

## EFFECT OF ADDITIONAL BEAN SPROUTS EXTRACT ON THE FERMENTATION TIME OF TEMPE MODIFICATION OF CITRIC ACID

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### Abstract.

Indonesia is the largest produced tempe country in the world and the largest soybean market in Asia. Tempe is in demand by the public, besides being cheap, tempe also has good nutritional value, contain by highly vegetables protein. The addition of citric acid in the tempe soaking process can affect the tempe fermentation time. Previous research shown that the optimal soaking time in the tempe production process using citric acid 10%. However, residual citric acid was 0.1-0.2% (standard WHO: 0.3%). This study is continued research for search another agent to accelerate fermentation such as bean sprout extract. Tempe soaking process used citric acid and bean sprout extract as additives that contained many minerals. Sprout extract is obtained by boiling or blending. Soybean soaking was carried out for 2 hours to obtain a result of 21.25 hours, fermentation efficiency 55.73% for combination-B and 23 hours fermentation efficiency 52.08% for BSE-NB. Test the citric acid content in tempe by using the HPLC (High Performance Liquid Chromatography) method and obtain the result that the residual citric acid content in tempe is 0.03% for combination-B and 0.11% hours for combination-NB. Moreover, organoleptics show combination-B preferred than conventional Tempe

**Keywords:** *Tempe, Fermentation, Bean Sprouts Extract, Citric Acid, HPLC*

### Introduction

Indonesia is the largest tempe commodity country in the world and the largest soybean market in Asia. As much as 50% of soybean consumption in Indonesia as the form of tempe, 40% tofu, and 10% in the ingredient of other products (such as taucu, soy sauce and others). The consumption tempe per person per year in Indonesia is currently estimated to be around 6.45 kg [1]. So that the most desirable and easy prospect of processed soybeans is tempe. Tempe was a processed food product made from fermented soybeans or several other ingredients [2]. Tempe was in demand by the public, besides being cheap. Tempe also has good nutritional value, contain by highly vegetables protein. That every 100 g of tempe fulfill with 20.8 g of protein, 8.8 g of fat, 1.4 g of fiber, 155 mg of calcium, 326 mg of phosphorus, 4 mg of iron, 0.19 mg of vitamin B1, and 34 mg of carotene [3]. Meanwhile, before being processed into tempe, it contains 3.2 g of fiber [1] and then enters the process of making tempe. Tempe production normally need 48 hours and it is need much time. Previous research result that tempe production can be accelerated by added citric acid 10% (with pH 4) with soaking within 4 hours need time 21.33 hour or 55.56% from normal hours [4]. The optimal soaking time in the tempe production process will be able to reduce the tempe production costs, because the time is more controlled and also affects the quality level of the tempe product which requires the ability to create an acidic atmosphere. However, the citric acid content in tempe modification has limited about 0.3% [5] and the previous research has 0.1-0.2% so this research focus on other alternative agent to replace citric acid with bean sprouts extract. Bean sprout extract is famous with acceleration on fermentation process because it has high nitrogen, carbon for microorganism growth.

### Formulation of Problem

1. Can the addition of bean sprouts extract in the soybean soaking process accelerate on tempe production/fermentation time
2. Can the addition of citric acid and bean sprout extract in the soaking process affect the quality of tempe and fermentation time
3. Can bean sprout extract replace the citric acid

### Research Purposes

1. To determine the effect of adding citric acid and sprout extract replace in the soybean soaking process to accelerate the fermentation of tempe.
2. Knowing the exact content of natural substances from bean sprouts by extraction to make additional substances.
3. Knowing the quality of tempe which has good nutritional value.

**Benefits of Research**

The benefits that are expected to be obtained from this research include: For science, it is hoped that this research can contribute to providing information on the method of accelerating tempe fermentation using citric acid and knowing the levels of substances in bean sprouts extract by direct or boiled methods. For other researchers, it is hoped that this research can be used as a reference in further research using the same raw materials and using different methods

**Body of Paper****Tools**

1. Tempe making tools: Stove, Digital scales, Tampah (webbing filter made by bamboo), Pan, Basin, Filter, Tray, Spoon, Universal pH, Plastic, Glass, Blender
2. Tools for Testing Organoleptic Properties and Acceptability: Test form, Fork, spoon, and plate

**Ingredients**

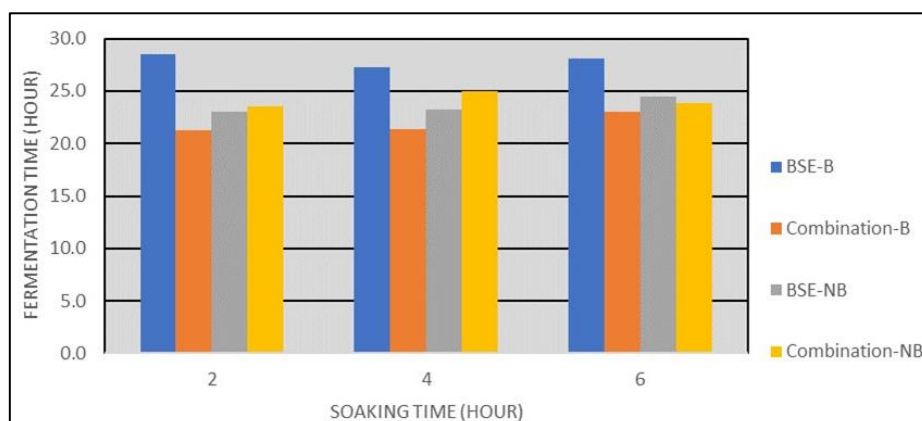
1. Tempe Ingredients : Soybeans, Yeast brand Raprma, Water, Bean sprout extract, Citric Acid
2. Ingredients for Testing Organoleptic Properties and Acceptability Tempe samples according to the treatment at the time of testing are presented, each of which is coded:

*Table 1. Research experiment design*

| Variation                    | Pretreatment | Extract | Addition                             | Soaking Time |
|------------------------------|--------------|---------|--------------------------------------|--------------|
| bean sprout<br>extract (BSE) | Boiled (B)   | 50 Gram | BSE+Citric Acid<br>(Combination-B)   | 2 Hour       |
|                              |              |         |                                      | 4 Hour       |
|                              |              |         |                                      | 6 Hour       |
|                              |              |         | BSE (BSE-B)                          | 2 Hour       |
|                              |              |         |                                      | 4 Hour       |
|                              |              |         |                                      | 6 Hour       |
| Non Boiled<br>(NB)           |              |         | BSE+Citric Acid<br>(Combination- NB) | 2 Hour       |
|                              |              |         |                                      | 4 Hour       |
|                              |              |         |                                      | 6 Hour       |
|                              |              |         | BSE (BSE-NB)                         | 2 Hour       |
|                              |              |         |                                      | 4 Hour       |
|                              |              |         |                                      | 6 Hour       |
| Conventional<br>(control)    |              |         |                                      | 8 Hour       |

**Results**

The researcher conducts an environmental interest that is made in such a way that it becomes ideal and fulfills the expected conditions for further studying the behavior of the object's behavior. Ideal conditions and deliberate arrangements have their advantages and disadvantages.



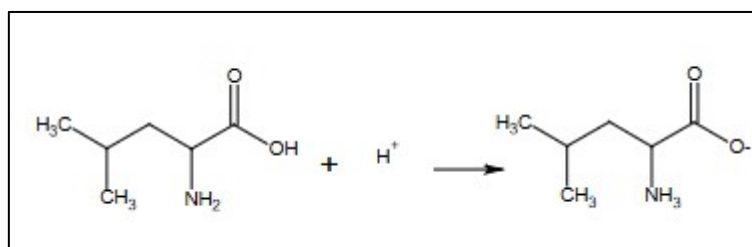
**Figure 1.** Effect soaking time on fermentation process

The figure shows that soaking time has effect on fermentation time. The best treatment for boiling treatment is Combination-B (BSE+Citric Acid with boiling) about 21.3 hour and for non boiling treatment is BSE-NB (BSE non boiling) about 23 hour. And the soaking time is effective for 2 hour. It probably the optimum content absorbtion can absorb 2 hour.

**Table 2.** Total time tempe production comparation

|                | Treatment           | Boiling | Soaking | Fermentation | Total Time | efficiency Fermentation |
|----------------|---------------------|---------|---------|--------------|------------|-------------------------|
| Mubarok (2019) | Soaking             | 2.00    | 4.00    | 21.33        | 27.33      | 55.56                   |
|                | Soaking and Boiling | 2.00    | 4.00    | 21.75        | 27.75      | 54.69                   |
|                | Soaking BSE-NB      | 2.00    | 2.00    | 23.00        | 27.00      | 52.08                   |
| Experiment     | Soaking             |         |         |              |            |                         |
|                | Combination-B       | 2.00    | 2.00    | 21.25        | 25.25      | 55.73                   |
| Control        | Conventional        | 2.00    | 8.00    | 48.00        | 58.00      | 00.00                   |

The data above shows that there is a significant effect of the addition of citric acid of the tempe fermentation process in the soybean soaking treatment with the addition of citric acid for 2 hours. This is because the acid plays a good role in the fermentation process so as to get the desired results. That acid used suitable for the growth of tempe mushrooms as well as a good and natural preservative so that in a certain ratio. It is used in the soybean soaking process using citric acid and the addition of bean sprout extract in the soybean soaking process. The soaking using citric acid and bean sprout extract in soybeans can accelerate the fermentation process. In this study, effective soaking of soybeans took 2 hours with a fermentation process of 21.25 hours.

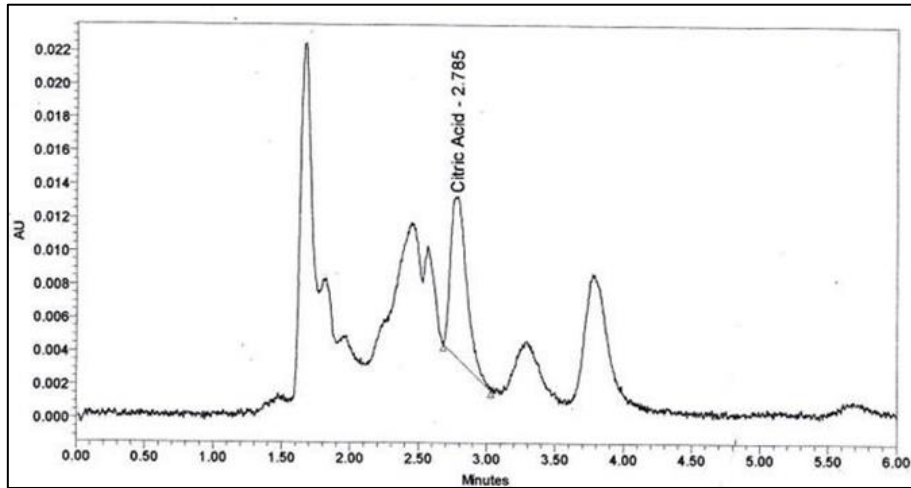


**Figure 2.** Citric acid role on fermentation process

Citric acid will donor proton  $H^+$  to attack leusin (tempe protein) to decompose into amino acid and bean sprout extract will provide nitrogen for microorganism growth [6].

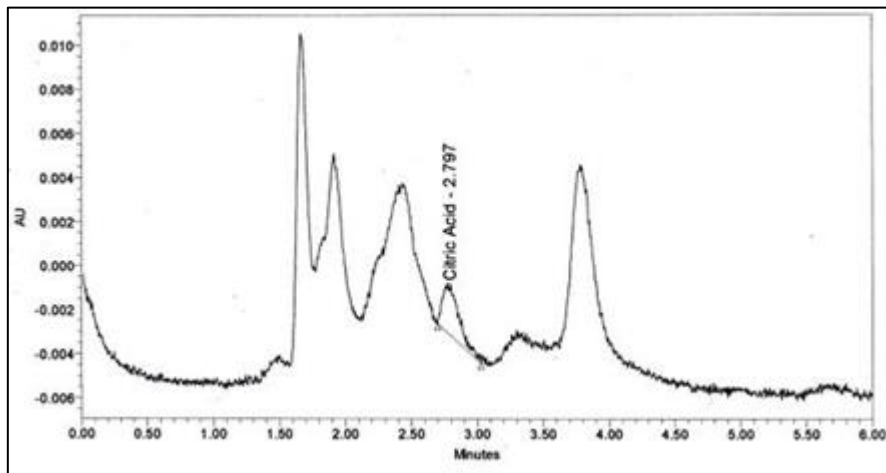
**Residual Citric Acid on Tempe**

The best treatment will check citric acid content of tempe using HPLC (High Performance Liquid Chromatography) method at the PT. Qualis Indonesia, and the following are the results of the analysis that has been carried out:



*Figure 3. Citric Acid content for Combination-NB*

Figure 3 shows that sample has residual citric acid content at peak of 2.785 with concentration 0.11%.



*Figure 4. Citric Acid content for Combination-B*

Figure 4 shows that tempe which has been added with ordinary bean sprouts extract has residual acid content at peak of 2,797 with concentration 0.03%. It decrease probably because citric acid consumed by microorganism.

*Table 3. Residual citric acid on tempe*

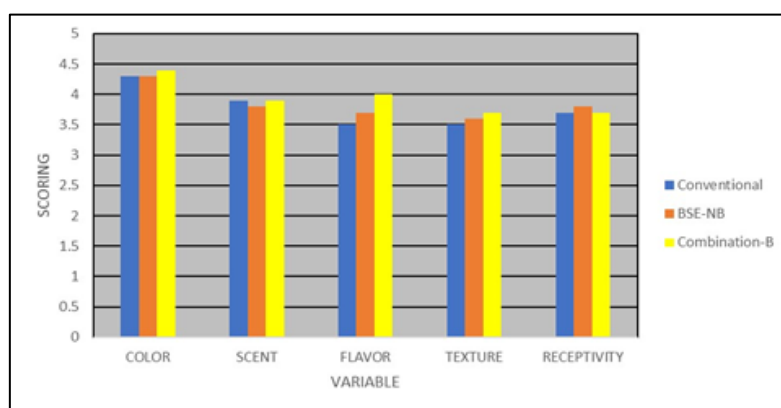
| Treatment              | Residual Citric acid |
|------------------------|----------------------|
| Mubarok (2019) Soaking | 0.1-0.2              |

|            |                           |      |
|------------|---------------------------|------|
| Experiment | Soaking<br>Combination-NB | 0.11 |
|            | Soaking<br>Combination-B  | 0.03 |
|            | BSE-NB                    | 0    |
| Control    | Conventional              | 0    |

Judging from the citric acid content above, all samples has 0.03 and 0.11% residual citric acid. It shown the sprout extract can reduce residual citric acid. It is declared safe for consumption based on the consumption limit for the use of citric acid in foodstuffs set by WHO (World Health Organization) which is 3,000 mg/kg or 0.3% [7].

### Organoleptic Test Results

After going through the citric acid test and the results were that the citric acid content was suitable for consumption, to be more sure, an organoleptic test was carried out which was assessed by 15 trained panelists. The results of the analysis are as follows:



**Figure 5.** Organoleptic test

Scoring: 5 = Excellent. 4= Very Good. 3=Good. 2= Fair. 1=Poor

The organoleptic result shows tempe with citric acid added (combination-B) and BSE prefer than conventional tempe because citric acid can repair tempe texture within fermentation by changed protein (denaturation) [8].

### Conclusion

From some data it can be concluded that soaking using citric acid and bean sprout extract in soybeans can accelerate the fermentation process. In this study, effective soaking of soybeans took 2 hours with a fermentation process of 21.25 hours with higher fermentation efficiency 55.73% than without sprout extract 55.56%.

The citric acid content of tempe has been tested using the HPLC (High Performance Liquid Chromatography) method and obtained the result that the citric acid content of tempe is safe for consumption about 0.03% (lowest than others for combination-B). In this study, bean sprout extract was also added as an additional substance that contains many minerals in it. The organoleptic test that has been carried out on tempe results is superior to tempe with citric acid added (combination-B) and BSE than conventional tempe.

### Acknowledgment

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