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The nutrient value of banana peel fermented by tape yeast as poultry feedstuff

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ABSTRACT: This study aims to evaluate the effect of different tape yeast levels as inoculum in the banana peels fermentation process to the nutritional content. This study used an experimental method with a Completely Randomized Design (CRD) in one way ANOVA with 4 treatments and 4 replications. Treatments based on differences in the addition of tape yeast, all treatments were incubated for 6 days. The four treatments are (P0) Banana peel without the addition of yeast tape; (P1) Banana peel with the addition of yeast tape 1.5%; (P2) Banana peel with the addition of 3.0% yeast tape; (P3) Banana peel with the addition of 4.5% yeast tape. The measured variables were dry matter, crude protein, crude fat, crude fiber, calcium, and phosphorus content. Data were analyzed by analysis of variance and followed by Duncan's multiple range test to measure any significances. The results showed that the level of yeast tape significantly increased crude protein, crude fat, calcium and phosphorus ($P<0.05$), and significantly reduced crude fiber of banana peel ($P<0.05$. However the level of yeast tape has no significant effect on the dry matter content of banana peels. Conclusion tape yeast level of 4.5% can increase levels of crude protein, crude fat, calcium and banana skin phosphorus. The highest reduction in crude fiber in the use of yeast tape 3%.

Keywords: banana peels; yeast; nutrient value; fermentation.

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INTRODUCTION

The quality and quantity of feed affect livestock productivity. Feed procurement can reach 70% of the total production cost. Corn is the main energy source in broiler feed which can reach 50-70% (Panda, et al., 2014). In Indonesia, fifty-one percent of corn utilization is dominated by the main raw material of the animal feed industry (Zakaria, 2011). On other hand, corn is not only used as feed material but also as food, this causes the tendency in the price increase of animal feed, hence it is necessary to use alternative energy sources from agricultural products and by-products to replace corn. Banana peel is one of the agricultural waste that can be used for animal feed, with metabolic energy content of 3051 Kcal/kg (Ulep and Santos, 1995).

Kepok banana peel weight is about 25 - 40% of the weight of bananas (Koni, Bale-Therik, and Kale, 2013; Wadhwa, Bakshi, and Makkar, 2015). Banana peels (*Musa paradisiaca* normalis) contain crude protein 3.6 - 8% (Koni, 2013; (Hudiansyah, Sunarti, and Sukamto, 2015; Wadhwa, Bakshi, and Makkar, 2015), crude fat from 2.52 - 6.2% (Koni, 2013; Wadhwa, Bakshi, and Makkar, 2015), crude fiber 18.71% (Koni, 2013), 37.64% (Hudiansyah Sunarti, and Sukamto, 2015), Ca 0.27%, and phosphorus 0.26% (Fitroh, Wihandoyo, and Supadmo, 2018) Kepok banana peels can be used as much as 7.5% in broiler feed (Koni Bale-Therik and Kale, 2013); 20% (Widjastuti and Hernawan, 2012) and 10% as corn substitute in broiler rations (Duwa et al., 2014), while Kepok banana peels fermented with *Rhizopus oligosporus* can be used up to 10% in broiler rations (Koni, Bale-Therik and Kale, 2013).

The high crude fiber of banana peels is a limiting factor for its utilization in broiler feed, therefore it is necessary to improve the nutritional value before use as broiler feed. Increasing the nutritional content of banana peels can be done through fermentation process. One of the inoculums can be used in the fermentation process is tape yeast. Tape yeast contains *Saccharomyces cerevisiae* (Suciani et al., 2011). Some research results show the increasing of nutrient value of materials fermented with tape yeast such as the results of the study of Muhiddin, Juli, and Aryantha, (2001) that protein content of cassava tuber peels can increase by 3.41% with dose of tape yeast as 3.0 g / kg and fermented for 8 days; increasing of protein by 24% (Hidayati, Ba'ido, and Hastuti, 2013), decreasing of crude fiber by 6.4% in cassava peel fermented with a mixture of *Saccharomyces cerevisae* and *Lactobacillus* spp (Oboh, 2006). The hypothesis in this study is the fermentation of kepok banana peel using tape yeast resulting in the highest decrease in crude fiber and increase in crude protein. This study aims to evaluate the nutritional content of banana peels fermented by tape yeast.

MATERIALS AND METHODS

The material used in this research is Kepok banana peel obtained from banana processing counter, tape yeast, chemicals for proximate analysis, calcium (Ca) ad Phosphorus (P) analysis.

Banana peel fermentation

The banana peel fermentation method refers to the research of Muhiddin, Juli, and Aryantha (2001) that is fermentation of cassava peel using *Saccharomyces cerevisiae*. Banana peel fermentation procedures, namely:

1. Selection. The used banana peel is ripe kepok banana peels which were marked by yellow color.
2. Washing. Banana peels are washed with clean water.
3. Cutting. Banana peels were cut in ± 5 cm length
4. Steaming. Banana peels were steamed for ±10 minutes then cooled
5. Yeast inoculation. After the banana peels were cooled, yeast was inoculated according to treatment.

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6. Wrapping. Mixed banana peels with yeast then wrapped in a plastic bag that has been perforated.
7. Fermentation. After the banana peels were wrapped, the sample was left at room temperature for 6 days.
8. The harvesting was done after fermentation, dried in 60°C oven and then analyzed the nutritional content

Laboratory analysis

The nutritional content of banana peels using proximate and minerals analysis was determined based on the AOAC method, (AOAC, 2005). First, the sample was dried in 105°C oven to assess water content (method 934.01), the Kjeldahl method, consists of digestion, distillation and titration (method 990.02) were used to assess the content of crude protein (nitrogen × 6.25), and extraction in acidic and alkaline solutions (method 978.10) were used to assess crude fiber. The mineral content of calcium (Ca), and phosphorus (P), were measured by dissolving ash samples in acid (mixture of HCl and HNO3). Next, Ca content was analyzed using AAS (method 942.05), and P is determined using the spectrophotometric method (method 965.17).

Research treatment

The method was used in this study is an experimental method using a Completely Randomized Design (CRD) in unidirectional pattern with 4 treatments and 4 replications. Treatments were based on differences in the addition of tape yeast, then all treatments were incubated for 6 days. The four treatments were: (P0) Banana peel without the addition of tape yeast; (P1) Banana peel with the addition of 1,5% tape yeast; (P2) Banana peel with the addition of 3% tape yeast; (P3) Banana peel with the addition of 4.5% tape yeast.

Data analysis

The measured variables were dry matter, crude protein, crude fat, crude fiber, phosphorus, and calcium. The data obtained were analyzed using analysis of variance (ANOVA) and when significant the means of treatments then submitted to Duncan's New Multiple Range Test (Gasperz, 2006).

RESULTS AND DISCUSSION

The effect of tape yeast level on the nutritional content of Kepok banana peels is presented in Table 1.

The dry matter content of banana peel fermented with tape yeast

The level of tape yeast has no significant effect on the dry matter content of banana peels. This means that the inoculum level of tape yeast up to 4.5% produces the same hydrolysis activity. Although the effect was not significant, the fermentation process reduced the dry matter content both on without (0%) and with the addition of tape yeast inoculum when compared to the dry matter content of unfermented banana peel, 95.76% (Koni, 2013). This is due to the nutrient utilization of substrate by microorganisms for growth in fermentation process. Reduction of dry matter content in fermented material was caused by metabolic activity of microorganisms during fermentation process (Adegbehingbe, Adetuyi, and Akinyosoye, 2014; Oluwamiyi and Bazambo, 2016).

Decreasing in dry matter was due to the metabolic activity of *Saccharomyces cerevisiae* which is producing H_2O (water), so there was increasing water content in substrate but decreasing the dry matter content (Olagunju and Ifesan, 2013). The results of this study are in line with the research of Boonnop et al., (2009) who reported that fresh cassava peel fermented with *Saccharomyces cerevisiae* increases the water content of 4.64%.

The crude protein content of banana peels fermented with tape yeast

Increasing concentration of tape yeast significantly affected the enhancement of crude protein content in banana peels ($P < 0.05$). It might cause by the additional tape yeast, resulted in higher growth of yeast, hence the protein production is even higher, associated with the fact that tape yeast is one of single-cell protein which is 6% of the wall cell consists of protein. The higher mycelium production was caused by the addition of inoculum presenting enhancement of total nitrogen content proportionally due to crude fiber degradation and carbohydrate conversion into energy which was needed for fungal growth process, resulting in the increase of protein content (Aro, 2010). Increasing of crude protein content in fermentation using tape yeast also occurs in cassava peel as the results of the study of Antai and Mbongo, (1994) who found that crude protein increased from 2.4% to 14.1%, respectively before and after fermentation using *Saccharomyces cerevisiae*; Muhiddin, Juli, and Aryantha (2001) showed that protein increased by 62.17% with 8-days yeast fermentation at the inoculation level of 3.0 g/kg; and from 3.2 to 21.1% after fermentation by *Saccharomyces cerevisiae* in the study reported by Boonnop et al., (2009).

Table 1. Effect of tape yeast level on the banana peel content of dry matter, crude protein, crude fat, crude fiber, phosphorus, and calcium

Nutrient content (%)	Treatment			
	P_0	P_1	P_2	P_3
Dry Matter	94,660±3,11	93,585±0,23	93,100±0,57	93,510±3,38
Crude Protein	5,960±0,47 ^{d}	6,245±0,19^{c}	7,805±0,22^{b}	9,285±0,19^{a}
Crude Fat	1,540±0,14^{d}	1,700±0,14^{c}	1,880±0,28^{b}	2,005±0,02^{a}
Crude Fiber	13,535±0,05^{a}	13,011±0,03^{b}	12,789±0,05^{bc}	12,711±0,17^{c}
Phosphorus	0,115±0,01^{d}	0,155±0,01^{c}	0,175±0,01^{b}	0,255±0,01^{a}
Calsium	0,465±0,01^{d}	0,505±0,01c	0,640±0,00^{b}	0,805±0,01^{a}

Note: Different superscripts on the same line shows significant differences (P <0.05), (P0) = Banana peel without the addition of tape yeast, (P1) = banana peel with the addition of 1,5% tape yeast, (P2) = banana peel with the addition of 3% tape yeast, (P3) = banana peel with the addition of 4.5% tape yeast

The crude fat content of banana peels fermented with tape yeast

Results of analysis of variance show that crude fat content of banana peel increased linearly as level of tape yeast was raised (P <0.05). This is presumably because the energy needs for the growth of *Saccharomyces cerevisiae* are met from carbohydrates so fat is not used as an energy source. In addition, *Saccharomyces cerevisiae* microorganisms have capability to produce enzymes that digest fat. Schousboe (1976) states that *Saccharomyces cerevisiae* produces lipases that breakdown the fat. Crude fat levels increase linearly with the increasing level of ragi tape, which due to fat content in the cell walls of microorganisms in yeast tape. Yeast cells of *Saccharomyces cerevisiae* contain 4-5% fat (Ahmad, 2005). The growth of *Saccharomyces cerevisiae* during the fermentation process converts carbohydrates into fat (Boonnop et al., 2009). Increasing of crude fat is also occurs in fermentation using *Saccharomyces cerevisiae* on pineapple peels from 2.03% to 3.85% (Aro, 2010) and cassava peels from 2.3 to 3.0% (Boonnop et al., 2009).

The crude fiber content of banana peels fermented with tape yeast

The increased level of the tape yeast cause decrease in crude fiber content on banana peels (P <0.05). The addition level of tape yeast inoculum of 3 and 4.5% have no differences in decreasing crude fiber content. The reduction of crude fiber content is associated with cellulolytic activity of *Saccharomyces cerevisiae* due to degradation of crude fiber. When compared to unfermented banana peel with crude fiber content of 18.71% (Koni, 2013), the fermentation process causes a decrease in crude fiber from 27.57 to 32.07%, and the higher decline was found on the additional levels of tape yeast up to 4,5%.

The reduction of crude fiber on cassava peel fermented with a mixture of *Saccharomyces cerevisae* and *Lactobacillus* spp was 6.4% (Oboh, 2006). Sitohang, Herawati, and Lili (2012) stated that *Saccharomyces cerevisiae* produces cellulase enzymes that are used to digest fiber. The decrease in crude fiber content of rice bran fermented using *Saccharomyces cerevisiae* was 17.43%, from 7 to 5.78%.

The content of phosphor and calcium in banana peels fermented with tape yeast

There was a linear increase of phosphor content of banana peels ($P < 0.05$) with the added level of tape yeast. The higher level of ragi tape the higher amount of microorganisms present in the tape yeast, resulting in the increase of nutrients produced by microorganisms (*Saccharomyces cerevisiae*) including phosphor. The results of this study are consistent with the opinion Olagunju and Ifesan, (2013) states that an increase in phosphor due to decline in phytic acid in sesame peanuts from 31.59 (mg/g) before fermentation to 18.13 (mg/g) after naturally fermented for 96 hours.

The addition levels of tape yeast increase the calcium content of banana peels ($P < 0.05$). This result can be explained that the microorganisms were used was able to produce enzymes. Wadamori, Vanhanen, and Savage (2014) stated that calcium content in kimchi increase from 286.94 ± 9.23 to 305.17 ± 7.73 mg per 100 g of dry matter after 5 days of natural fermentation. This change occurred due to oxalate decrease in kimichi from 62.79 ± 3.57 to 18, 61 ± 2.72 after fermentation. In contrast, the study (Oboh, 2006) reported that calcium content of cassava skin was 0.03% and there were no differences after fermentation using *Saccharomyces cerevisiae*.

CONCLUSION

The level of tape yeast at 4.5% can increase the content of crude protein, crude fat, calcium and phosphor of banana peel. The addition level of tape yeast at 3 and 4.5% reduce the crude fiber with the same value. Level of tape yeast has no influence on dry matter content of banana peel

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