



The effect of Drying Temperature in Making Edamame Soy Milk (*Glycine max* (L.) Merr.) on Water, Fat, and Protein Content Based on SNI with Ginger Flavored Superfood Drink Products (*Zingiber officinale*)

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Abstract. Business development in the food and beverage industry cannot be separated from food innovation, which can increase added value. One of the food industries that is growing rapidly in the bean-based food processing industry is edamame soybeans (*Glycine max* (L.) Merr). Edamame has many health benefits, namely its high content of vitamins A, B, iron, dietary fiber, and isoflavones. The use of edamame can be processed into various culinary products using processed flour as raw materials, such as puddings and pastries. Healthy drink products with a variety of herbal plants are currently in demand among the public and are growing rapidly. An innovation from edamame soybeans (*Glycine max* (L.) Merr), which is soy milk powder with additional herbal plant flavors, will add a delicious taste and aroma for public consumption. Another advantage of soy milk is that it is lactose-free and has a lower fat content, so edamame milk is good for those on a low-fat diet. Food processing using the drying method is one method of maintaining a longer shelf life; besides, this technology is the simplest and easiest processing technique. The process of making edamame milk powder (*Glycine max* (L.) Merr) and edamame beans (*Glycine max* (L.) Merr) was treated without soaking, by soaking, drying with a tray dryer, and flouring, then sieving with an 80 mesh size. According to SNI 01-2970-2015, skim milk powder has a maximum water content of 5%, a minimum fat content of 1.5%, a maximum of 26%, and a minimum protein content of 32%. The lowest fat content was found in edamame powdered milk (*Glycine max* (L.) Merr) after soaking and drying for 4 hours at a temperature of 80 °C, amounting to 11.68%. The edamame milk powder product is applied to herbal drinks with the addition of ginger flavor, namely ginger powder (1 gram), palm sugar (15 grams), and edamame vegetable milk powder (15 grams).

Keywords: Soy Milk, Edamame Milk Powder, Tray Dryer, Ginger Powder, Palm Sugar Powder.

1. Introduction

Edamame (*Glycine max* L.) is a soybean with quite a high protein content; namely, 100 grams of edamame contain 30.20 grams of protein. Fresh edamame per 100 grams has a calorie content of 147 Kcal, 12.95 grams of protein, 6.8 grams of fat, carbohydrates of 11.05 grams, crude fiber of 4.2 grams, vitamin A of 9 µg RAE, vitamin B1 of 0.435 mg, vitamin B2 of 0.175 mg, vitamin C of 29 mg, and isoflavones of 20.42 mg. Edamame has many health benefits, namely the content of vitamins A, B, and iron and high levels of dietary fiber, as well as isoflavones, which can act as anti-cancer agents. Edamame also contains high amounts of calcium, so it can strengthen bones and teeth and prevent the risk of osteoporosis. This shows that edamame has the potential to be developed into new products. Edamame can be processed into various culinary products using processed flour as a raw material, such as puddings and pastries. The innovative drink product made from edamame soybeans is vegetable-skimmed milk. The basic ingredient of this edamame milk product is edamame soybeans. The criteria for good-quality soy milk according to the Indonesian National Standard (SNI-01-2970-2015) are a minimum solids content of 11.5%, a minimum protein content of 2.0%, and a pH value of 6.5–7.0 with a normal color.

The nutrients contained in edamame can be used as an innovative drink product rich in nutrients, which is an alternative nutritional supplement for children during their growing years. Another advantage of soy milk is that it is lactose-free and has a lower fat content, so edamame milk is good for those on a low-fat diet. Processing edamame into flour is an alternative processing method that has several advantages, namely supporting the protein content in the final vegetable milk product, increasing shelf life, and providing health benefits. Apart from that, in Indonesia, it is widely cultivated to meet export needs, but the Indonesian people themselves are still underutilized, so using it to make flour can make it easier to process raw materials into a product. Food processing can be done through various methods, one of which is the drying method. Drying technology is a very promising alternative method for maintaining longer shelf life; besides, this technology is the simplest and easiest processing technique. Some foods are controlled drying conditions using various drying methods, one of which is using tray dryer.



Fig. 1. Edamame (*Glycine max* (L.) Merr.)

1.1. Drying

Drying is a method of food processing that has long been known. The aim is to reduce the water content of the material so that it is more durable, reduce the volume of the material, and save on transportation, packaging, and storage costs. However, there are losses incurred during drying, namely changes in the physical and chemical properties of the material and a decrease in the quality of the material [1]. Drying is the process of separating relatively small amounts of water from materials using heat energy. The result of the drying process is dry material that has a water content equivalent to the normal air balance water content or equivalent to a water activity value that is safe from microbiological, enzymatic, and chemical damage.

1.1.1. Tray Dryer

The working principle of a tray dryer is to operate in a vacuum and with indirect heating. This drying is used to dry materials that cannot be stirred thermally, so that the result is a dry, solid substance. This drying technology is suitable for drying edamame soybeans, which are sensitive to heat and easily moldy. The aim is to reduce the water content contained in the ingredients so that soybean powder is obtained with the properties of soy milk unchanged because the fermentation process stops. To complete the nutritional content of this edamame soy milk, other additional ingredients, such as ginger, are used. Therefore, the aim of this research is to determine the drying process with a tray dryer in making edamame flour (*Glycine max (L.) merr.*) as well as the chemical characteristics as a raw material for making vegetable milk with a combination of ginger (*Zingiber officinale*) to determine the nutritional value of soy milk. Edamame soy milk with the addition of ginger and cinnamon are based on chemical (moisture, fat, protein, calcium) and sensory (color, taste, aroma, and texture) characteristics.

1.2. Ginger

Ginger (*Zingiber officinale*) is one of the findings of the Zingiberaceae tribe, which occupies a very important position in the economy of Indonesian society. Ginger plays an important role in various aspects of use, trade, life, customs, and beliefs in Indonesian society, which is diverse and scattered. Ginger is also a commodity that has been used for thousands of years as part of a spice concoction that is widely traded around the world. Even though it is not very striking, the use of ginger commodities has developed over time, both in terms of quantity, variety, use, and economic value [7].

1.2.1. Benefits of Ginger

Ginger is used as a herbal medicine because it contains essential oils with active chemical compounds such as zingiberin, camphor, lemonin, borneol, shogaol, cineol, fellandren, zingiberol, gingerol, and zingerone, which are efficacious in preventing and treating various diseases. The active chemical compounds also contained in ginger that have anti-inflammatory and antioxidant properties are gingerol, beta-carotene, flavonoids, capsaicin, caffeic acid, curcumin, and salicylates [4].

1.2.2. Ginger Nutritional Content

Ginger is better for maintaining health because it contains the nutrients the body needs. Ginger has a high vitamin C content, namely around 4 mg. Apart from that, ginger also has a water content of 86% and a phosphorus content of 39 mg [5]. Nutrients are chemical elements contained in food and drinks that are absorbed by the human body to maintain life and produce energy.

1.3. Soy Milk

Soy milk is made from plants, especially nuts and cereals [9]. Soy milk, which is commonly known to the public as milk with other bean-based ingredients, is emerging. One of them is edamame milk, which is made from edamame soybeans. Edamame soybeans are known as a type of legume with the highest protein content, namely around 30–40%. According to [6], soybean protein content is quite high, namely 30.44%, when compared with other types of beans such as green beans (23.86%), red beans (23.58%), and peanuts (6.15%). However, yellow soybeans have disadvantages, one of which is that they taste less sweet than other types of soybeans, namely edamame.

1.3.1. Benefits of Soy Milk

Soy milk is good for consumption by people who are allergic to cow's milk, namely people who do not or are deficient in the enzyme lactase (b-galactosidase) in their digestive tract, so they are unable to digest the lactose contained in cow's milk [8]. Therefore, it is necessary to develop a product that has nutritional value similar to animal milk but does not contain lactose, namely soy milk. Soy milk protein has an amino acid composition similar to cow's milk, so it can be used as a substitute for cow's milk for those with allergies (lactose intolerance) or for those who don't like cow's milk.

2. Experimental Procedure

Treatment Variables for the drying process with a *tray dryer* for Edamame Soybeans.

| Drying process with a <i>tray dryer</i> on Edamame Soybeans using soaking treatment | | | |
|--|----------------------------|---------|---------|
| Drying Temperature (°C) | Drying Time (Hours) | | |
| | 4 Hours | 6 Hours | 8 Hours |
| 40°C | A1 | B1 | C1 |
| 60°C | A2 | B2 | C2 |
| 80°C | A3 | B3 | C3 |

| Drying process with a <i>tray dryer</i> on Edamame Soybeans without using soaking treatment | | | |
|--|--|--|--|
|--|--|--|--|

| Drying Temperature (°C) | Drying Time (Hours) | | |
|-------------------------|---------------------|---------|---------|
| | 4 Hours | 6 Hours | 8 Hours |
| 40°C | D1 | E1 | F1 |
| 60°C | D2 | E2 | F2 |
| 80°C | D3 | E3 | F3 |

2.1. Observation

Determination of Water Content (SNI 3836:2013), Soxhlet Method Fat Content Analysis (AOAC, 2005), Kjehdal Method Protein Content Analysis (AOAC, 2001).

2.2. Research Procedure

Edamame flour making diagram.

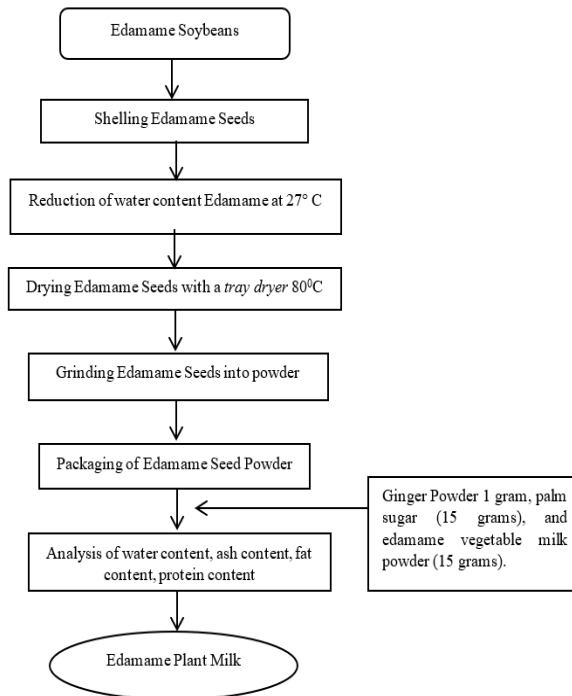


Fig. 2. Edamame flour making diagram.

2.2.1. Stages of the Healty drink process



(a) edamame soybeans



(b) Edamame milk, palm sugar, and ginger powder.

Fig. 3. Raw materials for making healthy drinks



Fig. 4. Healthy drink and packaged products

3. Results and Discussion

This research uses edamame soybeans as a raw material for making vegetable skim milk using a tray dryer as a drying medium. The independent variables used are

temperature and drying time. With variable temperatures of 40°C, 60°C, and 80°C. Meanwhile, the drying time variables are 4 hours, 6 hours, and 8 hours.

3.1. Determination of Water Content (SNI 3836:2013)

Water content is the main factor in making vegetable skim milk. The water content of edamame soybeans is expressed as a percent ratio of the sample weight before drying to the sample weight after drying. Water content analysis was carried out using a tray dryer at temperatures of 40 °C, 60 °C, and 80 °C. The results of determining the water content of edamame soybeans can be seen in Figures 5, 6, and 7.

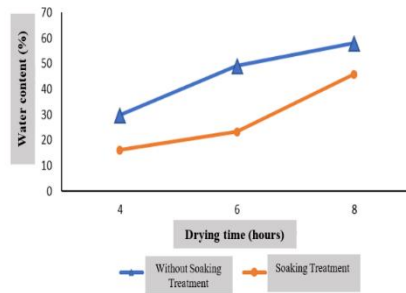


Fig. 5. Graph of the Effect of Drying Time at a Temperature of 40°C on the % Water Content Produced

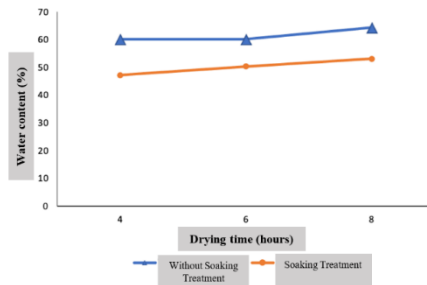


Fig. 6. Graph of the Effect of Drying Time at a Temperature of 60°C on the % Water Content Produced

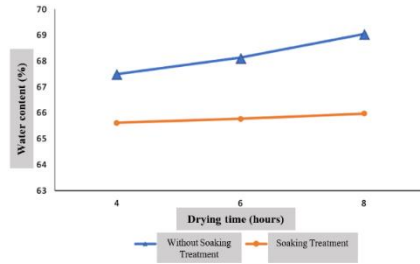


Fig. 7. Graph of the Effect of Drying Time at a Temperature of 80 °C on the Water Content Produced

Based on Figures 5, 6, and 7, it can be concluded that drying edamame soybeans without soaking has a higher water content compared to soybeans that are dried after soaking. Temperature and drying time also determine the water content. We can see this in Figures 5, 6, and 7, where the best drying can be seen in the treatment without soaking at a temperature of 80 °C with a drying time of 8 hours.

3.2. Fat Content Analysis Soxhlet Method (AOAC, 2005)

An analysis of fat content using the Soxhlet method was carried out in order to determine the fat content contained in edamame soybean vegetable milk powder. Because edamame soy milk is generally lactose-free with a lower fat content, soy milk is good for those on a low-fat diet. The composition of fat contained in edamame flour at a temperature of 80 °C can be seen in Figure 8.

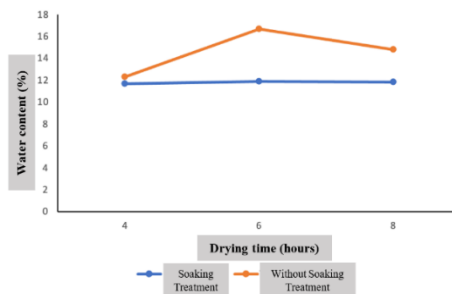


Fig. 8. Graph of the Effect of Drying Time at a Temperature of 80°C on the % Fat Content Produced

From Figure 8, it is known that the highest fat content in edamame flour without soaking with a drying time of 6 hours at a temperature of 80 °C is 16.68% (E3). Meanwhile, the lowest fat content found in edamame flour with a drying time of 4 hours at a temperature of 80 °C is 11.68%. (A3) According to SNI 01-2970-2015, powdered milk has a minimum fat content of 1.5% and a maximum of 26%. Based on the results obtained, overall, the edamame milk flour product meets the fat content requirements.

From Figure 8, it can be seen that edamame flour with soaking results in a lower fat content compared to edamame without soaking.

3.3. Analysis of Protein Content Kjedahl Method (AOAC, 2001)

Protein content is one of the most important elements in making edamame soy milk powder because edamame soy milk has an amino acid composition similar to cow's milk, so edamame soy milk can be used as a substitute for cow's milk for those who are allergic (lactose intolerance) or for those who don't like cow's milk. The protein composition contained in edamame flour at a temperature of 80 °C can be seen in Figure 9.

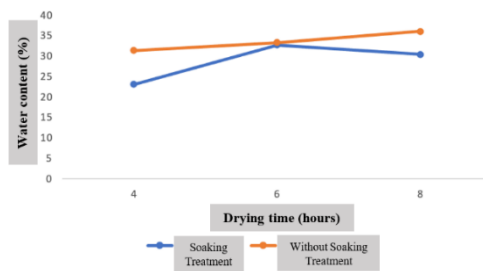


Fig. 9. Graph of the Effect of Drying Time at a Temperature of 80 °C on the Protein Content Produced

From Figure 9. it is known that the best protein content is found in edamame flour without soaking, with a drying time of 8 hours at a temperature of 80 °C of 36.04% (F3). Meanwhile, the lowest protein content was found in edamame flour, which was soaked for 4 hours at a temperature of 80 °C at 23.05%. (A3). According to SNI 01-2970-2015, powdered milk has a minimum protein content of 23%. Based on the results obtained, overall, the edamame milk flour product meets the protein content requirements.

From Figure 9. it can be seen that edamame flour with soaking causes lower protein levels compared to edamame flour without soaking. Apart from that, the length of the drying time also affects the protein content of the flour.

4. Conclusion

The best drying in this study was at a temperature of 80 °C with a drying time of 8 hours. The highest fat content in edamame flour without soaking with a drying time of 6 hours at a temperature of 80 °C was 16.68%. Meanwhile, the lowest fat content was found in edamame flour after soaking and drying for 4 hours at a temperature of 80 °C, amounting to 11.68%. According to SNI 01-2970-2015, powdered milk has a minimum fat content of 1.5% and a maximum of 26%. Based on the results obtained, overall, the edamame milk flour product meets the fat content requirements.

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