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## Study of squeezer machine performance of cooked soy porridge

R. M. E. Hadi<sup>1,\*</sup>, E. Chumaidiah<sup>1</sup>, S. Wulandari<sup>1</sup>

<sup>1</sup>Industrial Engineering Study Program, Industrial Engineering Faculty, Telkom University, Jl. Telekomunikasi, Terusan Buah Batu, Bandung, 40257, Indonesia

\*Corresponding author: rosadmeh2014@gmail.com

**Abstract.** Managers of tofu craftsmen complain a lot on the issue of soybean raw materials that the more days the price is increasing so high, so the benefits gained is decreasing significantly. To anticipate the continuous soybean price increase, the tofu craftsmen plan to make a squeezer machine of cooked soybean porridge which is useful to increase the juice, reduce the time of squeeze, and can ease the squeeze. The benefits of squeezer machine of cooked soybean porridge are that from the aspect of its output it will produce more, that in terms of time it can be faster, that the energy spent is very small because the squeeze utilizes the power of the driving motor, and the tofu dregs produced will be less. The performance study of hygienic tofu making by utilizing a squeezer machine of cooked soybean porridge will be done by comparing the measurement of squeeze time which is currently done by measuring the squeeze time by utilizing the squeezer machine of cooked soybean porridge and measuring the water content in the tofu dregs after the squeeze process. The results are by utilizing the squeezer machine of cooked soybean porridge meet the requirements in accordance with the wishes of the tofu craftsmen in which the water content in the tofu dregs is little, the tofu produced is more, and the process of squeeze is quicker.

### 1. Introduction

Based on the data obtained from the Department of Cooperatives of SME and Trade Industry of Bandung, each District has the potential to vary according to the environment. The existing industry in Bandung has 10,425 industries which consist of large, medium, and small industries. Almost 40% of the industry is catering industry [1]. On the data obtained from the Department of Cooperatives of SME and Trade Industry of Bandung, there are 1330 tofu craftsmen in Bandung in 2015 while there are 400 tofu craftsmen in District Babakan Ciparay. Tofu is folk food that has many protein contents. Tofu can also be used to prevent various dangerous diseases, because the tofu is made by thickening the soybean juice by using mineral salt. This soy essence is what makes tofu get benefits for health [2-3].

Cibuntu is an area that most of the population has a business of tofu maker, so it can be ascertained that the long experience in tofu business is a contributing factor in the success of business. In this case, the tofu entrepreneurs in Cibuntu in both the skill of making tofu and skill of marketing their products are very experienced. Although many kinds of tofu are famous in Bandung City such as Yun Yi tofu and Lembang tofu, but Cibuntu tofu has its own customers. Cibuntu tofu production is the largest in Bandung, almost 70% of tofu sold in Bandung city is the product of Cibuntu tofu craftsmen.

Tofu craftsmen of SQL and Terus Jaya are examples of tofu craftsmen who are innovating in the hygienic production process and have a program to hold a squeeze machine of cooked soybean porridge. That is because the manual squeeze process requires a long time and extra energy while using the squeeze tool can provide advantages such as faster processing time with less energy/ energy and more optimal squeeze results, so it can increase the juice.



## 2. Theoretical background

### 2.1. System Definition

The definitions of systems in different fields vary, but although the term system used varies, all systems in those fields have some general requirements, i.e. that the system must have elements, environment, interaction among elements, the interaction between the elements and their environment, and the most important is that the system must have a goal to be achieved.

Based on this requirement, a system can be defined as a set of elements that are combined with each other for a common purpose, or system is the relationship among several interdependent elements to achieve a goal [4]. Then the characteristics of the system are:

- a. The elements are more than 1 (one) and interconnected/ related;
- b. It has a purpose. All activities must be directed to achieve the goal, meaning that all systems have a purpose;
- c. Establishing a unified whole. Unity is worth more than a momentary success;
- d. Open/ interacting with the environment;
- e. There is a process of transformation changes.

A system has characteristics or properties and structures consisting of inputs, processes, outputs, system components, interfaces, or goals [4].

### 2.2. Tofu Squeeze Process

Soy is the most widely consumed nuts and as the most important source of vegetable protein in Indonesia. Viewed from the side of food and nutrition, soy is the cheapest source of protein in the world, as well as a source of high quality oil. The whole soybean seed, the flour or protein, and the oil can be processed into a variety of food products, animal feed, and products for various industrial purposes. Soybeans can be eaten immediately after boiled or fried. The boiled soybeans are usually selected young soybeans and in pods. In addition, the soybeans made into sprouts are consumed as a vegetable while the processed products of soybean are various soy products produced through the processing first, both through traditional and modern way.

Tofu is a processed product from soybean-based ingredients through the process of precipitation or agglomeration by agglomeration material. Tofu participates in supporting the role of daily food patterns in Indonesia both as a side dish and as a snack. Soybean as the basic ingredients of tofu has a protein content of about 30 - 45%. Compared with other protein ingredients such as meat (19%), fish (20%), and eggs (13%), soybeans are the highest protein-containing foods. In the outline, the process of making tofu has two parts, namely the making of extract (soy milk) and the clumping of protein from soy milk. The steps to make soy milk include soaking, milling, boiling, and filtering of soybean porridge obtained. The precipitation or agglomeration is carried out by the addition of agglomeration material such as acetic acid or  $\text{CaSO}_4$  salt. The use of  $\text{CaSO}_4$  is a traditional clumping method that can produce good quality tofu. In general, the manufacture of tofu in Indonesia is still limited in the scale of household industries that still depend on traditional ways [5].

### 2.3. Tofu Production Process

Tofu is a food product whose production level is relatively high. Tofu has a high nutritional value in which 100 grams of tofu contains 68 calories; 7.8 grams of protein; 4.6 grams of fat; 1.6 grams of charcoal hydrate; 124 mg of calcium; 63 mg of phosphorus; 0.8 mg of iron; 0.06 mg of vitamin B; 84.8 grams of water [6]. Tofu production is still done with simple technology made partly by the craftsmen themselves and in the scale of home industry or small industry, so the efficiency level of the use of resources such as water and soybean material is still low, and the level of waste production is very high [7].

Soybeans and soy foods are a source of food that can be obtained at low prices and have high protein content. For people especially Asians, tofu is a common food. In Indonesia, improving the quality of health directly is part of the improvement of food products made from soy, such as tofu, tempeh, soy sauce, and other products based on soybeans. The tofu industry in Indonesia is growing rapidly in line with the increasing population, but on the other hand this industry produces liquid waste that is potential

to pollute the environment. The tofu industry needs water for its processing, i.e. for sorting, soaking, peeling, washing, milling, boiling, and filtering. In general, the scheme of tofu-making process can be seen in Figure 1.

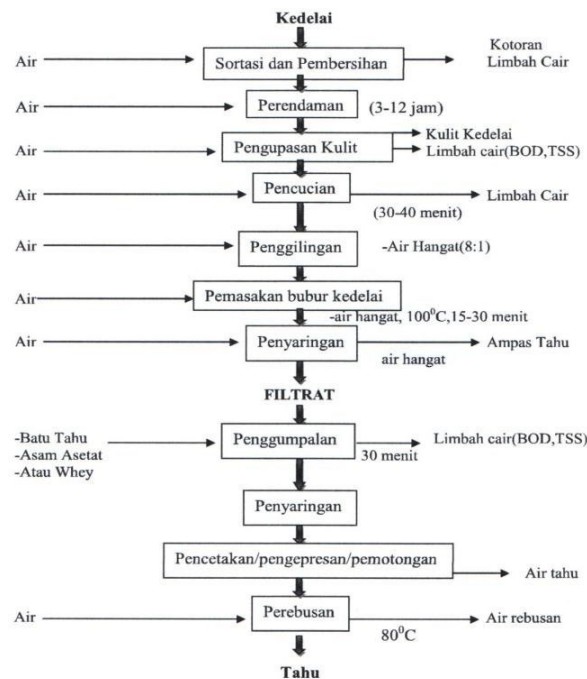


Figure 1: Tofu-Making Process

The waste water from the process of making this tofu produces liquid waste which is a source of pollution for humans and environment. The waste, when thrown into waters without being processed first, may result in the death of aquatic organisms including microorganisms that play an important role in regulating the biological balance of water, so the early handling of liquid waste is absolutely necessary to reduce contamination.

#### 2.4. Time Measurement

##### 2.4.1. Cycle Time

The cycle time is the time between the completions of two consecutive meetings, assuming a constant for all meetings. It can be said that cycle time is a direct observation result listed in the stopwatch. Generally, the time required to perform the elements of work will be slightly different from the cycle to the working cycle even though the operator works at normal and uniform speeds. Each element in a different cycle will not always be adjustable in the exactly same time. This variation and time value can be caused by several things. One of them can occur because of the difference in determining when the start or end of a work element should be read from the stopwatch. The cycle time is calculated by using the formula (1):

$$X = \frac{\sum t}{n} \quad (1)$$

Where:

X = Cycle Time

t = Observation Time

n = Number of observations made

##### 2.4.2. Normal Time

Normal time is the working time that has considered the adjustment factor that is the average cycle time

multiplied by the matching factor. In the practice of work measurement, the method of applying the operator's work performance rating is based on a single factor of operator speed, space, or tempo. This system is known as Rating/speed rating performance. The rating of this factor is generally expressed in percentage (%) or decimal number where the performance of normal work will be equal to 100% or 1.00. Rating factors are generally applied to normalize the working time obtained from work measurements due to the tempo or operator's work speed which changes. For this purpose, the normal time can be obtained from the following formula (2):

$$\text{Normal Time} = \text{Cycle Time} \times \frac{\text{Rating Factor (\%)}}{100 \%} \quad (2)$$

#### 2.4.3. Standard Time

The default time is the time which operators actually use to produce one unit of the product type data. Standard time for each part should be stated including tolerance for a break to overcome fatigue or for unavoidable factors, but the usage period of standard time has a limit. Thus the standard time can be obtained by applying the following formula (3):

$$\text{Standard Time} = \text{Normal Time} \times \frac{100 \%}{100 \% - \% \text{ allowance}} \quad (3)$$

### 3. Methodology

The number of tofu craftsmen in Indonesia is booming. Every tofu craftsman always wants to compete to show the best products to consumers. So do the tofu craftsmen in Bandung such as Cibuntu tofu in which they want to show that the products have different characteristics compared with the competitors of Cibuntu tofu. Tofu craftsmen of SQF and Terus Jaya, located in Cibuntu complained about soybean raw materials that are increasingly rising in price while the price of tofu is difficult to increase due to competing with other tofu competitors, so the profits are decreasing days by days.

To anticipate the continuous soybean price rises, the tofu craftsmen plan to make a squeeze machine of cooked soybean porridge which is useful to increase the juice and to reduce the time at the squeeze time, that is by making the squeeze machine of cooked soybean porridge. The process of making the current tofu and the problem solving can be seen in Figure 2.



Figure 2. Research Methodology

#### 4. Results and Discussion

##### 4.1. Measurement Result Data

Table 1. Measurement Data of Manual Squeeze Process Time

Measurement Order	Time (minutes)
1	20
2	23
3	20
4	25
5	21
6	21
7	24
8	22
9	25
10	23
$\Sigma$	224

Table 2. Measurement Data of Process Time with Squeeze Machine

Measurement Order	Time (minutes)
1	14
2	15
3	14
4	14
5	11
6	15

7	15
8	16
9	13
10	14
$\Sigma$	141

#### 4.2. Discussion of Research Results

##### 4.2.1. Manual Process

Rating factor: 110 %

Allowance : 15 %

$$\text{Cycle time} = \frac{\Sigma t}{n} = \frac{224}{10} = 22.4 \text{ minutes}$$

$$\text{Normal time} = \text{Cycle time} \times \frac{\text{Rating factor (\%)}}{100\%} = 22.4 \times \frac{110\%}{100\%} = 24.6 \text{ minutes}$$

$$\text{Standard time} = \text{Normal time} \times \frac{100\%}{100\% - \% \text{ allowance}} = 24.6 \times \frac{100\%}{100\% - 5\%} = 28.9 \text{ minutes}$$

##### 4.2.2. Process of Utilizing Machine

Rating factor: 110 %

Allowance: 15 %

$$\text{Cycle time} = \frac{\Sigma t}{n} = \frac{141}{10} = 14.1 \text{ minutes}$$

$$\text{Normal time} = \text{Cycle time} \times \frac{\text{Rating factor (\%)}}{100\%} = 14.1 \times \frac{110\%}{100\%} = 15.5 \text{ minutes}$$

$$\text{Standard time} = \text{Normal time} \times \frac{100\%}{100\% - \% \text{ allowance}} = 15.5 \times \frac{100\%}{100\% - 5\%} = 18.2 \text{ minutes}$$

#### 5. Conclusion

The main advantage of the utilization of squeeze machine of cooked soybean porridge in principle is due to its renewable character. This means that machine innovations can contribute to improve productivity efficiently and effectively and can solve the problems experienced by the tofu craftsmen during the production process. The squeeze machine of cooked soybean porridge is a hygienic innovation result system, pays attention to safety factor, and is designed anthropometrically. Squeeze machine of cooked soybean porridge is a system adapted to the needs of tofu craftsmen. The final result is as follows:

- Utilizing squeeze machine of cooked soybean porridge saves 10.7 minutes (62.9%) compared to manual squeeze process;
- The water content of the dregs is drier, so the amount of tofu that it produces will be more.

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