



## The Quality of Beef Meatballs Using Soybean Flour to Increase Dietary Fiber

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### ARTICLE INFO

*Keywords:* Beef Meatball,  
Tapioca Flour, Soybean  
Flour

*Received :* 1, December

*Revised :* 15, December

*Accepted:* 29, December

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### ABSTRACT

The aim to this study was to determine the composition of soy flour and tapioca flour in making meatballs on the physical and dietary fiber quality. The materials used in this study were soy flour, tapioca flour, beef, spices. The equipment used was a mill, gas stove, oven, refrigerator, digital scales, carper press, two glass plates with different thicknesses, weights, whatman 41, pH meter, fiber sheath. This study used a completely randomized design (CRD) with 4 treatments and 4 replications. The treatments consisted of R1 = 100% tapioca flour: 0% soy flour; R2 = 85% tapioca flour: 15% soy flour; R3 = 70% tapioca flour: 30% soy flour; R4 = 55% tapioca flour: 45% soy flour. The variables measured consisted of moisture, pH, water binding capacity, and crude fiber and were analyzed using analysis of variance with a completely randomized design in one-way pattern and continued with Duncan's New Multiple Range Test for significant variables. The results showed that the addition of soybean flour up to 45% did not affect the pH value and water content ( $P>0.05$ ), in meatball products fortified with soybean flour. The addition of soybeans with different levels gave a significant difference ( $P<0.05$ ) to the water binding capacity value of meatballs and there was an increase in the administration of 30-45%. Likewise, the dietary fiber of beef meatballs, there was an increase along with the addition of soybean flour. Based on the results of the research data and discussion, it can be concluded that 85% tapioca flour added with 15% soybean flour can increase dietary fiber in beef meatball products.

## **INTRODUCTION**

Meat is a livestock product that can meet human nutritional needs. Meat contains a source of high-value animal protein, rich in protein, fat, minerals and vitamins and substances needed by the body. However, the weakness of meat is that it is easily damaged and can cause degenerative diseases when consumed uncontrollably. According to Soeparno (2005) meat can be defined as all animal tissues and products of processing these tissues that are suitable for consumption. Organs such as the liver, kidneys, brain, lungs, heart, spleen, pancreas, and muscle tissue are included in this definition.

There are many processed meat products that are very popular in the public, including meatballs. Processed meat products such as meatballs are very popular foods in Indonesia. Meatballs are made from high quality meat mixed with spices, fillers and other additional ingredients, then shaped and steamed.

The diversification of biological products as extenders to improve the quality of processed meat products is increasingly developing today. Substitution with plant-based ingredients is quite popular because it has several advantages that can be utilized by processed meat products. According to Arnyke et al (2014), the advantages that can be taken through substitution of biological materials include increasing nutrition and increasing the preference value of the product. The use of plant products combined with processed meat products such as meatballs is an interesting part to study. A fairly well-known plant product that has high nutritional value is soy flour.

Soy flour and tapioca flour are semi-finished products that are basic ingredients for the food industry. Soy flour is an ingredient that can be added to making meatballs. The use of soy flour in making meatballs is expected to improve the physical characteristics of the product, nutritional value and have economic value. The composition of soy flour consists of 32.2 g protein, 4.3 g fiber, 17.7 g fat, 10.2 g water and 400 kcal energy (Adisarwoto, 2007). The nutrients contained in soy flour can be utilized in increasing the nutritional value contained in meatball products. The advantages of soy flour that are interesting to study are because soy flour contains high fiber.

Beef as the main ingredient of meatballs has a rather high fat content. Excessive fat consumption can be harmful to consumers. Fat can accumulate in the body so that it can cause various diseases such as stroke, heart, coronary, obesity and so on, therefore the fat in meatball products must be balanced with the presence of crude fiber content in soy flour. Fat absorbed by the body can be limited by the addition of soy flour. Fortification of soy flour is expected to produce meatball products that contain fiber, so that this product can be used as a source of health food.

The incorporation of soybean flour can enhance the quality of meatball products. Hermana et al. (2023) report an increase in the protein content of beef meatballs up to 23.31%, achieved through the use of 100% soybean flour without any tapioca flour. According to Mawati et al. (2017), the utilization of soybean flour as a fortifying agent can elevate the pH, water-holding capacity, and crude fiber content in chicken nugget products, with quality improvement noted at a 20% soybean flour incorporation. Additionally, research by Herlambang et al.

(2019) demonstrates that substituting tapioca flour with cassava flour (*Porang*) enhances water-holding capacity and pH levels, with a preference observed among panelists for a 50% blend of tapioca flour and 50% *Porang* flour.

Despite the various studies on flour substitutions, there is a lack of information regarding the application of soybean flour in different dosages for meatball products. The high fiber content in soybeans is expected to significantly improve meatball products, particularly concerning their fiber content.

## METHODOLOGY

### *Research Materials*

The materials used to make meatballs using soy flour substituted with tapioca flour, beef, and spices consisting of garlic, pepper powder, salt, ice, pH 7 buffer for pH testing, H<sub>2</sub>O, distilled water, NaOH, H<sub>2</sub>SO<sub>4</sub> 1.25%.

The equipment used to make meatballs are blender grinder, analytical scales, pans, knives, stoves, gas, ovens, refrigerators, coolers, digital scales, carper press water binding power test, two glass plates with different thicknesses, weights, transparent plastic, whatman 41, markers, pH meters, bowls/containers, fiber sheaths and a series of hydrolysis tools for fiber testing.

### *Experimental Design*

This study used a completely randomized design (CRD) with 5 treatments, consisting of:

R1 = 100% tapioca flour: 0% soy flour

R2 = 85% tapioca flour: 15% soy flour

R3 = 70% tapioca flour: 30% soy flour

R4 = 55% tapioca flour: 45% soy flour

Each treatment was repeated four times. The complete formulation of beef meatballs with the addition of soy flour is listed in Table 1.

Table 1. Beef Meatball Formulation and Soy Flour Fortification at Different Levels

Ingredients	Level fortification of soy flour on tapioca flour			
	R1	R2	R3	R4
Tapioca (g)	150	127	105	82,5
Soy flour (g)	0	22,5	45	67,5
Beef (g)	400	400	400	400
Ice cubes (g)	65	65	65	65
flavoring (g)	15	15	15	15
flavoring (g)	3	3	3	3
Pepper (g)	22	22	22	22
Garlic (g)	3	3	3	3

coconut (mL)	oil	30	30	30	30
Egg (grain)	yolk	2	2	2	2

**Observed Variables**

The variables observed in this study consisted of pH value, moisture, water binding capacity, dietary fiber

**Making Soybean Flour**

Soybean flour can be made by 1) One kilogram of soybeans is sorted to select good soybeans, removing foreign objects and damaged or broken soybeans, 2) Then the soybeans are washed clean, 3) the soybeans are drained and dried by drying in the sun or using an oven at a temperature of 500C for 12 hours and 4) Finely ground and sieved with a 60 mesh sieve to obtain fine soybean flour. For a clearer explanation of the making of soybean flour, see Figure 1.

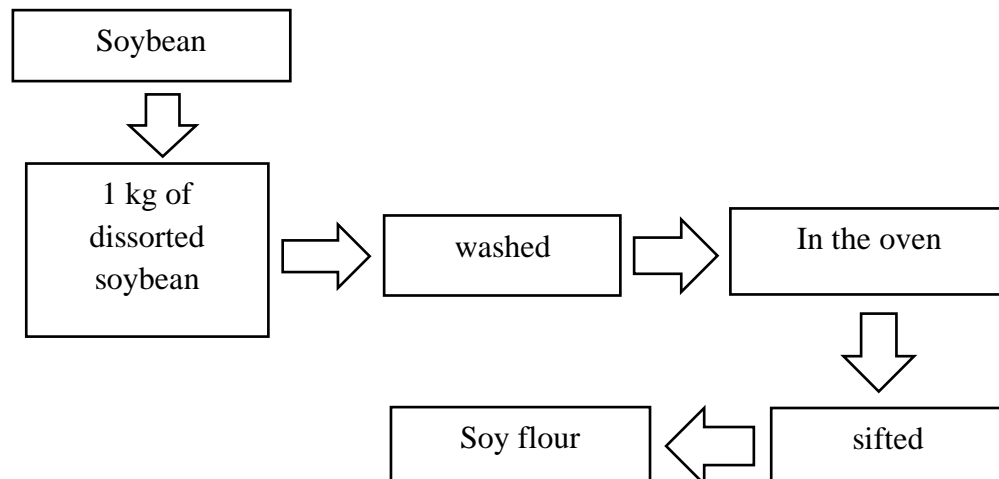


Figure 1. The making of Soybean Flour

**Meatballs**

Meatballs with soy flour substitution is done with four different levels of soy flour, namely 0, 15, 30, and 45%. Beef that has been separated from fat, cut into small pieces then ground until smooth. Ingredients consisting of garlic, shallots, flavoring, powdered milk, pepper, ice, salt, and tapioca flour are mixed. Then the ground beef is mixed with soy flour and tapioca flour. The dough after being homogeneous is molded in an aluminum container, steamed for 30 minutes at a temperature of 600°C - 700°C then cut. For a clearer process of making meatballs, the research can be seen in Figure 2.

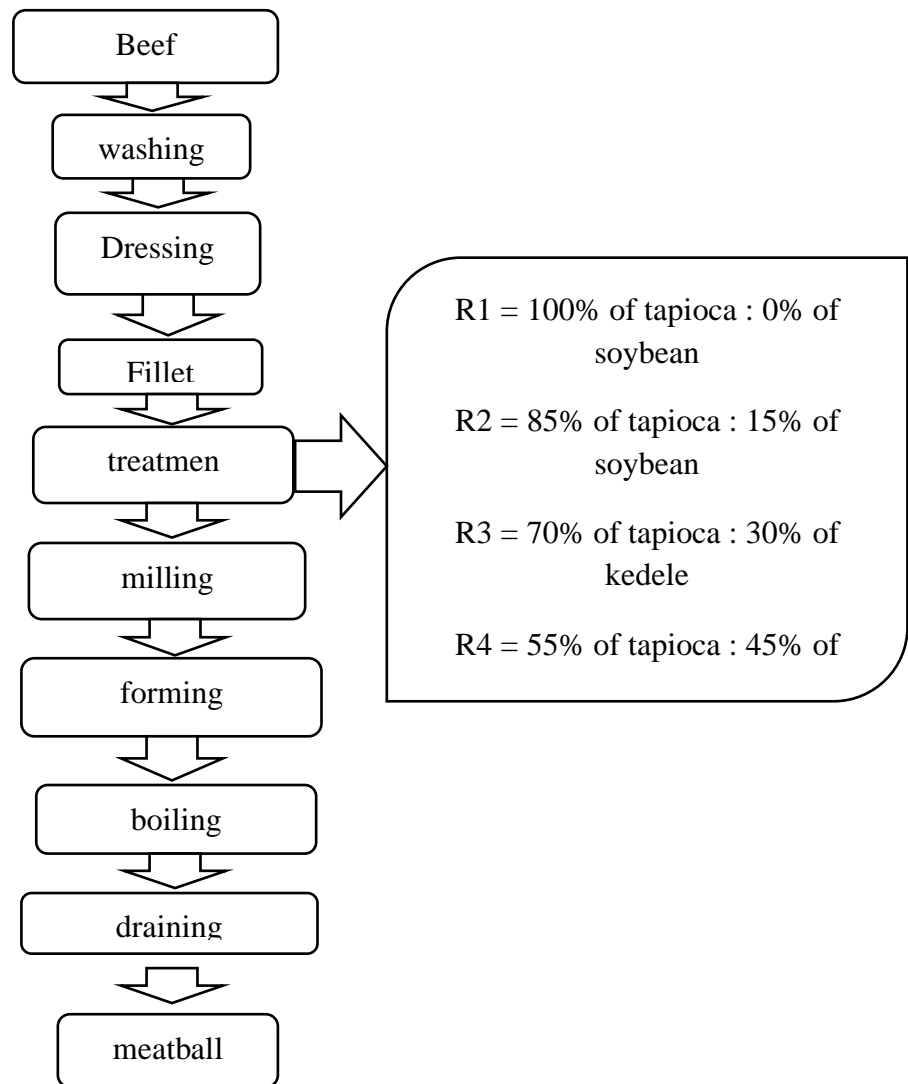


Figure 2. Diagram of Making Meatballs Using Soy Flour

### *Data Analysis*

The research data of each measurement variable consisting of pH value, water content, water binding capacity and dietary fiber were analyzed using analysis of variance (ANOVA) at a 95% confidence level, and continued with a test of the difference in the means of each significant variable. The difference test used was Duncan's New Multiple Range Test (DMRT) (Steel and Torrie, 1995)

### **RESULTS AND DISCUSSION**

The results of research on the effect of using soy flour in beef meatball products on the pH value, water content, water holding capacity and fiber content can be seen in Table 2.

Table 2. Average pH Value, Water Content, Water Holding Capacity, and Food Fiber Content of Beef Meatballs at Different Treatment Levels.

Variables	Treatment			
	R1	R2	R3	R4
pH	6,93	6.86	7.06	6.99
Moisture (%)	61.56	59.5	60.11	58.62
Water holding capacity (%)	39.18 <sup>a</sup>	48.26 <sup>b</sup>	49.66 <sup>b</sup>	50.24 <sup>b</sup>
Dietary fiber (%)	0.67 <sup>a</sup>	0.89 <sup>b</sup>	0.94 <sup>b</sup>	0.97 <sup>b</sup>

Description:

R1 = 100% tapioca flour without soy flour; R2 = 85% tapioca flour and 15% soy flour; R3 = 70% tapioca flour and 30% soy flour; R4 = 55% tapioca flour and 45% soy flour.

Superscripts on the same row indicate significantly different ( $P < 0.05$ )

### *pH Value*

The results of the pH value observations in Table 2 showed that the addition of soy flour did not have a difference in the pH value of meatball products fortified with soy flour ( $P > 0.05$ ). The provision of soy flour up to 45% in this study showed no significant difference. The pH value of tapioca flour 55% - 100% statistically in this study ranged from 6.86 - 7.06. The unchanged pH value of meatballs added with soy flour is largely determined by the pH of the meat. The pH value of beef meatballs is largely determined by the pH of the beef. In this study, meat had the largest portion of up to 400 g, while soy flour was used in this study only up to 67.5 g (in Table 1).

Meat generally has a pH range of 5.3 to 6.0. The results of this study indicate that the pH of meatballs is respectively 6.93, 6.86, 7.06, and 6.99 higher than the pH of meat. The increase in meatball pH compared to meat pH is because meatball pH is a product that has gone through a cooking process. Soeparno (2005) stated that cooking will cause a decrease in the acidic group so that the isoelectric point increases, also due to the addition of salt in making meatballs. Furthermore, the ultimate pH of meat, which is the pH achieved after muscle glycolysis is exhausted or glycolysis is no longer sensitive to glycolytic enzyme attacks, is normally 5.4 - 5.8. The rate of post mortem glycolysis in meat causes glycogen to break down into glucose, glucose will be broken down by enzymes into lactic acid (Dewi, 2012).

### *Moisture*

The results of observations of water content are in Table 2 showed that the addition of soy flour shows no significant difference ( $P > 0.05$ ) in meatball products fortified with soy flour. With the understanding that the provision of soy flour up to 45% level in 55% tapioca flour, the water content is still the same

as the meatball product without the addition of soy flour. The water content in this study ranged from 58.62 - 61.56%. The unchanged water content in meatballs added with soy flour is largely determined by the pH of the meat. The pH value of the meat in this study which was simultaneously analyzed gave no significant difference.

### ***Water Holding Capacity***

The results of observations of water holding capacity in Table 2 showed that meatballs with soy flour fortification at different levels provide a significant difference in the water holding capacity value.

Furthermore, based on the Duncan test, it shows that there is a difference in the water holding capacity value ( $P < 0.05$ ) in meatball products fortified with soy flour. The average water binding capacity value of meatballs using soy flour in treatment R1 is different from the treatments in R2, R3 and R4. The water holding capacity value of meatballs using 100% tapioca flour without soy flour is 39% lower than the combination of tapioca flour and soy flour which reaches 48.26% - 50.24%. In other words, the use of 55 - 85% tapioca flour combined with 15 - 45% soy flour can increase the water holding capacity of meatballs compared to only using tapioca flour without soy flour. Although statistically, the use of 15% soybeans showed no significant difference in the average water holding capacity with the use of 45%, there was a tendency for an increase in the water holding capacity of meatballs and this was clearly caused by the addition of soy flour. The role of soy flour in increasing the water holding capacity of meatballs is due to the high protein content in soy flour. According to Soeparno (2005), the water holding capacity of meat plays a very large role in the manufacture of processed meat products, for example, during the heating process, grinding, mixing ingredients, or in the emulsification process into processed meat products. The weight loss during meat processing is partly due to water evaporation, so that the water in the meatball product is also strongly bound by the soy flour protein in addition to being bound to the meat protein. Meat and soy flour are components that can bind water in meatballs. Meat has the ability to bind its water or added water as long as there is an external force. Soeparno (2005) stated that the water binding capacity changes significantly with heating at a temperature of 600C because the sarcoplasmic protein is almost completely denatured due to cooking. High temperatures increase protein denaturation and affect the water binding capacity. The amount of water contained in meatballs depends on the amount of water added to the dough and the proportion of meat used (Triatmojo, 1992).

### ***Dietary Fiber***

The results of dietary fiber observations listed in Table 2 show that meatballs with soy flour fortification at different levels provide a significant difference in the dietary fiber value of beef meatballs. With the understanding that meatballs given soybean flour can increase dietary fiber content compared to beef meatballs without using soybeans. The use of soybeans 15% to 45% dietary fiber content has no significant effect.

The significantly different research results can be caused by the soybean flour used in beef meatballs containing a lot of crude fiber. According to Adisarwoto (2007), the fiber content in soybean flour is 4.3 g per 100 g of soybean flour. In this study, the crude fiber content in meatballs using soybean flour tends to increase, the higher the amount of soybean flour added to the meatballs, the higher the crude fiber content.

The crude fiber contained in meatballs can be used as an index of dietary fiber content. Basically, the dietary fiber content is higher than crude fiber. During the heating process, crude fiber does not change because crude fiber can only be degraded by strong acids and strong bases for 30 minutes. The main content of crude fiber is cellulose. In the digestion process, cellulose is not digested. Cellulose provides filling and coarse material in food that helps maintain mobility and overall digestive health (Suhardjo et al., 2006). According to Budianta et al. (2001) this process is caused by the presence of dietary fiber which acts as a water binder. Darajat (2010) explains that dietary fiber has a very large surface area and a capillary structure so that it has the ability to absorb high water.

## **CONCLUSSION AND RECOMMENDATIONS**

The combination of tapioca flour and soybean flour can be utilized in the production of meatballs, significantly enhancing the dietary fiber content of the product. An incorporation of 85% tapioca flour with an addition of 15% soybean flour is sufficient to elevate the fiber content in beef meatballs.

## **FURTHER STUDY**

Further research is warranted to include organoleptic testing.

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