Utilization of *Ie Asam Sunti* as a Natural Coagulant Alternative in Tofu Production Process

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Asam Sunti is one type of spices that only exist in the province of Aceh, made from star fruit wuluh by drying and fermentation repeated for 5 days. The resulting waste is called *Ie Asam Sunti*, which is only used as food stirrer or as a spice of grilled fish especially in Pidie district. The injectable acids used in this study were from starfruit fermentation results collected until day 4. This study aims to utilize waste *Ie Asam Sunti* as an alternative to natural agglomeration and preservative tofu. The process optimization using Surface Response Method of Central Composite Design with Minitab 14 software shows that the regression model is significant to the model and interaction between factors with P_{value} is less than 0.005. The optimum conditions were obtained at volumes of *Ie Asam Sunti* 150 mL, 5 hours soybean soaking time and 25 minutes of clotting time obtained 121-135% knowl, protein content (12.57-14.15)% and texture (395,71-.459,65) gr with a very good taste. Protein content was tested by Kjeldahl method, texture tested using LFRA Texture Analyzer and taste organoleptic tested with untrained panelists of 25 people.

Keywords: *Ie Asam Sunti*; *Asam Sunti*; minitab 14, and tofu.

1 Introduction

The Acehnese people are known for their distinctive flavor of Aceh, which is the product of star fruit *Asam Sunti*. *Asam Sunti* is a flavor of cuisine with a distinctive flavor and aroma. The preparation of *Asam Sunti* is done in a very simple way that star fruit ready to harvest soaked overnight, then do salting, fermentation and drying for 4-5 days. Every morning star fruit dried in the sun and leaving waste in the liquid just thrown away, but there are some people of Aceh, especially in Pidie area the waste is sterilized by boiling for 0.5-1 days used as a preservative fish or as a baked fish sauce or as a substitute Lime juice while cooking typical *Asam Keueng* cuisine of Aceh. either.

According to [1], star fruit contains formic acid, citric acid, ascorbic acid (vitamin C), saponins, tannins, glucoside, flavonoids, and some minerals, especially calcium and calsium in the form of potassium citrate and calcium oxalate. Star fruit contains a very high level of vitamin C. The vitamin C contained in it is about 25.8 mg/100 grams. Citric acid can be used in preserving food, as an antioxidant that prevents rancidity and retains color and aroma. Citric acid can also act as sequester of metal binder chemical compounds in the form of complex bonds.

The ethanol extract from star fruit showed positive test on flavonoid and terpenoid test where both of these compounds were suspected as antimicrobial. The crude extract of star fruit is still effective as antibacterial to S, Aureus and E, Coli bacteria, but for ethanol it gives the inhibition zone. Smaller than when it is compared with antibiotic inhibition zones such as penicillin, [2].

In vitro test on the bacteria E, Coli, S, Aureua, M, Luteus and P, fluorescen showed the potential of active as antibacterial. The antibacterial potency contained in the fruit of star fruit makes the

opportunity to be developed as a natural preservative of formalin replacement [3].

Tofu is a processed soybean products which very popular in Indonesia and most widely produced. As much as 40% of Indonesian soybean consumption is processed into tofu. Tofu has the original color of white, compact texture but still soft and soft. The principle of making tofu is generally the extraction of soybean protein with water and then coagulated with some clotting materials such as tofu ($CaSO_4$), acids (vinegar), and certain salts. Tofu is often called the boneless meat because of its high nutritional content, Protein quality equivalent to animal flesh. Even protein of tofu higher than soy protein and tofu has the best quality of vegetable protein because it has the most complete amino acid composition and has high digestibility or 85% -98% [4].

The addition of tofu stone as a coagulant has no effect on the preservation of the product, so it is necessary to add other ingredients such as salt or even the addition of formalin, which is very dangerous for health. Similarly, with the addition of vinegar that sometimes produces products with an acidic taste.

The use of *Ie Kuloh sira* coagulant produces solid tofu and good taste because there is still salt (NaCl) because *Ie Kuloh Sira* is the salt industry's remaining water that does not crystallize [5]. The combination of nutrients content of star fruit like citric acid and the addition of salt in the process of making *Asam Sunti* gives the opportunity to make sunti acid as a healthy agglomeration and have a longer save time as research done by [6] that based on the concentration of citric acid of 15% can produce tofu which protein content 17,98% and rendement is 168,19%. In addition, coagulation has never been used as a clumping tofu. So it is very rationable to be published as coagulant which is eco friendly.

The principle of making tofu is generally the extraction of soybean protein with water and then coagulated with agglomeration materials in the form of acids (vinegar) and certain salts. The clumping of proteins by vinegar will take place rapidly and

simultaneously throughout the soybean juice, so much of the water that was originally mixed in the soybean essence will be trapped inside. Discharge of trapped water can be done by applying pressure. The greater the pressure, the more water can be excreted from the lumps of protein. That protein blob is then known as tofu.

2 Materials and Methods

2.1 Tools and Materials

The research was conducted at the Laboratory of Biotechnology and Food Department of Chemical Engineering State Polytechnic of Lhokseumawe. Tools used: Stove, juicer, pan, cooker, Tofu mold scales, tissu, Blacu cloth, Measuring cup, Mixer, Thermometer. The materials used were: Soybean, gallon water, *Ie Asam Sunti*.

Protein is amphoteric because it has carboxyl groups and amine groups in amino acids so that proteins can be acidic or alkaline depending on the pH value they have. The charge on the protein is also determined by the chain of the chain, the condition where the positive and negative charges of the protein are equal, so the protein is said to reach the isoelectric point [7].

2.1 Research Methodology

The research method used is Surface Response Method of Central Composite Design using Minitab 14 software with 3 factors that is soaking time of soybean (3 hours, 4 hours, 5 hours, 6 hours and 7 hours); Volume *Ie Asam Sunti* (50; 100; 150; 200; and 250 mL) and protein clotting time: 15 min, 20 min, 25 min, 30 min, and 35 min.

2.2 Research Procedure

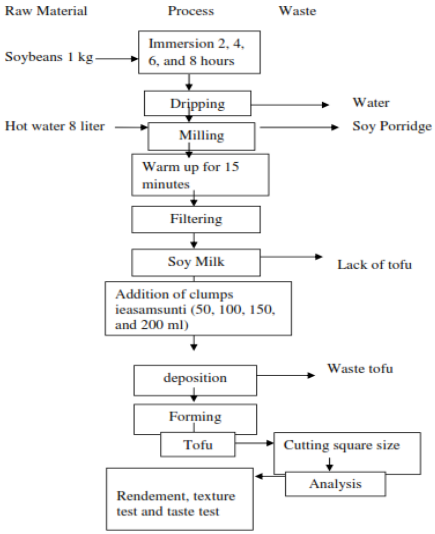

Fig. 1. The Process of Tofu from the *Asam Sunti* Ignition Clot.

3 Results and Discussion

The results of statistical analysis can be seen that the volume of coagulation (X1), soaking time (X2) and agglomeration time (X3) have a significant effect on the yield with 72.5% contribution, 61.3% protein content and 69.1%.

3.1 Rendemen

Treatment of X1 X2 has significant effect on yield with P_{value} 0,050 and X2X3 0,012 with R2 = 72,5%. Variant analysis showed that the regression model was significant with P_{value} of 0.05 and Lack of feet 0.002 so that the regression equation obtained was :

Y = -7,28459E_04X12 - 5,09152X22 - 0,127293X32 + 0,2625X1X2 -0,0675X1X3 + 4,625X2X3 - 0,78425X1 - 114,524X2 - 4,98189X3 + 409,675.

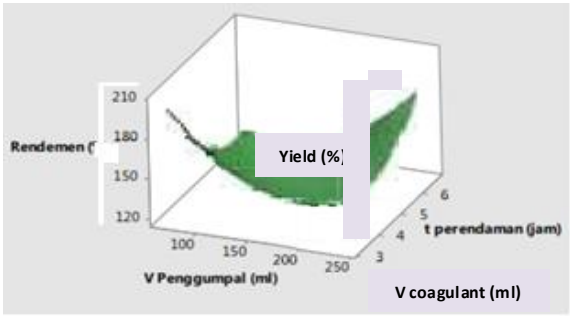

Fig. 2. Surface Plot of yield (%) vs t soaking (hr); V Coagulant (mL).

At the time of aggregation 25 minutes the increase of rendement occur with the increase in volume *Ie Asam Sunti*, but the yield will decrease significantly at the time of increase in volume *Ie Asam Sunti* due to the decrease of pH due to the formed protein will dissolve and difficult to precipitate. This happens because it has passed the isoelectric pH of soybeans.

3.2 Protein Levels

Treatment of X1 X2 has less significant effect on protein levels with P_{value} 0,064 with R2 = 61,3%. Variant analysis showed that the regression model was less significant with Lack of feet 0.079 it was due to the usage of protein test tool was irrelevant actually by using Kjeldahl apparatus. The regression equation obtained was :

Y = 0,000800747 X 120.303301 X 22 + 0.0824788 X 32 + 0.0114500X1X2 - 0.0127700X1X3 - 0,518500X2X3 + 0,0132489X1 + 15,2739X2 + 0.672106X3 -30,0650.

The longer the immersion will occur changes in the structure and changes in protein levels due to the release of the protein structure [8].

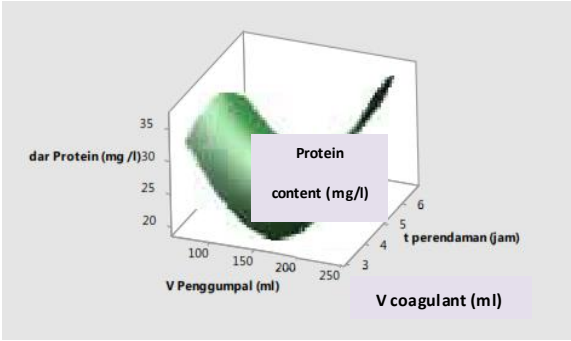

Fig. 3. Surface plot of Protein content (mg/L) vs t soaking (hour); V coagulant (mL).

Protein levels were in the range 20-22.5 mg/L with T bundle 25 minutes. Coagulation volume is in the range of 100-220 mL. At a volume below 100 mL protein will be difficult to dissolve because the pH of the solution is still high so it has not been able to precipitate protein in soy milk. While in the range of 220 mL volume, protein content is higher but there is a decrease in yield.

3.3 Texture

Treatment X1 X2 has significant effect on texture with P_{value} 0.028 and treatment X2X3 with P_{value} 0,009 with R2= 69,1%. The analysis of variance shows that there is interaction between the three variables with P_{value} 0.011 so that the regression equation obtained is

$$Y = 0{,}00560869X12 + 4{,}98843X22 - 0{,}957926X32 + 0{,}946600X1X2 - 0{,}332320X1X3 + 20{,}7840X2X3 + 2{,}40736X1 - 734{,}805X2 - 5{,}87766X3 + 2145{,}63.$$

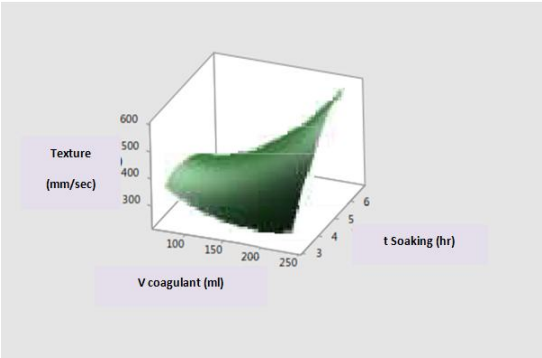

Fig. 4. Surface plot of Texture (mm/det) vs t soaking (hour); V coagulant (mL).

The texture value obtained is almost close to the texture of the branded tofu of 556 mm/sec. The texture of tofu is getting softer on the low volume of *Ie Asam Sunti*.

4 Conclusion

Ie Asam Sunti can be used as one of the alternative of aggregate tofu clumping which is eco friendly. Based on statistical analysis with Minitab14 volume software *Ie Asam Sunti* , soaking time and coagulation time have real effect and interaction between factors to yield, protein content and tofu texture. Volume of *Ie Asam Sunti* 150 mL, 5 hours immersion and 25-minute agglomeration yielded a tofu product with a rendement range of (121-135) %, protein content (20-22.5) mg/L and texture (300-350) mm/s.

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