. So, making of another product from lentils are needed. Grinding / milling is recommended to be the best way to remove cyanide and phytate acid completely. Final product of grinding usually formed as fine material for example flour so lentils can be made into flour-based food.

Cyanide can be toxic if bounded with trivalen ferric (Fe^{3+}). Due to consumption of cyanide, more than 40 kinds of enzymes in the body can be inactivated. The most obvious of these is non-active site is cytochrome enzyme consist of cytochrom a-a3 complex and electron transfer system. When cyanide bounded with the complex enzyme, electron transfer will be inhibited (electron transfer from cytochrome a3 to oxygen molecules). For the effect, the oxygen utilization in the cells will be decreased. Cyanide can cause physiological diseases as effect of formed ATP during the processes. Cytochrom oxidase is the final product of phosphorilation. As long as metabolism cycle still depending on electron transfer system, cells are unable to use oxygen, so aerobic respiration can be reduced. These things cause histitoxic cell hipoxia. So, the point is cyanide toxicity caused by unability of tissue to use oxygen. Cyanide is fast poisoned and cause death in short time depends on type of cyanide. Larger dose of cyanide that consumed, the bigger effect that body get. Commonly, cyanide can make death of cell. When cyanide in blood increased, repiration rate will be decreased and will be tight breath.

Tofu is made by coagulating soy milk and pressing the resulting curds. Although pre-made soy milk may be used, most tofu producers began by making their own soy milk, which is produced by soaking, grinding, boiling and straining dried (or, less commonly, fresh) soybeans. Coagulation of the protein and oil (emulsion) suspended in the boiled soy milk is the most important step in the production of tofu. This process is also accomplished with the aid of coagulants. Two types of coagulants (salts and acids) are commonly used commercially. The third type of coagulant, enzymes, is not yet used commercially but shows potential for producing both firm and "silken" tofu. Types of salt coagulant :

- Calcium sulfate (gypsum): The traditional and most widely used coagulant to produce Chinese-style tofu. It produces a tofu that is tender but slightly brittle in texture. The coagulant itself has no perceivable taste. Use of this coagulant also makes a tofu that is rich in calcium. As such, many tofu manufacturers choose to use this coagulant to be able to market their tofu as a good source of dietary calcium
- Chloride-type Nigari salts or Lushui Magnesium chloride and calcium chloride: Both of these salts have a high solubility rate in water and affect soy protein in the same way, whereas gypsum is only very slightly soluble in water and acts differently in soy protein precipitation, the basis for tofu formation. These are the coagulants used to make tofu with a smooth and tender texture. In Japan, a white powder called *nigari*, which consists primarily of magnesium chloride, is produced from seawater after the sodium chloride is removed and the water evaporated. Depending on its production method, *nigari/Lushui* may also contain small quantities of magnesium sulfate (Epsom salt), potassium chloride, calcium chloride, and trace amounts of other naturally occurring salts. Although the term *nigari* is derived from *nigai*, the Japanese word for "bitter," neither *nigari* nor pure magnesium chloride imparts a perceivable taste to the finished tofu. Calcium chloride is a common coagulant for tofu in North America. Fresh clean sea water itself can also be used as a coagulant

Acid coagulant that used for making tofu production is Glucono delta-lactone (GDL): A naturally occurring organic acid also used in cheese making, which produces a very fine textured tofu that is almost jelly-like. This coagulant is used especially for "silken" and softer tofus, and confers an almost imperceptible sour taste to the finished product. Commonly used together

with calcium sulfate to give soft tofu a smooth tender texture. And enzyme coagulant that used is papain with ratio of enzyme substrate is 1 : 400. Enzyme coagulant is rarely used but actually it is the most effective on tofu production. Among enzymes that have been shown to produce tofu are papain, and alkaline and neutral proteases from microorganisms. In the case of papain, the enzyme to substrate ratio, by weight, was held constant at 1:400. An aliquot of 1% crude papain was added to "uncooked" soy milk at room temperature and heated to 90–100 °C

METHODOLOGY

Research is aimed to create new innovation in food industry based on lentils and solve the problem of Indonesia's dependence of soybean. Methodology has done by web survey and literature hunting. We learned all about lack of soybean in Indonesia and how to solve the problem. Besides that, we also find what the good substituent of soybean. It is lentils with species *Mucuna pruriens*. Then, we learned about how to treat lentils properly and making of flour-based food from lentils.

Research has done in Wonogiri, Jawa Tengah. Lentils is treated by many treatments for 7 days. Treatments used in the research are submersion, cooking, drying, and addition of NaCl salt, then concentration of cyanide acid and phytic acid is measured everyday. Based on research, the concentration of cyanide acid during 7 days treatment in sequence are 14.72, 10.44, 5.58, 3.329, 2.14, 2.31, and 1.34 (mg/gr). In the other hand, phytic acid is not too different with cyanide acid. Phytic acid's concentration in sequence are 9.84 mg/g, 8.50 mg/g, 7.36 mg/g, 3.99 mg/g, 2.21 mg/g, 0.544 mg/g, and 0.142 mg/g. From information above, we can conclude that phytic acide can be removed completely but cyanide acid can't be removed completely. Cyanide acid can't be removed completely because it is trapped inside the vacuole,so milling is the best way to remove cyanide acid completely and after milled, it can be made into flour-based food. We chose tofu.

There are 6 steps for manufacturing of lentils tofu. These are making of lentils flour, drying to remove cyanide acid, submersion with water, addition of coagulant, moulding, and product. Dried lentils are soaked in water for 12-14 hours. Then the lentils are mashed and mixed with water. Then, soymilk is extracted with roller press. Coagulating agent is added into the soyjuice. Coagulating agent is added to curdle the liquid. There are 3 kinds of coagulant that can used. They are acid coagulant, enzyme coagulant and salt coagulant. For this research, we use enzyme coagulant as coagulating agent because from the literature we know that although

enzyme coagulant is rarely used, actually it is the most effective in manufacturing of lentils tofu. Enzyme coagulant added with the ratio of enzyme substrate is 1 : 400.

SURVEY RESULT AND DISCUSSION

The production of soybean in Indonesia is around 2.200.000 ton per year. The utilization of soybean in Indonesia is 50% for tempeh manufacturing, 40% for tofu manufacturing, and the other 10% is for other products manufacturing. But in fact, the production level of soybean in Indonesia is about 800.000 ton only per year. So, Indonesia has around 1.400.000 ton soybean deficit per year. It means Indonesia have to export soybean from other countries. And, it means that Indonesia's dependence to the other countries is high. This is very dangerous, and the solution must be found out as soon as possible.

The solution came from legume named "lentils". Lentils is a kind of legume which has a lot of similarities with soybean. Lentils can become the solution of soybean deficiency in Indonesia. Lentils can be processed into tofu. If we can substitute soybean with lentils as the material of tofu manufacturing, the deficit of soybean can be greatly reduced. Tofu production in Indonesia take 40% of soybean utilization. It means the number of soybean used for tofu production is around 880.000 ton per year. And if we can substitute it with lentils, the deficiency of soybean in Indonesia can be reduced to 520.000 only, shown in the simulation below.

Production of Soybean in Indonesia = 800.000 ton
Utilization of Soybean in Indonesia = 2.200.000 ton
Deficit = 1.400.000 ton
Utilization of Soybean for Tofu
= 40% x 2.200.000 ton
= 880.000 ton
If we can substitute with lentils :
The deficit can be reduced
= 1.400.000 – 880.000 ton
= 520.000 ton

Lentils is produced into tofu instead of tempeh because of its anti-nutrition and toxic compound contents. Lentils contain phytic acid and cyanide acid. Phytic acid can be removed with submersion, drying, and addition of substance like salt, etc. But, cyanide acid can't, because cyanide acid is trapped inside the vacuole. The only way to remove cyanide acid in lentils is by milling it into flour. After lentils milled into flour, the vacuole is broken and release the trapped cyanide acid. And the cyanide acid can be removed by drying.

Milled lentils flour can't be processed into tempeh because tempeh must be manufactured from the whole lentils. So, the other option is to process the flour into

tofu. Tofu can be made from lentils flour, and lentils tofu contain no cyanide acid and phytic acid in it.

Koro benguk is a kind of beans that have a very high nutrient content. This kind of beans can be use to replaced soybean to create an innovation product. Koro benguk can be growth in every kind of soil. Koro benguk also can be growth in a land, 2000 m above sea level. Koro benguk can grow well on average temperature 14°C – 27°C in rain area or 12°C to 32°C in a tropic area.

A straight type koro benguk can grow well on highest rain level; which is 4200 mm/year and on the lowest rain level which is 700 mm/year. The root system of this plant can reach the deepest underground water supply in a very dry land surface condition. This plant can produce a good crop even in a dry season because of its root system. The growth of those two types of koro benguk plant can be optimum if they placed straight under the sunshine without any canopy above them. But still can produce a good crop when they placed under the canopy. After all, koro benguk can also grow well in an acid soil or even neutral pH soil (4.4-6.8).

Despite of koro benguk has much superiority; it also has a few inferiorities. There are anti-nutritional contents inside koro benguk. Phytic acid and cyanide acid are contents that can be dangerous to human health. Cyanide acid is a chemical compound that has Cyano group C≡N, with the carbon atom three-hooked to the nitrogen atom. CN group can be found in many compounds. Some of them are in a gas phase, and the other in a solid or liquid phase. Some of them are like salt, and some of them are covalent. Some of CN groups are molecular, some ionic, and many of them are polymeric. Cyanide can release a poisonous cyanide ion CN- (Anonim-b, 2006).

Phytic acid is another anti-nutrition chemical compound that can be found inside legumes. In a fermentation process, the contents of this acid can be reduced by 1/3. It caused by, during the fermentation process, Rhizopus oligosporus release a phytace enzyme that would break Phytic acid (inosinol Hexaphosphat) into inosinol and organic phosphate. Some of organic Phosphate used by rhizopus itself to grow (Sudarmadji, 1975). Phytic acid itself has a chemical name called myo inositol 1,2,3,4,5,6- hexachis (dihigrogen phosphate) (Oberleas, 1973). Brown and his colleague, in the year 1961, have done a research to figuring out the structure of phytic acid. The result of their research shows us that phytic acid has 18 H ions; agreed to Neuberg opinion. 12 H ions that released after titration process; while the other 6 H ions remaining have the characteristic of weak acid and difficult to

react with water. Phytace defined by enzyme that catalyzed hydrolysis phytic acid into free inositol and 6 organic P anions (Pa). There are two kinds of phytace acids. The first is 3-fitase or myo-inositol hexachyphosphat 3-phosphohydrolase (EC 3.1.3.8); which would catalyze dephosphorylise phytic started from 1st position. And the second one is 6-fitase; which would catalyze fitat from 6th position. Both of them would perfectly catalyze dephosphorilate fitat acid into myo-inosytol and Pa (Nayini&Markakis, 1984).

The effect of consuming cyanide

The topics that would be discussed in this study are the contents of cyanide acid inside koro benguk. Cyanide acid can cause dangerous effect to human body. The symptom that would appear to human body caused by cyanide acid could be nuisance to blood pressure, sight interference, distraction to the lungs, central nerve, heart, endocrine system, autonomous system and metabolism system. The object usually feels like a burn in the eyes because of irritation and hard to breathe because the mukosa of the respiratory tube is irritated. Cyanide gas is dangerous if human inhale it in a large amount. This gas can caused hiperpnea to human body just in 15 seconds, and 15 seconds after hipernea, human can loose their consciousness. 3 minutes after that, human body feel a symptom called apnea; and within 5 to 8 minutes, the heart muscle become weak because hipoksia and ends with death.

In a low concentrate, the effect of cyanide would be appear after 15 or 30 minutes later. This condition allowed the victim to be saved with giving them antidotum. The first symptom that would be appear if someone poisoned by cyanide are temporary hiperpnea, headache, dispnea, feel worried, nervous, to much sweating, skin become red, body become weak, and vertigo. HCN is very fast absorbed by digestion, and then goes along the blood line and attached to oxygen. HCN is dangerous to the respiratory system, which is oxygen in the blood current attached by HCN compound and cause failure to the respiratory system. Depends on how much cyanide has been consumed, HCN can cause death if there were 0.5 – 3.5 mg HCN per kg weight (Winarno, 2002).

The mechanism of oxygen blocking happened when cyanide acid attached with Fe3+ that deactivated the enzyme inside human body. This condition makes the function of the oxygen decreased. Because the oxygen cannot well functioned, it become a poison to the body. If the body consume cyanide in a large amount can cause death.

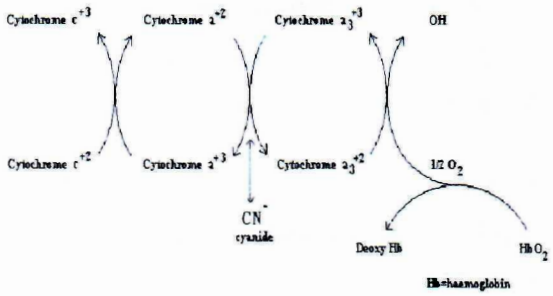

Figure 1 Cyanide Toxicity Mechanism

The way to remove cyanide acid and creating a new innovation of food product

Based on a 30 or 40years research, the way to remove cyanide acid are desiccation, submersion, and adding another acid.

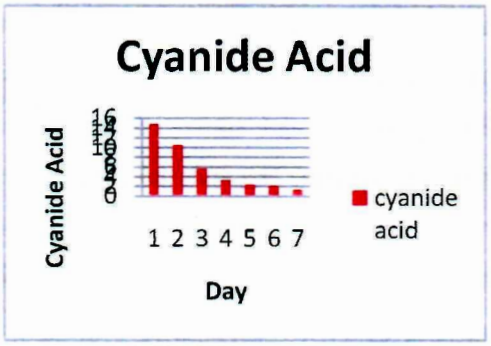

Figure 2. Cyanide acid during treatment

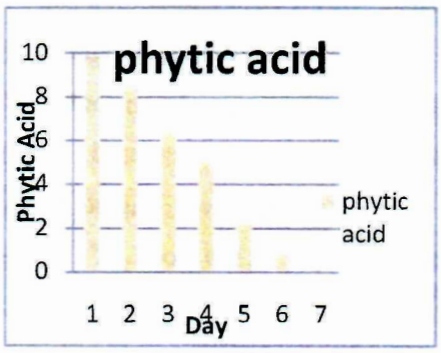

Figure 3. Phytic acid during treatment

It can be seen in graphic above, heating process will reduce the level of cyanide and phytic acid. But the heating process will also reduce the nutrient content in the food. Cyanide located inside the vacuole. It needs to be concern that the only way to remove cyanide without loosing the nutrient inside the beans is grinding the beans and then dried it. Because its already becoming flour, there is no way to make a Tempe from this bean. Otherwise, making a tofu can be the alternative way to make a food product from this flour. Making a tofu from koro benguk beans is not too different with making a tofu from soybean. First, we submersion the beans into water, grind it and then dried it. Add a coagulate agent when it becoming a flour.

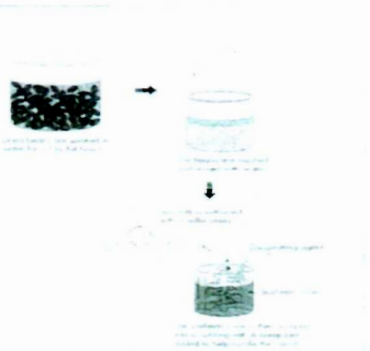

Figure 4 Manufacturing of tofu

The cyanide contents inside koro benguk beans can be removed, but cannot turned into food product called Tempe. Tofu is a kind of food product that being suggested by government. Tofu that made from koro benguk beans can fulfill 40% of Indonesian

people demand for tofu so it can reduce the import of soybean.

CONCLUSION

Indonesia has a crisis on soybeans, so Indonesia needs material substance to substitute demand of Soybeans in Indonesia. The good substituen is lentils because lentils can grow well in dryland and grow along a year. The common food product based on lentils is tempeh. But, the research during the last 30-40 years said that in tempeh still contains some undesirable compounds like cyanide acid and phytic acid that can't remove completely by some treatment because they are trapped inside the vacuole. Cyanide acid can plays role as toxin if consumed excessive, while phytic acid is anti-nutritional compound that not really dangerous but it is better to not consume it. So, the solution is milling it to make flour. Because vacuoles are crumbled, cyanide acid and phytic acid can be out entirely and soluble with water. Then, the flour can be made into flour-based food as tofu. Beside can remove the undesirable compound, the making of tofu from lentils can solve the problem about lack of soybean in Indonesia.

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