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THE EFFECT OF THE USE OF DURIAN SEED FLOUR (*Durio zibethinus* Murr) AS A FILLER ON THE PHYSIOCHEMICAL AND MICROBIOLOGY OF SALAMI

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ABSTRACT

The purpose of this study was to determine the physicochemical and microbiological of salami using durian seed flour (*Durio zibethinus* Murr) as filler. The study was conducted using a completely randomized design with 5 treatments P0 (0%), P1(5%), P2 (10%), P3 (15%), and P4 (20%) each treatment was repeated 4 times. Parameters measured include physical (water holding capacity, cooking loss, and tenderness) and chemical (water content, protein, fat, carbohydrates), and microbiology (pH and *Total Plate Count*). The data used analysis of variance (ANOVA) and continued with the Tukey test. Based on the results of the study, it was found that the cooking losses decreased from 24.48% - 8.31%'; Water Holding Capacity increased from 27.78% - 51.97%; Softness increases from 13.94 - 22.39 mm/g/10 seconds. While the chemical quality of the water content increased from 40.46% - 44.84%; Fat decreased from 19.95 – 13.75%; Protein decreased from 24.90 - 20.74%; Carbohydrates increased from 40.46 – 44.84%; Microbiological such as pH 4.07 – 4.08; Total Plate Count decreased from 3.57 x 10^3 CFU/gram – 3.038 x 10^3 CFU/gram. The conclusion of this study shows that durian seed flour can be used as a filler in salami it can improve the physicochemical and microbiological with a level of 15%.

Keywords: Durian seed flour, Chicken laying hens, salami

INTRODUCTION

Durian (*Durio zibethinus* Murr) is a very popular fruit in Indonesia. Fruit with the nickname The King of fruits is found in many tropical areas. According to Prasetyaningrum (2010), people usually consume durian flesh because it has high nutritional value and tastes good, while the durian skin and seeds are disposed of as waste. The percentage of the weight of the coated part of the fruit or the flesh is low, namely only 20-35%. The nutritional content of this fruit is carbohydrates, protein, and vitamins B and C (Feng *et al*., 2016). Ripe durian seeds contain 51.1% water, 46.2% carbohydrates, 2.5% protein, and 0.2% fat. The carbohydrate content is higher than cassava (34.7% carbohydrates) or sweet potatoes (27.9% carbohydrates). Durian seeds can be used as an alternative to processed food in the form of flour which can add information about nutrition to the community and create a clean environment (Setio *et al*, 2013). Durian seed starch has similarities to tapioca starch such as starch content, namely amylose, and amylopectin, so it can be combined with tapioca starch as a salami filler.

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The use of durian seed flour as a mixture in food processing has not been widely used. To increase the use of durian seeds as a food source, it is necessary to know the maximum limit for adding durian seed flour to the dough, so that it can produce processed products with good quality, even though they contain aspects of toxicity, especially the content of cyclopropene fatty acids, and possibly HCN. Cyclopropene fatty acids can be anesthetic and affect the body's metabolism so that it can cause dizziness, thin body, and reduce fertility. The crude polysaccharide extract content of durian seeds has the potential to be used as an alternative source of food additives in the food industry (Bronikowska *et al*., 2012).

Durian seeds contain two main components, namely starch and gum which contain carbohydrates and protein (Amid and Mirhosseini, 2012). The filler material that is generally used in the manufacture of sausages is tapioca flour. Tapioca flour has a high level of elasticity and starch content (Melia *et al*. 2010). Durian seed flour contains starch as high as tapioca flour. Tapioca flour has a starch content of around 90% (Reputra 2009) and durian seed flour contains starch of 88.68% (Malini, 2016), so durian seed flour can be used as a filler for sausage dough. Salami (fermented sausage) is a processed meat product mixed with fat and meat through a fermentation process using lactic acid bacteria cultures such as *Lactobacillus acidophylus* and *Lactobacillus Plantarum*. Based on the above background, a study has been carried out to examine the use of waste-based durian seed starch (*Durio zibethinus* Murr) as a filler in terms of physical, chemical, and microbiological quality.

MATERIALS AND METHODS

The equipment used is a Philips HR 7620 brand Food, a thermometer, and Harner as a filling tool into sausage casings, and sausage casings with a size of 30 mm to wrap salami. Casing straps, a sausage press (hand stuffer), a smoker for smoking salami, a basin for storing meat, plastic mats for storing spices, gloves, electric scales, knives, and cutting boards. The materials used include 96 weeks old Isa Brown culled laying hens, which were obtained from a livestock company in Tetey Village, Dimembe District, Minahasa Regency, and durian seeds (*Durio zibethinus* Murr). Seasonings for making salami such as garlic, ginger, pepper, nutmeg, sugar and salt, flour, skim milk, fat, ice, or ice water. The starter cultures for the fermentation of *Lactobacillus plantarum* and *Lactobacillus acidophillus* were obtained from the Food and Nutrition Center, Gadjah Mada University, Yogyakarta,

The study was carried out using a completely randomized design (CRD) with 5 treatments and each treatment was repeated 4 times so that 20 treatment combinations were

obtained (Steel and Torrie, 1995). The main ingredients in making salami consist of a chicken laying hens meat and fat in a ratio of 80:20. The meat and fat are ground together, then frozen for 24 hours. The ground and frozen meat are then ground using a food processor along with spices, salt, sugar, garlic, ginger, pepper, nutmeg, and starter cultures of *Lactobacillus Plantarum* and *Lactobacillus acidophilus* in a ratio of 1: 1. As a treatment, durian seed flour (*Durio zibethinus* Murr) as filler, namely 0% (P0), 5% (P1), 10% (P2), 15% (P3), and 20% (P4) To the sausage dough is usually added skim milk, fat, ice or ice water and vegetable protein. After mixing well, the dough is put into a casing with a diameter of 30 mm, then tied. Then hung on a rack and allowed to condition for 24 hours at room temperature (Arief *et al*., 2008). Salami underwent a conditioning process, then fermented for 6 days at room temperature. Fermentation is interspersed with a smoking process for 1 hour per day. The temperature during smoking is maintained at 30-35ºC. The fuel used is dry coconut shells, and the variables measured consist of physical qualities such as water holding capacity, cooking loss (Soeparno, 2005), and tenderness (Muchtadi and Sugiyono, 1992) and Chemical quality such as proximate analysis (the content of water, protein, fat, carbohydrates) (AOAC, 2005) as well as Microbiology measurements (pH *and Total Plate Count*) (Lukman D. W and Trioso, 2009**).** The process of making salami is in the flow chart (Figure 1).

RESULTS AND DISCUSSION

Effect of Treatment on Cooking Loss

The results of the research on the effect of treatment on the physical properties of salami using durian seed flour (*Durio zibethinus* Murr) on cooking loss (%), water holding capacity (%), and tenderness (%) are presented in Table 1. The data in Table 1 shows that cooking loss decreased from 24.48% to 8.31% along with the increasing level of use of durian (0%, 5%, 10%, 15%, 20%,) thus The use of durian seed starch flour affects the cooking loss of salami because durian seed flour on salami can bind free water or the amount of water bound and between muscle fibers and even other compounds found in salami products so that cooking loss becomes small. Low cooking loss means that the quality of salami with the use of durian seeds can be said to be good,- because if a food product has a low cooking loss, it means the product is of good quality. This is supported by Soeparno, (2005) that meat or processed meat products with low cooking losses have better quality than meat with high cooking losses because the loss of nutrients during cooking will be less

Effect of Treatment on Water Holding Capacity

The increasing water holding capacity of the research results from 27.78% - 51.97% indicates the effect of treatment using durian seed starch flour on salami can bind free water, especially during the meat emulsion formation process because both can grow well in a medium with water content. sufficient (Fardiaz, 1992). The data from the analysis of the water-holding capacity of salami can be seen in Table 1. WHC contained in salami products is affected by water content. Soeparno (2005) stated that WHC is defined as the ability of meat to bind water or added water during the influence of external forces water holding capacity of meat is affected by the state of meat protein, although only less than 5% of water binds directly to the hydrophilic group of meat protein (Bintoro, 2008). Furthermore, it is said that WHC, juices, and texture are interrelated which is a determining factor for meat quality.

An increase in water holding capacity will be followed by an increase in tenderness. Besides being influenced by the addition of filler, the tenderness is also influenced by the water-holding capacity. The high water holding capacity results in a small amount of water being lost during the smoking process of the salami, resulting in a better texture and tenderness of the salami. Meat tenderness is determined by at least three meat components, namely myofibrils and their contraction status, connective tissue content and degree of cross-linking air binding capacity by meat protein, and meat structural juices (Soeparno, 2005).

Effect of Treatment on Tenderness

The data from the analysis of tenderness on salami with the use of durian seed starch flour (*Durio zibethinus* Murr) gave a very significant effect ($P < 0.01$) on tenderness. There was an increase in the tenderness of salami P0 (13.94) mm/g/10 seconds (without durian seed meal) to P4 (20% durian seed meal) tenderness reaching 22.39 mm/g/10 seconds. This shows that the use of durian seed flour in salami processing can increase tenderness because the increasing use of durian seed starch will cause more water to be bound so that tenderness increases. According to experts, the tenderness of the meat is largely determined by at least three components of meat, namely the myofibril structure and contraction status, the content of connective tissue and the level of cross-linking, and the water-binding capacity of meat proteins and meat juices. Factors that affect meat tenderness are classified into antemortem factors such as genetics, race, age, and sex, livestock stress, and postmortem factors such as withering, freezing, processing methods including cooking and the addition of tenderizers (Soeparno, 2005).

Effect of Treatment on Water Content

Data from the analysis of salami water content can be seen in Table 2. The water content of salami with the addition of durian (*Durio zibethinus* Murr) seed flour was 40.47% - 44.84%. The water content is far below the standard water content stipulated by SNI No. 3820:2015, which is a maximum of 67%. The use of durian seed flour up to 20% does not significantly affect the water content of the salami. The water content will greatly affect the quality of the salami. The high water content will make it easier for microbes (bacteria, molds, and yeast) to multiply, affecting the salami's quality

Opinion Winarno (1992) that the water content in food ingredients also determines the freshness and durability of food. This opinion was clarified by Buckle *et al*. (2009) that water content is very important in determining the durability of food ingredients. Until now, the water content of fermented sausages has not been determined, but with the acquisition of water content ranging from 40.47 (P0) to 44.84% (P4) it is close to the results of Soeparno's research (2005), which explains that dry sausage has a moisture content of around 25 – 45%, while the dry sausage has a water content of around 55 – 60%; the water content of the research results between 40.47% - 44.84% still meets the requirements of SNI 3820-2015; the water content of meat sausage is 67%. The research product is salami in the dry sausage category. According to Hui *et al*. (2001), fermented sausage (dry sausage) has a moisture content of 30% - 40%; Andry Pratama *et al* (2021) water content of 54.93%,

Effect of Treatment on Protein Levels

Based on the data in Table 2 shows that the protein content of salami using durian seed flour decreased from 24.90% - 20.74%. While the protein content of sausages according to SNI 01-3820-2015 is at least 13%, so this result is still far above the recommendation. The data in Table 2 explains that the protein content of salami using durian seed flour (*Durio zibethinus* Murr) as a filler has decreased, especially in the treatment using durian seed flour with a higher level. The decrease in protein content was due to protein denaturation which caused the protein to lose its secondary and tertiary structure due to external pressure. Similar to previous studies protein decreased from 20.42% to 18.54%. using 3% yeast starter and 2% lactic acid bacteria each (Sembor, 2017). It can be stated in this study, using 2% lactic acid bacteria (*L.acidhophyllus* and *L. plantarum)* to produce 24.90% protein content indicates the effect of lactic acid bacteria in increasing protein levels.

Effect of Treatment on Fat Content

Based on the data in Table 2 shows that the fat content of salami using durian seed flour has decreased from 19.95 – 13.75%. The low-fat content of the research results is thought to be caused by the very low-fat content of durian seed flour, namely 1.18%, therefore the higher the use of durian seed flour is accompanied by the lower the fat content of salami. The high use of durian seed starch causes a decrease in the levels of salami fat produced, this is because durian seed starch has a lower fat content than the fat content of chicken meat so the addition of durian seed starch concentration in salami products causes a decrease in salami fat levels. The fat content of culled laying hens meat is 1.3% while the fat content of durian seed flour is. The decrease in fat content as a result of research suggests that fat degradation is carried out by lipase enzymes produced by lactic acid bacteria and produces a series of free fatty acids which characterize taste, aroma, and texture which are highly dependent on the type of fatty acid produced and the amount of concentration. Bedia, *et al*., (2011), the fat content tends to decrease in the processing of half-cooked pork salami using bacterial cultures as a treatment, namely from 49.07 ± 3.11 grams/100 grams. While Andry Pratama *et al*. (2021) the fat content is 9.21%, which is produced in fermented lamb sausage with the addition of 2% *Candida apicola yeast*.

Effect of Treatment on Carbohydrate Levels

Based on analysis of variance, it was shown that salami using durian (*Durio zibethinus* Murr) starch flour had a very significant effect (P <0.01) on carbohydrate content (%). The data in Table 2 showed an increase in carbohydrate content along with an increase in the percentage of durian seed flour from 41.26 (PO) to 44.41% (P2).

Durian seeds consist of two main components, namely starch and gum. The crude polysaccharide extract content of durian seeds has the potential to be used as an alternative source of food additives in the food industry (Bronikowska *et al*., 2012). Raw durian seeds can be processed into flour and used as a substitute for carbohydrates because durian seeds contain as much as 43.6 grams of carbohydrates per 100 grams (Zuhri, 2015). The high carbohydrate content in salami products is accompanied by a higher level of durian seed flour, up to 20%. Durian seed flour is a source of carbohydrates so the levels of carbohydrates in salami also increase. The ratio of amylose and amylopectin greatly determines the final product of a food ingredient. The amylograph properties of foodstuffs indicate the selection of varieties according to the desired product. The composition of amylose and amylopectin affected the starch profile. Ratnayake *et al*. (2002) stated that amylopectin affects the starch granule development process. Amylose can inhibit the development of starch granules by forming a

complex with fat which inhibits the increase in peak viscosity at high temperatures (Sang *et al*. 2008; Singh *et al*. 2010).

Effect of Treatment on pH (Degree of Acidity)

The results of the research on the effect of treatment on the pH of salami using durian seed flour (*Durio zibethinus* Murr) as a filler are presented in Table 3. The data from the analysis of diversity showed that the use of durian seed starch flour as a filler or filler in the processing of chicken laying hens salami did not show a significant effect (P > 0.5) on acidity (pH) as shown in the table 3.

Based on the results of the study, salami using durian seed flour as a filler turned out to be very low in acidity (pH), ranging from 4.04 to 4.08. Processing of salami using durian with a fermentation time of 6 days will cause a decrease in the pH value. Based on the results of the study, salami decreased the pH value during fermentation because in processing salami products using lactic acid bacteria starter cultures of *L.plantarum and L.acidophillus* as a starter experienced controlled growth so that they were able to produce lactic acid, as a result, the pH dropped. This is the opinion of Fardiaz (1992) and Gonzalez-Fernandez, *et al*., (2006) that LAB (*L.acidophyllus and L.plantarum*) prefer to grow in acidic conditions, namely at pH 4 - 4.5. The results showed that the level of acidity in salami affects the number of microorganisms. Statement from Harmain (2012) that changes in the pH value of fermented catfish sausages is caused by a fermentation process by the lactic acid bacteria *Lactobacillus Plantarum*. The change in pH value was caused by the presence of lactic acid produced from carbohydrate metabolism by lactic acid bacteria *L. Plantarum*. The presence of lactic acid bacteria such as *L. plantarum* and *L. acidophylus* also causes a decrease in pH during fermentation. The lactic acid produced by the lactic acid bacteria will be excreted outside the cells and accumulate in the fermentation media, thus increasing the acidity, and decreasing the salami's pH while Andry Pratama *et al*., (2021) reported that the pH value of fermented sausages using yeast *candida apicola* was 4.83.

Effect of Treatment on TPC (*Total Plate Count*) (CFU/gram)

The data in Table 4 shows that the total salami bacteria using durian seed flour was up to 20%, each of which was added 2% lactic acid bacteria (L. acidophyllus and L. plantarum), the total bacteria decreased even for treatment P2 (10% seed meal). durian), P3 (15%) and P4 (20%) showed no significant difference (P > 0.5)

The decrease in total bacteria in salami was due to using durian seed flour as a filler as well as using starter cultures of microorganisms *L. acidophyllus* and *L. plantarum* with the same amount of 2% each, although each treatment was different. using durian seed flour showed no significant effect. However, the treatment using durian seed flour as much as 20% decreased the total bacteria (3,038 x 10 3 CFU/gram). This means that salami products use durian seed flour (20%) and the addition of starter cultures of *L.acidophyllus* and *L. plantarum* each as much as 2% produces salami with low total bacteria. This is due to the effect of the viability of the product., thus causing the total number of bacteria to be low. In addition, the processing of salami using starter cultures of *L. acidophyllus* and *L. plantarum* can also be caused by high production of lactic acid and a decrease in pH during the fermentation process. This substrate change can eliminate the potential for harmful microorganisms such as *Salmonella, Staphylococcus,* and *Clostridia* (Abunyewa *et al*., 2000). Tina Dewi Rosahdi *et al* (2022) reported that the number of bacteria in jackfruit seed flour was 3.24×10^{10} cells/ml, while in durian seed flour it was 3.04×10^{10} cells/ml.

CONCLUSION

Based on the study, it was found that the cooking loss was significantly different from 24.48% - 8.31%'; Water holding capacity was significantly different from 27.78 % - 51.97%; The different tenderness was significantly increased from 13.94 - 22.39 mm/g/10 seconds. Meanwhile, the chemical quality of the water content increased from 40.46% - 44.84%; Fat decreased from 19.95 – 13,75%; Protein decreased from 24.90 - 20.74%; Carbohydrates increase from 40.46 – 44.84%. %, pH 4.07 – 4.08; Total Plate Count decreased from 3.57 x 10^3 – 3,04 x 10^3 CFU/gram The conclusion of this study shows that durian seed flour can be used as a filler in salami products so that it can improve the physicochemical and microbiological quality with a level of 15%.

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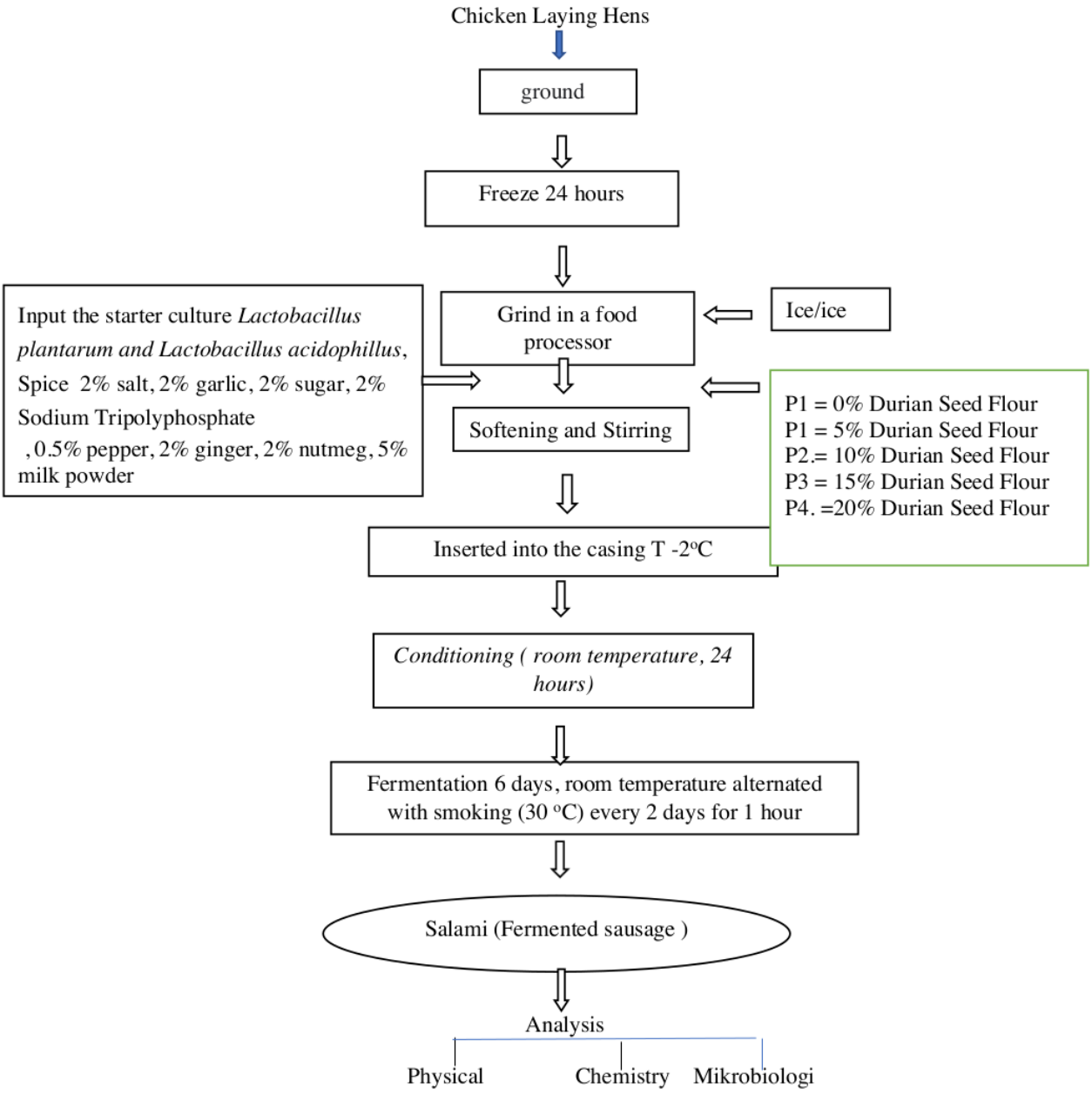

Figure 1. Making Salami (fermented sausage)

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Table 1. Average Cooking Loss (%), Water Holding Capacity (%), and Tenderness (mm/g/10 seconds) Salami Using Durian Seed Starch (*Durio zibethinus* Murr) as Filler

Average (%)			
Treatment	**Cooking Loss**	**Water Holding Capacity**	**Tenderness** mm/g/10 sec
P0	**24,48^{a}**	**27,78^{a}**	**13,94^{a}**
P1	**22,96^{a}**	**34,59^{b}**	**15,78^{a}**
P2	**18,49^{b}**	**43,59^{c}**	**17,79^{b}**
P3	**13,41^{c}**	**47,17^{c}**	**20,45^{c}**
P4	**8,31^{d}**	**51,97^{d}**	**22,39^{c}**

Note: Different letters in the same column indicate a significant difference (P < 0.05)

Table 2. Average water content (%), protein (%), and fat (%) and carbohydrates (%) Salami Using Durian Seed Starch Flour (*Durio zibethinus* Murr) As Filler

Average (%)				
Treatment	**Water Content**	**Protein**	**Fat**	**Carbohydrate**
P0	**40,47^{c}**	**24,90 ^{a}**	**19,95^{a}**	**40,46^{c}**
P1	**42,64^{b}**	**22,11 ^{bc}**	**19,90^{a}**	**42,64^{b}**
P2	**43,44^{ab}**	**21,88^{bc}**	**17,06^{ab}**	**43,44^{ab}**
P3	**45,18^{a}**	**21,74^{c}**	**16,70^{b}**	**45,18^{a}**
P4	**44,84^{a}**	**20,74^{c}**	**13,75 ^{c}**	**44,84^{a}**

Note.
P0 = Salami without durian seed flour
P1 = Salami with the addition of 5% durian seed flour
P2 = Salami with the addition of 10% durian seed flour
P3 = Salami with the addition of 15% durian seed flour
P4 = Salami with the addition of 20% durian seed flour
Different letters in the same column indicate a significant difference (P < 0.01)

Table 3. Average pH of Salami Using Durian Seed StarchAs a Filler

Treatment						
Repeat	**P0**	P1	P2	P3	P4	Total
1	4,10	4,01	4,04	4,11	4,08	
2	4,05	4,05	4,04	4,10	4,06	
3	4,10	3,99	4,05	3,99	4,09	
4	4,03	3,97	4,02	4,04	4,09	
Total	**16,28**	**16,02**	**16,15**	**16,24**	**16,32**	
Average	**4,07**	**4,005**	**4,04**	**4,06**	**4,08**	**81,01**

Table. 4 Analysis of the Variety of Effects of Treatment on Total Lactic Acid Bacteria (CFU/gram) using durian seed flour (*Durio zibethinus* Murr) as Filler

Treatment (…..x 10^3 CFU/gram)						
Repeat	**P0**	**P1**	**P2**	**P3**	**P4**	**Total**
1	**3,579**	**3.491**	**3,431**	**3,342**	**3,255**	
2	**3,568**	**3,477**	**3,447**	**3,301**	**3,176**	
3	**3,579**	**3.505**	**3,431**	**3,301**	**2,400**	
4	**3,556**	**3,556**	**3,415**	**3,322**	**3,322**	
Total	**14,282**	**14,029**	**13,724**	**13,266**	**12,153**	**67,454**
Average	**3,571^{a}**	**3,507^{a}**	**3,431^{ab}**	**3,316^{ab}**	**3,038^{b}**	

THE EFFECT OF THE USE OF DURIAN SEED FLOUR (Durio zibethinus Murr) AS A FILLER ON THE PHYSIOCHEMICAL AND MICROBIOLOGY OF SALAMI

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