

TEMPEH SOYBEANS WITH LOCAL PRODUCTION FROM A NEW METHODS

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Abstract. Politeknik Negeri Jember (POLIJE) is the leading vocational institutions that promote applied research as a form of downstream to solved the problems of stakeholders (both industry and society). The indicator of the vocational college' performance is the number of innovations that have been implemented in the industry and society. One of the problems found in the SME community partners primarily in the food industry, especially in the tempeh processing industry. Making tempeh with local raw materials and traditional methods requires a lot of water and the product also decays quickly. POLIJE team, Wibisono; Santoso and Budiati initiated industrial tempeh in Al Islah Jenggawah Jember for using local soybean. Training and coaching activities is funded by the Indonesian Ministry of Research, Technology and Higher Education through PKM Programs (Community Partnership Program). In the event, POLIJE team giving equipment to the process of making modern tempeh, such as an incubator for the production of special ragi (yeast) equipped with gear sensor (sensor cable thermometer, TDS tester and others); soybean washing machine; soybeans peeler (for the development of turnover) as well as digital microwave for preparation of media for yeast. In the treatment process before the community service is to get local tempe with the highest levels of genistein. As for the treatment factor is the type of yeast which includes raprima (factory made) yeast with artificial yeast based on the Wibisono method. The duration of fermentation uses a time duration of 0; 6; 12; 18 and 24 hours. Each time fermentation has been determined, genistein (and genistin) is tested. The research results above indicate that optimal hydrolysis of genistin is carried out at 43 °C for 18 hours. PP Al Islah recognize that using washers soybeans, can save up to 30 minutes each 100 kg of material and no raw material is wasted, and it can save water usage so that will be able to reduce water tempeh industrial waste products. The results showed no difference in the value of TSS (Total Suspended Solid) between manual washing compared with modern equipment, Also results of research studies the content of genistein showed increased by 33% compared to conventional methods.

Keywords: less water; local soybean; new method; tempeh

Introduction

Jenggawah village is the center of tempeh industry with 189 small industry of tempeh; but 13 persons of these known at this time didnt continue produce. One of business unit that is still capable of running is the Pondok Pesantren Al Islah Jenggawah. One cause of the inability to survive in that business because of the US soybean prices continue to soar, even touching on the price of Rp. 17.500, - per kg (price on the market Jenggawah Jember on March 2019) and on the other hand consumers are demanding products that are affordable purchase price. Mentoring program interventions related to the use of raw materials of non soy, such as koro tempeh or a mixture of corn has been done, but the Kyai Ahmad Mu'in (PP Al Islah leaders as partners in PKM) has expressed lack of positive market response. Edamame tempeh done as an alternative, but never received positive response related a greenish color perception. The profits of PP Al Islah has reduced up to 40% and a reduction in the number of workers from 14 to 8 staff.

The actual best alternative solution using local soybean because of the highest price in the market Jenggawah just only Rp. 3.800, - per kg. Disadvantage of local soybeans for tempe production is the product will be faster rotten / broken (only lasted half a day) because the yeast used traditional

tempeh such as *R. mesenterius* difficult to penetrate the soybean pieces. This is coupled with ideal conditions were not good at soaking and fermentation process. Local soybean is also known to be very wasteful of water which produces liquid waste more so that makes it difficult to craftsmen tempe in the dry season.

Wibisono (leader of PKM) has a new method that has proven technology, the addition of *L. plantarum* POLIJE 15420 (publication number HKI: 3-I.05.01.03.050. 0226 / 2010, on January 28, 2010) for a method of making tempe from soybeans local provide a longer shelf life (5 days at room temperature). Artificial yeast produced from Wibisono's research was initiated using the addition of *L. plantarum* POLIJE 15420 bacteria. The bacteria were obtained from the identification of 719 sequences of 16S rRNA successfully read properly using Primer 283F 5' - GAG AGT TTG ATC CTG GCT CAG GAC-3' and Primer 261R 5' - AAA GGA GGT GAT CCA GCC GC - 3'. The primers used are based on the results of previous studies to identify lactic acid bacteria that have the ability to produce β -glucosidase enzymes. The sequence of bases obtained is as follows.

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AGAGACACCTAAGCTGGAGGCGTGCCTAAACAAGCAAGTCGAACGAACTCTGGTATTGA
TTGGTGCTTGCATCATGATTTACATTTGAGTGAGTGCGGAACTGGTGAGTAACACGTGGG
AAACCTGCCAGAAGCGGGGGATAACACCTGGAAACAGATGCTAATACCGCATAACAAC
TTGGACCGCATGGTCCGAGTTTGAAAGATGGCTTCGGCTATCACTTTTGGATGGTCCCGC
GGCGTATTAGCTAGATGGTGAGGTAACGGCTCACCATGGCAATGATACGTAGCCGACCTG
AGAGGGTAATCGGCCACATTGGGACTGAGACACGGCCCAAACCTCCTACGGGAGGCAGCA
GTAGGGAATCTTCCACAATGGACGAAAGTCTGATGGAGCAACGCCGCGTGAGTGAAGAA
GGGTTTCGGCTCGTAAACTCTGTTGTTAAAGAAGAACATATCTGAGAGTAACTGTTTCAG
GTATTGACGGTATTTAACCAGAAAGCCACGGCTAACTACGTGCCAGCAGCCGCGGTAATA
CGTAGGTGGCAAGCGTTGTCCGGATTTATTGGGCGTAAAGCGAGCGCAGCGGTTTTTTAA
GTCTGATGTGAAAGCCTTTCGCTCACCCGAGAGTGCATCGGAAAACCTGGGGTAACTGGGT
GCAGAAGAGGACAGTGTACTCATGTGTAGCGGTGAATGCGTAGTTATTTATGGTAGAAAA
CCCCCAGTTGGCCGA
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The content of guanine and cytosine (nucleotide acids) above isolates were 30 and 21 mol%, with the highest basic amino acid composition being glycine (29.69 mol%), alanine (27.36 mol%), threonine (22, 30 mol%) and cysteine (20.66 mol%). Based on the composition of the content mentioned above, it was suspected that *L. plantarum* POLIJE 15420 isolate was identified to be able to work well under fermentation temperature conditions with a low pH content in the carbohydrate substrate.

Materials and Method

Material

The material used is Jember local variety tempeh obtained from the local market. The type of yeast used is raprima yeast as the first treatment and artificial yeast as the second treatment. Raprima yeast is obtained from LIPI through online purchases while artificial yeast is obtained by making yeast using the Wibisono method.

Methods of Implementation and Action Plans

In the treatment process before the community service is to get local tempe with the highest levels of genistein. As for the treatment factor is the type of yeast which includes raprima (factory made) yeast with artificial yeast based on the Wibisono method. The duration of fermentation uses a time duration of 0; 6; 12; 18 and 24 hours. Each time fermentation has been determined, genistein (and genistin) is tested.

The process of artificial yeast propagation is to use the patented method of Wibisono. The multiplication uses the addition of *L. plantarum* POLIJE 15420 bacteria. The formulation of *L. plantarum* POLIJE 15420 bacteria can be carried out by a dedicated partner (by selected staff from Koperasi PP. Al Ishlah), while the process is by preparing $\frac{1}{2}$ the ampoule (about $\pm 8 \cdot 10^6$ cells) culture from agar sloping the test tube into 1 liter of mineral water containing 8% skim and 1% granulated

sugar then incubated 24 hours at 37 °C. Propagation of the formulation is done by taking as much as ½ liter (500 ml) of the formulation and then added to aquadest until it reaches 1 liter and added back with the composition of sugar and milk at the same concentration (8% skim and 1% sugar), and so on until 4 stages of addition (4 stages of looping). Use the formulation by pouring ½ liter of the formulation on 20 to 25 kg of soybeans and draining. The addition of rice flour (2%) at the time of draining was not only intended to reduce the water content, but also to increase the C / N ratio factor of mold so that there was an increase in nutrition.

The best results that were obtained from the above treatment were used for the process of making tempe with local varieties with fermentation time adjusted to the results of the most optimal genistein products. The implementation of the service activities is carried out as follows

1. The first stage of training a new method of making tempe soy-based local. This activity was agreed to be implemented by 25 person of the partners (PP Al Islah as many as 10 people) and 15 people from outside the cottage. Initial commitment is the willingness to training of the trainer for other person when asked by Tim PKM. In the first phase of this activity, the responsibility for PKM given to members of the team, Agus Santoso, which has expertise in the field of food.
2. The second stage, in line with the first phase, carried out the introduction of a new method of making yeast obtained by patents (Wibisono method). Making the yeasts is done by specialized staff of PP Al Islah and can be to sell to other tempeh producers (ensure the sustainability of yeast). This stage is held directly by Wibisono (as the owner of the patent) and assisted by POLIJE Team of PKM who are experts in the field of microbiology.
3. In the first and second phases, organoleptic and laboratory testing (Food Analysis Laboratory of the Politeknik Negeri Jember) to ensure trust and resource materials that can be delivered on the product label. In this event involved three students of D3 Food Industry Technology and three students from the Department of Management for a business calculation.

Result and Discussion

One of the given machine is fermentor for multiplication of yeast which is a modification with the use of a temperature between 40 - 45°C. First introduction indeed such processes performed on yeast propagation activities, so in the final program, the PP Al Islah is no longer using the commercial yeast. According to research of Wibisono (2011) that the yeast on the native or commercial yeast are generally not conditioned to produce enzymes that can be used for hydrolysis of carbohydrates in corn (most of non soybean). The ragi tempeh produced by a new method of Wibisono has been tested had a better adaptability compared to the commercial yeast.

The process of multiplication "new yeast" using fermentors handed over from competent staff that selected by POLIJE team. As we know that the yeast based on Wibisono's patent have a advantages; that it contains lactic acid bacteria in the formulation and that can be to maintain the pH in acidic conditions, so that the shelf life of the product is longer than the traditional method. Also results of research studies the content of genistein showed increased by 33% compared to conventional methods. Genistein with the 33% increase was obtained from the 18 hour fermentation time according to the results of the following table below

Table 1. Concentration of Genistin and Genistein (mg / 100g) at the Level of Fermentation Time with Incubation Temperature of 43°C

Types of Yeast Used	Isomer Type	Inkubation Time (hours) ¹				
		0	6	12	18	24
LIPI Yeast	Genistin	2,199	1,884	1,318	0,903	0,866
	Genistein	0,316	1,854	1,657	1,989	1,918
Artificial Yeast	Genistin	2,199	1,877	1,272	0,739	0,578
	Genistein	0,316	2,225	2,038	2,645	2,321

¹ Average of 3 replications

The research results above indicate that optimal hydrolysis of genistin is carried out at 43 °C for 18 hours. The optimum temperature and pH conditions are thought to cause transformation from the form of malonilgenistin to genistin which is further hydrolyzed by enzymes thereby increasing the amount of genistein that is formed. Genistein is an isoflavone that is more resistant to the temperature conditions of fermentation, but has damage to its hydroxyl ability when treated with acidic conditions. The interesting thing is the adaptability of the *Lactobacillus* bacteria in artificial yeast even though under acidic conditions due to the presence of the F0F1-ATPase enzyme subunit that is able to remove excess proton H⁺ from its cell membrane using ATP. *Lactobacillus* in addition to producing the enzyme β-glucosidase, also produces lactic acid in addition to plantaricin. The interesting thing about the *Lactobacillus* bacteria is that there is an increase in the production of lactic acid in growth media when given a temperature of 43 °C starting from 6 hours of incubation, but in that condition there will be a decrease in the production of the β-glucosidase enzyme which is thought to be due to a decrease in pH from 6.8 to around 5.7 (outside the optimal pH) at 24 hours of fermentation.

The data above is in line with the results of Wibisono's research which has reviewed that the Fermentation Index (submitted as the Wibisono index, the term initiated in the Dissertation) has the largest index during fermentation to 20 hours. The fermentation index obtained was 1.2767. An index term that represents the quotient of the reduction ratio of genistin to the ratio of increase in genistein which is a measure of the hydrolytic potential of the enzyme from the conversion of genistin to genistein during fermentation. The reduction ratio of genistin based on time (t) during fermentation can be formulated by:

$$\text{Genistin Reduction Ratio} = (\text{Gin}_0 / \text{Gin}_t)$$

With Gin_0 = the amount of early genistin
 Gin_t = the amount of genistin at time of t

While the increase in genistein refers to the amount of genistein concentration at a particular time unit divided by the amount at the initial time (t = 0). This formula is determined by:

$$\text{Genistein Increase Ratio} = (\text{Gen}_t / \text{Gen}_0)$$

With Gen_t = the amount of genistein at time of t
 Gen_0 = the amount of early genistein

So the fermentation index (the Wibisono index, popularized during the Dissertation) is calculated based on the genistin reduction ratio divided by the ratio of genistein increase, with the formula:

$$\text{Fermentation Index (W Index)} = \text{genistin reduction ratio} / \text{genistein increase ratio}$$

Another machine which have been introduced is the raw material washers that using a water pump with a minimum pressure of 2 bar and pump power of 250 watts. The machine provides advantages intervention, reduce 30 minutes of process each 100 kg. This process require less water with the washing process (it refer to “go green” principle).

The market sales with the new branding (something like healthy food with a new technology) also offset by cooperation with “Warung Bu Paidah” Ambulu, lined with small stalls around SD, “Depot Sauda”, “Depot Jenewa”, “Depot Enak Rasa” in Ambulu and hawker center “La Rossa” Ambulu. Especially for the two partners based in Ambulu, product of interest is a processed product tempeh chips. Another cooperation have been done with the Puskesmas Jenggawah stalls, and a small stall in the Market Ajung Jenggawah.

Conclusion

Introductions of the equipment required for intervention activities before intervention of a new process. In these activities, the students and staff from stake holder well understand the working of modern equipment. PP Al Islah recognize that using washers soybeans can save up to 30 minutes

each 100 kg of material and save water usage, so it will be able to reduce tempeh waste products. Also results of research studies the content of genistein showed increased by 33% compared to conventional methods.

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