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Physical Quality of Broiler Chicken Meat Added with Banana Weevil Enriched β-glucan from *Saccharomyces cerevisiae* in Feed

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Abstract

This study aims to determine the effect of adding banana weevil flour enriched with β-glucan fiber from *Saccharomyces cerevisiae* to feed on the physical quality of broiler meat. The research method used a completely randomized design and analysis of variance; this study used 200 DOC consisting of 5 treatments and 4 replications. Each replication contains 10 chickens. The level of β-glucan administration from *Saccharomyces cerevisiae* with banana weevil flour was P0 (control); P1 (25 ppm); P2 (50 ppm); P3 (75 ppm); and P4 (100 ppm). The treatment started from 16 to 37 days old. The physical quality test was carried out with thigh meat samples. Physical quality test data were analyzed by analysis of variance, and if there was a significantly different ($P<0.05$), it was further tested with Duncan's Multiple Range Test. The results of the physical quality test on broiler chicken meat showed that the addition of banana weevil flour enriched with β-glucan fiber from *Saccharomyces cerevisiae* in the feed on the physical quality of broiler meat was not significantly different ($P>0.05$) on the pH value, water holding capacity, reduced cooking, and tenderness. The results of the study concluded that adding banana weevil flour enriched with β-glucan fiber from Saccharomyces cerevisiae in feed on the physical quality of broiler meat did not affect the physical quality of broiler meat.

Keywords : Banana weevil; broiler meat; physical quality test; Saccharomyces cerevisiae and β-glucan.

Introduction

Broiler chickens are poultry that have the potential to produce meat. The advantages of broiler chickens are that they have a relatively fast growth rate of productivity and are quite efficient in using feed. This means the ratio between the resulting body weight gain is the same as the amount of feed consumed, and the product price is relatively affordable. Broiler chickens have a fast growth rate, but the drawback is that it has a fairly high-fat content; this will be a good place to develop spoilage microorganisms which will reduce the meat quality so that the impact on the meat carcass will easily damage. In addition to relatively fast growth, fat growth will be followed, where high body weight is associated with high body fat accumulation. The high-fat content in carcasses will be a concern for consumers. Carcasses of good quality are carcasses with low-fat and high protein content. The fat content of broiler chicken is in the range of 5.79-8.44%, with a fat mass of ±10% higher than that of other local chickens, which is 1.18-2.76% (Ismoyowati & Widyastuti, 2003). The body needs nutrients such as carbohydrates, protein, vitamins, minerals, and, no less importantly, fat. Fat is a nutrient the body needs; fat is a source of high-calorie-producing energy (Sulistyoningsih, 2014). If you consume too much fat, your body will experience obesity, high cholesterol, heart disease, and fatigue. Therefore, to produce healthy broiler meat carcasses, it is necessary to reduce the fat content to be safe for consumption. One of the efforts made is by adding β-glucan.

β-glucan here has a role in influencing fat absorption by binding fatty acids, cholesterol, and bile salts in the digestive tract. A very easy source of β-glucan is β-glucan from *Saccharomyces cerevisiae*. *Saccharomyces cerevisiae* is a type of fungus or yeast that can synthesize β-glucan from its cell wall. The growth process of *Saccharomyces cerevisiae* requires a nutrient medium consisting of carbon, nitrogen, oxygen, vitamins, and minerals. One source of carbohydrate that can be used for *Saccharomyces cerevisiae* is easy to obtain and relatively inexpensive, namely the banana weevil.

The Banana weevil is the tuber of the stem at the bottom of the banana stem, under the ground. Besides being cheap, easy to obtain, and not competing with humans, the banana weevil also has a high carbohydrate content, namely 66.2%, protein of 3.40%, and energy of 2,450 kcal/kg (Taran, Ballo, & Sinlae, 2015). The use of banana weevil in flour is based on the fact that the weevil is a component of polysaccharides that can be processed into a new source of flour (Saragih, 2013). Banana weevil is rich in dietary fiber (Astawan, 2004). (Rudito, Syauqi, Obeth, & Yuli, 2010) stated that the chemical characteristics of banana weevil were 6.69% water content, 0.11% ash content, and 2.6 mg/kg HCN content. Banana weevil has a starch composition of 76% and 20% water, resembling tapioca starch and sago flour (Rosdiana, 2009). The crude fiber found in the banana weevil is β-glucan or water-soluble fiber (Tala, 2009). The dietary fiber affects the physical quality of meat, such as tenderness, water-holding capacity, pH value, and cooking loss. Microscopically, the structure of food fiber is in the form of a capillary and has a greater ability to absorb water (Darojat, 2010). The increase in water-holding capacity is not only determined by myofibril proteins but is also determined by the water-binding component broadly. The swelling of the water-binding component increases with increasing water content, but the swelling is not infinite.

The community's need for high-quality chicken meat is increasing, both chemical quality and physical quality. One way that can be done on the physical quality of meat is by optimizing the tenderness, pH value, water holding capacity and reducing the cooking loss of meat (Hamiyanti, Sutomo, Rozi, Adnyono, & Darajat, 2013). The addition of banana hump enriched with β -glucan fiber did not have a negative effect on productivity, abdominal fat, and the relative weight and length of the small intestine (S Imam & Suryadi, 2021; Shokhirul Imam, Suryadi, & Fitriani, 2020). Based on this description, research will be conducted on the effect of banana weevil which is rich in β-glucan fiber on the physical quality of broiler meat including tenderness, water holding capacity, pH value and cooking loss.

Materials and Methods

It The research was carried out in the Field Laboratory and Feed Technology Laboratory, Department of Animal Science, Jember State Polytechnic.

Materials

The materials used include Cobb strain DOC, commercial feed BR1, kepok banana weevil, molasses and *Saccharomyces cerevisiae* starter, pH meter, warner–bratzler shear force and stopwatch.

Methods

In this study, the addition of banana weevil flour was divided into four, namely P0 = commercial feed (control feed); P1 = control feed + 25 ppm β-glucan; P2 = control feed + 50 ppm β-glucan; P3 = control feed + 75 ppm β-glucan; P4 = control feed + 100 ppm β-glucan. Each treatment was repeated 4 times; each unit contained 10 chickens.

Fermented banana weevil and *Saccharomyces cerevisiae*

Fermentation of banana weevil flour and Saccharomyces cerevisiae is done by chopping the banana weevil into small and thin pieces and then drying it for 1 to 4 days in the sun to dry, then grinding it into flour. Banana weevil flour added 50% water and stirred until smooth. The mixture is steamed for 45 minutes. Cool the mixture and add the *Saccharomyces cerevisiae* by 0.5%. The mixture is put in black plastic, ensuring it is airtight (anaerobic). Fermentation was carried out for 3 days. The fermented product is dried in the sun. Banana weevil flour enriched with β-glucan from *Saccharomyces cerevisiae* is ready to be analyzed and used.

Application of β-glucan percentage

The percentage of treatment will be converted into β-glucan content obtained from laboratory test results so that what is given is not pure β-glucan but the fermented banana weevil as a medium and *Saccharomyces cerevisiae* as a microorganism to produce β-glucan. The percentage of use of feed ingredients, especially as an energy source, followed the conversion of β-glucan content in fermented banana weevil flour from Saccharomyces cerevisiae but did not change the number of nutrients used. The nutrient content of feed follows BSN (BSN, 2006).

Experimental design

This study used a completely randomized design (CRD) consisting of 5 treatments and 4 replications. Each replication contained 10 birds, so the number of broilers needed was 200, and 20 randomized units were found. The treatment started when the chickens were 16 and 37 days old. The calculation of the dose of banana weevil flour fermented by *Saccharomyces cerevisiae* refers to the laboratory analysis results of β-glucan levels, which can be seen in Table 1.

Table 1. Results of analysis of β-glucan content from fermented banana weevil flour and Saccharomyces cerevisiae.

No	Sample Code	Parameter Test	Unit	Result	Test Method
1	Fermentation	β-glukan	%	0,224	In-house Method

Source: Integrated Laboratory and Technology Innovation Center, University of Lampung.

Feed ingredients

The feed used during the study was BR1, produced by PT Panca Patriot Prima and given 2 times a day in the morning at 07.00 WIB and in the afternoon at 16.00. The nutrient content of the feed used in this study can be seen in Table 2.

Tabel 2. Composition of Feed Nutrient Content BR1

Nutrient Content	Amount
Water content (%)	Max. 12%
Crude protein (%)	20 - 22 %
Lysin	Min. 1,20 %
Methionine	Min. 0,45 %
Methionine + cystine	Min. 0,80 %
Threonine	Min. 0,75 %
Tryptophan	Min. 0,19 %
Crude fat (%)	Max. 6 %
Crude fiber (%)	Max. 5 %
Ash (%)	Max. 7 %
Calcium (%)	Min. 0,9 - 1,1 %
Phosphorus (%)	Min. 0,7 - 0,9 %
Coccidiostat	Robenidin
Aflatoxin	Max. 40 ppb
Urea level	ND (Non Detection)

Source : PT Panca Patriot Prima.

Rearing

Feeding starter period using BR1 from 1 to 15 days old without treatment and feeding was given 2 times a day with a ratio of 40% in the morning and 60% in the afternoon. Drinking water adlibitum. The vaccines given are ND (*Newcastle Disease*), IB (*Infectious Bronchitis*), and *the Gumboro* vaccine. The bulkhead/plot was made at the age of 15 days. Each experimental unit/plot with an area of 1 m2 contains 10 chickens. The application of treatment with banana weevil flour enriched with β-glucan fiber from *Saccharomyces cerevisiae* at 16 days old. After the chickens are 37 days old, harvesting will continue with the research parameters.

Data collection

Data collection was carried out after post-harvest by taking samples of the thigh meat for physical testing.

Research Parameters

Several research parameters were examined on the physical quality of broiler chicken meat:

pH value

This pH value was measured by taking a sample on the thigh weighing 2 grams chopped and put into a glass beaker, then adding 20 ml of distilled water, stirring until homogeneous. pH was measured with a pH meter by inserting it into a glass beaker.

Water holding capacity

Water holding capacity was measured using the FPPM (The Filter Paper Press Method) method by taking the thigh meat, cutting and weighing approximately 300 mg, then placing it on filter paper and weighing 10 kg for 5 minutes. The wet and meat areas on the filter paper are depicted on mica plastic; the wet area is calculated using millimeter block paper. The weight of water released during pressing can be calculated using the formula:

mgH_20=(wet area area)/0.0948 – 8.0

so that the free water content can be calculated using the formula:

DIA=% water content - 〖(mgH_20)/300 x 100%〗

Cooking loss

Cooking loss was measured by measuring weight loss (Soeparno, 2015). Take a sample of the thigh, cut in the direction of the fiber, and weigh as much as approximately 25 grams. The meat is put in plastic and packaged without any air cavities. The meat is cooked in a pan on a gas stove at 80 C for 60 minutes. Then it is cooled still closed using running water; the meat is removed from the plastic and then wiped with a tissue, after which the final weight is weighed. Calculation of cooking loss with the formula:

Cooking loss= (weight before cooking-weight after cooking)/ (weight before cooking).

Tenderness

Tenderness was measured by taking a sample of the thigh, which was cut toward the fiber with a thickness of 0.67 cm and a thickness of 1.5 cm. The sample is placed on a Warner-Bratzler shear force device. Calculated by the formula:

Tenderness = (measurement average)/ (10 seconds)

Data analysis

The data obtained during the study were analyzed using a Completely Randomized Design (CRD), and then the One-Way ANOVA test was carried out using the SPSS program; if the results of the analysis of this study are a significant difference (P<0,05), continued with Duncan's Multiple Range Test (DMRT).

Results and Discussion

Tabel 3. pH value, water holding capacity, cooking loss, and tenderness

Parameters	Treatment					Significance
	P0	P1	P2	P3	P4	
pH value	6,30	6,23	6,33	6,29	6,42	ns
Water holding capacity	48,05	55,60	51,60	51,12	49,47	ns
Cooking loss	36,81	36,55	36,28	37,34	36,74	ns
Tenderness	14,72	15,02	13,97	13,87	13,35	ns

ns: non-significance

pH Value

The pH value on the physical quality of broiler meat that was given the addition of banana weevil flour enriched with β-glucan fiber from *Saccharomyces cerevisiae* can be seen in Table 3. The results of adding banana weevil flour from a dose of 25 ppm to a dose of 100 ppm were not significantly different (P>0.05) on the pH of the meat. The average pH value of the meat in this study was 6.23, 6.29, 6.33, and 6.42. The pH of the meat in this study was still relatively normal. According to the Indonesian National Standard, broiler meat's normal pH range is 6 to 7.

Based on the treatment, the addition of β-glucan from banana weevil flour at P1, P2, P3, and P4 was not significantly different. Research (Moon et al., 2016) showed that the concentration of β-glucan in meat was not significantly different from the pH value. It is suspected that the ratio provided has good protein content so that new cell tissue is formed, which can form muscle protein fairly quickly and causes the pH of the meat to remain normal. In addition, one of the other factors, namely the content of β-glucan does not affect fat, water-soluble precursors, and the release of substances in meat (Soeparno, 2015). Proteins have the main function of forming new tissues and maintaining existing tissues (Winarno, 2004). The main component used to hold water in meat is protein. If the protein content is sufficient, the meat can bind the liquid well and will not release too much liquid because the water-holding capacity is constant. The high pH value causes the high-water holding capacity.

Research (Yami, Sheep, & Merkel, 2008) pH value can be declared influential due to factors such as age, muscle type, the stress level of livestock before slaughter, environmental temperature, and treatment of additives before slaughter. The pH of the meat can also be affected by the ambient temperature. (Rini, Sugiharto, & Mahfudz, 2019) Maintenance of broiler chickens with a high environmental temperature (35-36^{o}C), the meat produced will have a lower physical quality than those reared at normal temperatures (23-24^{o}C), inhibiting the rate of pH decline. If the pH of a product is still relatively normal, the growth of bacteria in the meat will be quite fast.

Water Holding

The value of water holding capacity on the physical quality of broiler meat, given the addition of banana weevil flour enriched with β-glucan fiber from *Saccharomyces cerevisiae*, can be seen in Table 3. Based on Table 3, the average value of the results showed that the results of the analysis of water holding capacity with the addition of banana weevil flour enriched with β-glucan fiber from *Saccharomyces cerevisiae* were not significantly different (P>0.05) on the water holding capacity of broiler chicken. The value of water holding capacity obtained from the treatment had an average value of 48.05%-55.60%; the value of water holding capacity had no significant effect due to the nutrient content of the feed given in the form of fat and crude fiber.

The fat content has a negative relationship with the protein content (Oktaviana, 2009), increasing the protein content of broiler chicken meat so that the water-holding capacity of the meat increases due to the protein's ability to bind water chemically, and the fat content of the meat decreases. Meat with high-fat content has a higher water-holding capacity than meat with low-fat content. Chickens that consume less energy will experience a decrease in carcass fat, whereas if they consume more energy than they need, they will show an increase in carcass fat (Anggorodi, 1985). The content of crude fiber that is too high in the feed causes the feed to be indigestible so that it can carry digestible food substances out with the feces (Wahyu, 1997). (Parakkasi, 1990) stated that an increased crude fiber content in feed can cause a decrease in digestibility so that broilers are less able to utilize food substances. This causes the fat content to decrease so that the water-holding capacity decreases. Muscles with a high-fat content will have a high-water holding capacity, and vice versa. If the fat content of the meat is low, then the resulting water-binding capacity will also be low (Soeparno, 2015).

The effect was insignificant because the composition of the feed and the treated feed's consumption were relatively the same. It was suspected that the protein content in the treated feed was not significant. The function of protein is to bind water. (Soeparno, 2015)) meat and carcass protein content can affect water-holding capacity. Protein is a factor that determines the binding capacity of water. If the protein content in meat is higher, the water-holding capacity will also be higher. (Lawrie, 2003) factors affecting the water holding capacity are pH value, protein content, meat carbohydrates, and intramuscular fat. The low value of water holding capacity is caused by the absence of glycogen in the meat to be broken down, resulting in a high final pH value. Water holding capacity has a relationship with the level of tenderness in meat when it is cooked; the higher the water holding capacity of the meat, the better the quality of the meat, which will also increase consumer preferences.

Cooking Loss

The cooking loss value on the physical quality of broiler meat, given the addition of banana weevil flour enriched with β-glucan fiber from *Saccharomyces cerevisiae*, can be seen in Table 3. Based on Table 3. the average value of the results showed that the results of the cooking loss analysis with banana weevil flour were not significantly different (P>0.05) against the cooking loss of broiler chicken. The cooking loss value obtained from the average treatment ranged from 36.55% to 37.34%. The cooking loss value is relatively the same on average. The feed contains relatively the same crude fiber, resulting in the same cooking loss. (Soeparno, 2015), the cooking loss value of meat ranges from 1.5 to 54.5%, with a range of 15 to 40%.

The provision of crude fiber will trap fat so that the absorbed food substances will decrease. (Sutardi, 1997) states that crude fiber in poultry's digestive tract can trap fat so that the nutrients absorbed by the poultry body decrease. Meanwhile, it greatly affects cooking loss because intramuscular fat inhibits or reduces the liquid meat that comes out during heating. However, meat containing greater intramuscular fat will lose greater fat. The greater fat content will increase the water-holding capacity of the meat protein due to the presence of intramuscular fat that covers the microstructural network of the meat. Besides that, the fat on the surface of the meat will melt when cooked and cover the meat so that cooking loss is lower. Ration with high crude fiber content has a low digestibility value (JøRgensen, Zhao, Knudsen, & Eggum, 1996).

In addition, the results of the use of feed with the addition of treatment with banana weevil flour enriched with β-glucan fiber from Saccharomyces cerevisiae can increase the protein content in the meat because the protein content in the meat can bind water in the meat to reduce shrinkage in the cooking process. (Kartikasari, Hertanto, Santoso, & Patriadi Nuhriawangsa, 2019) The water content influences cooking loss in the meat during the cooking process; protein content can be a factor in the water binding process; if the protein content is more, less cooking loss will occur in the meat. In addition, to see how the meat quality can be seen from the percentage of cooking loss, good meat has a relatively low cooking loss rate than meat with a high cooking loss.

Tenderness

The tenderness value on the physical quality of broiler meat, given the addition of banana weevil flour enriched with β-glucan fiber from *Saccharomyces cerevisiae*, can be seen in Table 3. The value of tenderness on the physical quality of broiler meat given the addition of banana weevil flour enriched with β-glucan fiber in the feed from *Saccharomyces cerevisiae*. Based on Table 3. the average value of the results showed that the results of the tenderness analysis with the application of banana weevil flour were not significantly different (P>0.05) on the tenderness of broiler chicken meat.

The results of the study with the addition of β-glucan at the tenderness value of P1 15.02 mm/g/10 seconds at a dose of 25 ppm, P2 13.97 mm/g/10 seconds at a dose of 50 ppm, P3 13.87 mm/g/10 seconds with a dose of 75 ppm and P4 13.35 mm/g/10 seconds with a dose of 100 ppm, this value is relatively low. A low tenderness value indicates that the meat is denser and less fatty. This was because the meat produced from the five ration treatments had relatively the same meat fat content, resulting in an unrealistic tenderness value. The higher the energy level, the more fat is produced so that the tenderness of the meat increases (Soeparno, 2015). The fat produced does not completely enter the meat because, in the poultry body, there is a process of accumulation of fat under the skin (sub-cutan) in large quantities; besides that, there is also an accumulation of abdominal fat, namely fat contained in the abdominal cavity. As a result, the fat content of the meat remains constant Low. The thigh muscles are thought to have much activity, considering that broiler chickens are poultry species that rarely move, so the thigh muscles are mostly composed of myofibril fibers and meat protein, which causes a higher water-holding capacity so that the tenderness of the meat will be lower. This follows the opinion of Lawrie (Lawrie, 2003), which states that muscles that do much activity have more myofibril fibers, and meat protein as a connector in the muscle has an important influence on the value of meat tenderness. The higher the protein content of the meat, the lower the tenderness value of the meat.

This research ratio also contains relatively the same crude fiber, protein degradation can be caused by enzymes present in the meat cells themselves or protease enzymes that are intentionally added from outside (Ili, Lalel, & Manu, 2016). So, it produces relatively the same tenderness. Giving β-glucan or not giving β-glucan to broilers does not affect tenderness; this indicates that protein intake is adequate for the growth period. In addition, the β-glucan added in the ration has not been able to meet the needs of broiler muscle growth because the meat muscle itself contains collagen, which is the main structural protein in connective tissue and has a major influence on meat tenderness. (Kokoszynski, Bernacki, Korytkowska, Krajewski, & Skrobiszewska, 2013) stated that tenderness is influenced by meat components, namely the muscle structure of meat containing collagen, which is the main structural protein in connective tissue and has a major influence on meat tenderness. Tenderness is influenced by meat components, namely the myofibrillar structure and contraction structure, the content of connective tissue, and cross-linking level. (Patria, Afnan, & Arief, 2016) States that meat tenderness is influenced by antemortem factors such as genetics, age, and management, as well as stress and postmortem factors, namely chilling, refrigeration, withering, and processing methods. The tenderness of the meat can be determined by measuring its breaking power; the lower the breaking power value, the more tender the meat.

Conclusion

This research can be concluded that in feeding with the addition of banana weevil flour enriched with β-glucan fiber from *Saccharomyces cerevisiae* to a level of 100 ppm on the physical quality of broiler meat, this has no significant effect ($P>0.05$) on the pH value, water holding capacity, cooking loss, and tenderness.

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