Enhancing the Quality of Beef Sausage by Using Papaya Peel Flour as a Filler

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Abstract. The focus of this research was the development of papaya peel flour as a filler in beef sausages. Using papaya peel flour as an additional ingredient in beef sausages can increase the added value of agro-industrial waste. This research aimed was to evaluate the quality of beef sausages with the addition of papaya peel flour. The research material was beef sausage made from beef with papaya peel flour and other optional ingredients. The research method used was an experiment in the laboratory using a completely randomized design with 4 treatments and repeated 5 times. Beef sausages incorporated with papaya peel flour were formulated with the addition of 0.1%, 0.2%, 0.3% (of the total meat used), and without addition as a control. Beef sausage quality parameters were evaluated from pH, cooking loss, water holding capacity, yield, color L (lightness), a* (redness), and b* (blueness). The experimental results showed that papaya peel flour had a very significant effect ($p<0.01$) on the quality of beef sausage. Papaya peel flour can increase pH value, water holding capacity, yield, redness (a*), and blueness (b*) of beef sausage. A decrease occurred in the cooking loss, and brightness (L). Based on the research results obtained, incorporating beef sausage with 0.3% papaya peel flour produces the best quality.

Keywords: Beef Sausage, Papaya Peel Flour, Filler.

1   Introduction

Innovation in food product development is currently growing rapidly. The demand for healthy food and having health effects for consumers is increasing [1]. Consumers are starting to focus on health so that this encourages the industry to compete in producing healthier and quality products, namely low fat, using natural ingredients, low sodium, but still having a delicious taste. Increasing public awareness of this, provides a challenge for researchers and industry players to produce safe and healthy products. Currently, the meat processing industry can make better products based on quality, safety, and shelf life by using the latest processing technology.

Sausage is a popular meat product in the world. Generally, sausages contain high levels of fat and protein, but are low in fiber [2]. Diversification and innovation need to be done to meet market demand. Sausages with higher nutritional value will provide higher selling value in the community. One innovation that can be given is the

effort to use natural alternative ingredients but have bioactive benefits [3]. This effort is a strategy carried out by researchers to answer consumer needs and desires.

One of the increasing environmental issues is agricultural wastes such as papaya peels, which are considered wastes in the process of fruit processing, mostly thrown without optimal utilization, thereby increasing the volume of organic waste capable of destroying the balance of the ecosystem. Decomposition of papaya peels in landfills results in the production of methane gas, which is hazardous to the atmosphere and contaminates soil and water [27]. Moreover, agricultural waste, if poorly managed, can be a source of health problems, particularly when exposed to pathogenic microorganisms thriving in decomposing organic matter. The search for effective ways of managing papaya peel waste is of essence lest it contributes to the already jeopardizing impact on the environment and human health.

Fruit peel is the outermost part of the fruit and is a by-product or waste. Papaya peel is one example of agricultural waste that still contains nutrients and bioactive compounds. Papaya peel flour has a high content of fiber, vitamins, and minerals [4]. The fiber in papaya peel can be used as a binder and filler in food products [5]. Papaya peel can be converted into flour to be applied to food products [6]. In the food industry, papaya peel can be used as an alternative as an emulsifier that can help form and stabilize emulsions in food.

Papaya peel flour has the potential to increase the nutritional value of food. In previous studies, beef sausages were added with soy flour [7], porang flour [8], grasshopper flour [9], and barley flour [10]. Research on the addition of papaya peel flour in beef sausages has never been done. This study aims to evaluate beef sausages with the addition of papaya peel flour based on physical quality including pH value, cooking loss, WHC, yield, and color.

2 Materials and Methods

2.1 Materials

The materials used in this study were fresh beef fore shank, vegetable fat s, tapioca flour, sausage seasoning including sugar, salt, nutmeg, ginger, garlic, and egg white, ice cubes, papaya peel flour with treatments of 0.1%, 0.2%, and 0.3%.

2.2 Methods

The research method used a completely randomized design with four treatments (control without the addition of papaya peel flour, 0.1%, 0.2%, and 0.3% addition of papaya peel flour) with five replications. The research was conducted by means of experiments in the laboratory.

Table 1. Sausage Formulation.

The Ingredients (%)	S0	S1	S2	S3
Fresh beef	60	60	60	60
Vegetable fats	10	10	10	10
Tapioca flour	8	8	8	8
Sugar	2	2	2	2
Salt	2	2	2	2
Nutmeg powder	0.25	0.25	0.25	0.25
Ginger powder	0.25	0.25	0.25	0.25
Garlic powder	3	3	3	3
Egg white	4.5	4.5	4.5	4.5
Ice cubes	10	10	10	10
Papaya peel flour	0	0.1	0.2	0.3

2.3 Preparation of Papaya Peel Flour

Papaya peel is washed clean, cut into small pieces, and dried in an oven at 60°C until dry with a moisture content of 8 %. The dried papaya peel is ground using a blender until it becomes a fine powder. Papaya peel flour is sieved to obtain a uniform particle size [11].

2.4 Beef Sausage Preparation

Beef and fat were finely chopped and mixed with sausage seasoning. Ice cubes were added to obtain the desired texture. The addition was carried out according to the treatment, namely adding papaya peel flour as much as 0.1%, 0.2%, and 0.3% of the total meat used and without adding papaya peel flour. The meat mixture that had been added with flour was put into sausage casings. Boiling water was prepared at 70°C for 30 minutes to ensure maturity and food safety. Ice water was prepared in a container, sausages that had reached the level of maturity were put into ice water. The sausages were drained and analyzed according to the variables measured.

2.5 Parameter Measurements

pH measurement is cut the sausage into small pieces. If necessary, homogenize the sample using a cup and mortar. Add 10 grams of sausage to 90 ml of distilled water in a beaker glass. Stir until the sausage is dissolved. Calibrate the pH meter according to the tool instructions. Dip the pH electrode into the sausage solution and record the pH value read [12]. Cooking loss measurement is weight the raw sausage sample with an analytical balance and record the initial weight (W1). Cook the sausage mixture at a specified temperature (e.g. 80°C) until it reaches the desired doneness. Weigh the cooked sausage and record the final weight (W2). Calculate the cooking loss using the formula: (W1-W2)/W1*100% [13]. WHC measurement is cut the sausage into small

pieces and weigh it with an analytical balance (W1). Place the sausage sample between two sheets of filter paper or gauze. Press with consistent pressure (eg using a certain weight). Weigh the squeezed sausage to get the wet weight (W2). Calculate WHC using the formula: (W2-W1)/W2*100% [14]. Yield measurement is weight the raw sausage sample and record the initial weight (W1). Process or cook the sausage according to the procedure. Weigh the processed product and record the final weight (W2). Calculate the yield using the formula: (W2-W1)*100% [15]. Color measurement is cut the sausage and smooth the surface for measurement. Calibrate the CIELAB colorimeter according to the instrument instructions using the available color standards. Place the sausage sample in the measuring area of the instrument. Take color readings to obtain La*, b*, and C* values. Save the L, a*, and b* data from the measurements [16].

2.6 Data Analysis

Statistical tests use analysis of variance (ANOVA) to determine whether there are significant differences between treatments. If ANOVA shows a significant difference, Duncan's test is performed to determine the specific differences between the different treatments.

3   Results and Discussion

3.1 pH Value

The results showed that papaya peel flour added to beef sausage had a very significant effect ($p<0.01$) on the pH value (Table 2). The more papaya peel flour added, the lower the pH of beef sausage. This is because there is a proteolytic enzyme or papain in papaya peel flour. Papain can interact with protein, resulting in protein breakdown and affecting the pH of beef sausage [17]. The breakdown of meat protein by papain can lower the pH. With the breakdown of the protein structure of beef sausage, it will affect the texture produced by the sausage. The pH value is an important parameter in making beef sausage because it affects the texture, color, and taste of the final product. The pH value of beef sausage usually ranges from 5.0 to 5.5. A pH value that is too high or too low can affect the softness, stability of the fat emulsion, and shelf life of the product [18].

Table 2. The quality of beef sausage with papaya peel powder.

Treatment	pH ± SD	Cooking loss (%) ± SD	WHC (%) ± SD	Yield (%) ± SD
S0	5.80[c] ± 0.02	7.52[d] ± 0.39	45.64[a] ± 0.24	184.65[a] ± 0.24
S1	5.74[b] ± 0.03	6.31[c] ± 0.22	47.39[b] ± 0.35	186.12[b] ± 0.23
S2	5.72[b] ± 0.02	5.66[b] ± 0.26	49.66[c] ± 0.18	187.19[c] ± 0.12
S3	5.64[a] ± 0.02	4.34[a] ± 0.38	51.16[d] ± 0.23	188.90[d] ± 0.31

Note: Notations on the same row indicate very significant differences ($p<0.01$)

3.2   Cooking Loss

The results showed that papaya peel flour added to beef sausage had a very significant effect ($p < 0.01$) on cooking loss (Table 2). The more papaya peel flour added, the lower the cooking loss of beef sausage. Papaya peel flour can affect cooking loss due to the formation of a softer texture and can increase WHC. This activity occurs with the reaction resulting from the interaction between papain and meat protein [17]. Papaya peel flour is used as an ingredient that limits water from coming out a lot during the cooking process [19]. The addition of curcumin to sausages can reduce the cooking loss rate, because the phenolic compounds in curcumin can increase the water holding capacity [25]. Reducing cooking loss can mean increasing yield.

3.3   Water Holding Capacity (WHC)

The results showed that papaya peel flour added to beef sausage had a very significant effect ($p < 0.01$) on WHC (Table 2). The more papaya peel flour added, the more WHC beef sausage could be increased. WHC in meat products can be influenced by several factors, including the meat protein used, the processing treatment, and the additional ingredients used [20]. In this study, the addition of papaya peel flour containing papain can break down protein chains. This certainly affects the increase in WHC in beef sausage. Papain can work actively at temperatures of 30-80°C [21]. The increasing WHC of beef sausage is influenced by papaya peel flour which can break down protein bonds and bind water. The combination of cassava and coconut composites added to chicken sausage as filler can increase the WHC value [26].

3.4   Yield

The results showed that papaya peel flour added to beef sausage had a very significant effect ($p < 0.01$) on the yield (Table 2). The more papaya peel flour added, the more the beef sausage yield could be increased. The increase in beef sausage yield was influenced by the nature of papaya peel flour. The papain content in papaya peel flour helps increase water binding, thus increasing the yield and stability of sausage emulsion [22]. The formation of a stable emulsion between water and fat minimizes the occurrence of separation and reduces cooking loss [23]. Thus, the amount of beef sausage yield increases. The addition of papaya peel flour to beef sausage can increase yield, this is because the bioactive components of papaya peel flour interact with meat protein to hold the water capacity in the sausage so that there is a decrease in cooking loss.

3.5   Color

The results showed that papaya peel flour added to beef sausage had a very significant effect ($p < 0.01$) on color (Table 3). The more papaya peel flour added, the more it could reduce brightness and increase redness and yellowness in the color of beef sausage. This is due to the addition of papaya peel flour. The pigments contained in pa-

paya peel affect the color produced by beef sausage. Papaya generally contains carotenoids, papaya flesh that is still attached to the papaya peel can affect color changes [24]. In addition, papaya peel still contains chlorophyll so it can increase redness and yellowness in beef sausage.

Table 3. The average color of beef sausage.

Treatment	L ± SD	a* ± SD	b* ± SD
S0	$63.70^d \pm 0.44$	$5.87^c \pm 0.28$	$13.09^d \pm 0.23$
S1	$58.03^c \pm 0.51$	$1.43^a \pm 0.16$	$11.47^a \pm 0.23$
S2	$57.64^b \pm 0.17$	$1.64^a \pm 0.37$	$12.93^b \pm 0.42$
S3	$55.80^a \pm 0.55$	$2.92^b \pm 0.26$	$14.60^c \pm 0.39$

Note: Notations on the same row indicate very significant differences ($p<0.01$)

4   Conclusion

Papaya peel flour added to beef sausage can improve the physical quality of the product. The addition of 0.3% papaya peel flour produces the best quality beef sausage.

Disclosure of Interests. The authors have no competing interests to declare that are relevant to the content of this article.

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