Research Article

Anaerobic Fermentation Can Improve Banana Peel Nutrients and Their Use in Crossbred Native Chicken Diet

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Abstract | This study was aimed to examine the effect of anaerobic fermentation on the nutrient content of banana peels and their use on performance of crossbred native chickens. Banana peels were fermented (FBP) anaerobically for 21 days with addition of 10% tapioca flour as an additive. Then banana peels without and with fermentation were analyzed for their nutrient content. This fermented banana peel was then applicated to the crossbred native chicken diet with different levels. There were four treatments and five replications. Treatments were FBP0: diet without fermented banana peels, FBP1: diet with 10% fermented banana peels, FBP2: diet with 20% fermented banana peels, and FBP3: diet with 30% fermented banana peels. The parameters were nutrient content, feed intake, body weight gain, and feed conversion ratio. Data on nutrient content of fermented and unfermented banana peels were analyzed descriptively, while data on feed intake, body weight gain, and feed conversion were analyzed by using analysis of variance and continued with Duncan's multiple range test. The results of this study indicated that the anaerobic fermentation process for 21 days increased the crude protein content, and decreased the crude fiber and tannins of banana peels. The level of fermented banana peels had a significant effect (P<0.05) on body weight gain, feed intake but had no significant effect (P>0.05) on feed conversion. Body weight gain and feed intake of crossbred native chickens up to eight weeks of age, fed banana peels up to 20% were not significantly different (P<0.05) with control diet.

Keywords | Banana peel, Fermentation, Nutrition, Crossbred native chicken, Feed intake, Weight gain

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INTRODUCTION

Banana peel is a waste from banana processing that has not been utilized optimally. The peel weight is 20 to 40% of the weight of the Kepok banana (*Musa paradisiace* L) fruit (Koni et al., 2013). Kepok banana peel can be used as a poultry feed ingredient and is used at 3% (Farman et al., 2016), 5% (Putra et al., 2019), 7.5% (Koni, 2013), and 10% (Duwa et al., 2014). The limited use of banana peels is due to the high fiber content of 11.5-11.95% (Tartrakoon et al., 1999), 44.28% (Mosa and Khalil, 2015) and tannin content 4.69-6.84% (Tartrakoon et al., 1999). High crude fiber in poultry feed can reduce the digestibility of the feed. Tannins can bind protein, starch (Mullik et al., 2016), so that the protein digestibility decreases. Tannins can inhibit the action of the enzymes amylase, lipase and protease thereby affecting the metabolic processes in the poultry body (Reddy and Pierson, 1994). Crude fiber and tannins

can be reduced through processing such as fermentation.

The fermentation process is able to degrade various anti-nutrients in the feed (Reddy and Pierson, 1994) such as tannins (Wahyuni et al., 2008; Mullik et al., 2016; Namah et al., 2021; Koni et al., 2022b; Koni and Foenay, 2022), reducing phytic acid (Koni et al., 2022a, 2023) and reduce crude fiber (Widyastuti, 2008; Abel et al., 2015). Fermentation has a positive effect on banana peel nutrients, thus increasing their utilization in feed as reported Koni et al. (2013) fermented banana peel with the fungus *Rhyzopus oligosporus* can be used up to 10% in broiler feed, and Salombre et al. (2018) that banana peel silage is used up to 15% in broiler diet.

Information about anaerobic fermentation (generally using lactic acid-producing microorganisms such as lactic acid bacteria) of banana peels and the effect of its use on the performance of free-range chickens is not yet available. Therefore, the aim of this research was to determine the effect of using fermented banana peels in feed on the growth performance of crossbred native chickens.

MATERIALS AND METHODS

Fermented banana peel

Banana peels are fermented (FBP) for 21 days, the process for making banana peels is fermented according to the instructions of Chrysostomus et al. (2020). Banana peels are taken from banana processing facilities; ripe banana peels are marked with yellow peel color, then separated from fruit stalks and washed to remove dirt attached to the peel, drained and cut ± 3 cm, weighed and then mixed with 10% tapioca flour. Put it in a thick plastic jar while compacting it, then close it tightly and insulate the surface to make it airtight. Banana peels are fermented at room temperature (25-27 °C) for 21 days. After 21 days it is opened and sun dried for two days. Then analyzed the nutrient content. A 10% sample of FBP was taken to analyze dry matter, crude protein, crude fiber Association of Official Analytical Chemists (AOAC, 2005) method. Fiber fraction analysis, including neutral detergent fiber (NDF), acid detergent fiber (ADF), and lignin, was conducted according to the procedure outlined by Van Soest et al. (1991). Calcium was determined by the Atomic Absorption Spectroscopy (AAS) method and phosphorus using spectrophotometry (AOAC, 2005) Analysis of total tannins using Burns (1971) method.

Chicken, treated diet, and cage

A total of 160 crossbred native chickens unsex were used in this study with an average initial body weight of 38.68±0.56 g These chickens were fed according to the level of use of fermented banana peels (FBP). The treatments were FBP0: diet without fermented banana peels (Control), FBP1: diet with 10% fermented banana peels, FBP2: diet with 20% fermented banana peels, FBP3: diet with 30% fermented banana peels. Each treatment had five replications and each unit used eight crossbred native chickens. Treatment feed given 1-56 days. The nutrient content of the treated feed was prepared according to the instructions of National Standardization Agency of Indonesia (BSNI (National Standardization Agency of Indonesia) BSNI, 2013). Details are shown in Table 1. All feed ingredients were ground with the same particle size then weighed according to the formulation and mixed until homogeneous then made in crumble form. The total experimental cages were 20 units. Each unit measures 80 cm long, 70 cm wide, and 50 cm high. The cage temperature ranges from 27-32°C, with air humidity 53-68%. Lighting for 12 hours from 18.00 to 06.00 am. The bedding of the cage uses rice husks and is changed every week.

Table 1: Formulation and nutrient content of treatments diet.

Feed ingredients	Age 1-21 days (%)				Age 22-56 days (%)			
	FBP0	FBP1	FBP2	FBP3	FBP0	FBP1	FBP2	FBP3
Fermented banana peel	0.00	10.00	20.00	30.00	0.00	10.00	20.00	30.00
Corn	50.00	46.00	42.00	38.00	58.00	54.00	50.00	46.00
Rice bran	18.00	12.00	6.00	0.00	21.00	15.00	9.00	3.00
Meat bone meal	8.60	8.60	8.60	8.60	4.60	4.60	4.60	4.60
Soy bean meal	18.00	18.00	18.00	18.00	11.00	11.00	11.00	11.00
Palm oil	3.00	3.00	3.00	3.00	2.00	2.00	2.00	2.00
Premixes	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
L lysine HCL	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Dicalcium phospat	1.00	1.00	1.00	1.00	2.00	2.00	2.00	2.00
NaCl	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

FBP0: diet without fermented banana peels (Control), FBP1: diet with 10% fermented banana peels, FBP2: diet with 20% fermented banana peels, FBP3: diet with 30% fermented banana peels.

Research variable

The research variables were the nutrient content of fermented banana peel. Experiments on chicken diet with the feed intake variable obtained by weighing the feed given and the remaining feed every week, body weight gain obtained by weighing the body weight of the chickens every week and the feed conversion ratio which was comparison between feed intake and body weight gain.

Statistical analysis

Data containing nutrients were analyzed descriptively by looking at the average value, while data on feed intake, body weight gain and feed conversion ratio were analyzed by analysis of variance and followed by Duncan's multiple range test with a probability value of 5% (Agustono et al., 2011).

RESULTS AND DISCUSSION

Banana peel nutrients before and after fermentation

The fermentation process results in changes to the nutrient composition of banana peels, shown in Table 2. The nutrient content of banana peels was improved through anaerobic fermentation with the addition of 10% tapioca and fermented for 21 days. It was seen that crude protein increased by 74.35% and crude fiber decreased by 31.45%, tannins decreased by 97.38%. The decrease in fiber fractions such as neutral detergen fiber (NDF), acid detergen fiber (ADF) and Lignin were, respectively 22.21%, 9.7% and 20.94%.

Table 2: Nutrient composition of banana peels before and after fermentation using 10% tapioca for 21 days.

Nutrient component (%)	Unfermented banana peel (BP)	Fermented banana peel (FBP)
Dry matter	74.20±0.85	70.94±1.41
Crude protein	3.90±0.07	6.80±0.71
Crude fat	8.56±0.17	10.80±0.71
Crude Fiber	14.37±0.95	9.85±1.18
Ash	10.60±0.35	9.98±0.07
Calcium	0.21±0.08	0.18±0.08
Phosphorus	2.06±0.24	1.02±0.22
Tannins	4.97±0.02	0.13±0.02
NDF	45.86±0.45	35.67±0.44
ADF	32.41±0.38	29.26±0.59
Lignin	17.90±0.39	14.15±0.54

NDF: neutral detergent fiber, ADF: Acid detergent fiber.

Performance of chicken fed with fermented banana peels

The initial body weight of the chickens with the same treatment is shown by the data in Table 3 where the initial body weight was relatively uniform. Provision of fermented banana peels had a significant effect on body weight, body weight gain and feed intake both in chickens aged 1 to 4 weeks and those aged 5-8 weeks and overall. The value of feed conversion had an effect on the age of 1-4 weeks had a significant effect ($P<0.05$) while those aged 5-8 weeks and overall had no significant effect ($P>0.05$). During maintenance, none of the chickens died.

Table 3: The effect of giving fermented banana peels to the performance of native chickens.

Parameter	Treatments				SEM	P value
	FBP0	FBP1	FBP2	FBP3		
Initial body weight (g/bird)	38.326	38.728	38.778	38.878	0.129	0.482
Body weight (g/bird)						
4 weeks old	379.152^{c}	375.652^{c}	344.702^{b}	319.104^{a}	5.888	0.000
8 weeks old	698.652^{b}	680.526^{b}	676.652^{b}	604.778^{a}	8.897	0.000
PBB (g/bird/week)						
1-4 weeks	85.206^{c}	84.230^{c}	76.482^{b}	70.056^{a}	1.478	0.000
5-8 weeks	79.874^{b}	76,220^{a}	82,988^{b}	71.420^{a}	1.467	0.019
1-8 weeks	82.542^{b}	80.226^{b}	79.736^{b}	70.738^{a}	1.117	0.000
Feed intake (g/bird)						
1-4 weeks	742.954^{ab}	789.126^{b}	715.602^{a}	697.776^{a}	11039	0.008
5-8 weeks	1237.228^{c}	1129.826^{bc}	1196.326^{b}	924.150^{a}	29.944	0.000
1-8 weeks	1980.176^{b}	1918.952^{b}	1911.928^{b}	1621.926^{a}	35.225	0.000
Feed conversion ratio						
1-4 weeks	2.108^{a}	2.388^{bc}	2.282^{ab}	2.510^{c}	0.047	0.010
5-8 weeks	4.500	4.382	4.171	4.572	0.146	0.816
1-8 weeks	3.304	3.360	3.228	3.542	0.073	0.499
Mortality 1-8 weeks (bird)	0	0	0	0		

FBP0: diet without fermented banana peels (Control), FBP1: diet with 10% fermented banana peels, FBP2: diet with 20% fermented banana peels, FBP3:` diet with 30% fermented banana peels. Mean followed by different superscript letters in the same row indicating a significant difference ($P<0.05$). SEM: Standard error of the mean, p: probability

Fermentation effect on banana peel nutrients

Based on data (Table 2) it can be seen that fermentation can enrich the nutrients of banana peels. The increase in protein is probably because the fermented banana peel substrate is donated from the bodies of microorganisms and the protease enzymes produced by microorganisms (Hudiansyah et al., 2015; Mandey et al., 2015). This increase in protein also occurred in banana peels which were fermented using the fungus *Rhyzopus oligosporus*, before fermentation the 6.56% crude protein increased to 14.88% after fermentation (Koni et al., 2013). Fermentation using cow rumen fluid can increase protein from 5.97% to 6.38% (Ridla et al., 2016). Crude fiber content after 21 days of fermentation decreased by 31.45%. This decrease in crude fiber was followed by a decrease in the fiber fraction, namely NDF, ADF and lignin, respectively 22.22%, 9.72% and 20.95%. The decrease in crude fiber and fiber fraction is due to the fermentation process of microorganisms to produce cellulolytic enzymes which have the ability to reduce crude fiber. Microorganisms produce cellulolytic enzymes such as cellulase and xylanase (Mandey et al., 2015).

This nutrient improvement also occurred with a decrease in tannin content of 97.38%. This is because microorganisms that play a role in fermentation produce enzymes that can degrade anti-nutrients such as tannase enzyme (Cho et al., 2019; Namah et al., 2021). Tannins in banana peels fermented with goat rumen fluid during six days of fermentation decreased by 13.08%, the decrease in tannins in banana peels fermented with 6% palmyra liquid sugar was 33.72% (Koni et al., 2022b).

The effect of fed fermented banana peels on performance of crossbred native chickens

Based on the data in Table 3, it reveals that the initial body weight of the chickens with the same treatment was indicated by no difference in body weight (P>0.05). This shows that the initial state of experimental chickens has a uniform initial body weight. This supports an experiment that gives effect only from the level of use of fermented banana peels in feed. Increasing the level of fermented banana peels tends to cause a decrease in body weight of chickens for all ages, both 4 weeks and 8 weeks. This is possibly due to differences in the amount of feed consumption and nutrient digestibility in the treated feed, the higher the banana peel the digestibility decreases (Salombre et al., 2018). In addition, the presence of tannins in fermented banana peels (0.18%) with increasing use results in a higher accumulation of tannins so that the nutrients bound and disposed of through the excreta also increase. Tannins cause a decrease in feed consumption in livestock (Tandi, 2013). Based on analysis of variance the use of banana peel silage in feed had a very significant effect (P<0.01) on crossbred native chicken body weight gain. Fed banana peel silage of 10, 20, and 30% tended to reduce the body weight of native chickens, the higher the administration of banana peel silage, the free-range chicken's body weight decreased. This is due to the tannin content which can cause the digestibility of nutrients such as protein in native chickens to decrease. This is in accordance with what is described by Tandi (2013) that tannins can inhibit metabolic processes in the body of livestock such as binding to protein and starch so that they are difficult to digest by protease and amylase enzymes into amino acids and glucose.

Increasing the level of fermented banana peels caused a decrease in feed intake both at 1-4 weeks of age and at 5-8 weeks of age and consumption during the 1-8 weeks of the study (P<0.05). This was probably due to the presence of antinutrients in fermented banana peels so that reduce the level of livestock preference on feed containing FBP. Tannins generally have a bitter and astringent taste, thereby reducing consumption (Khalifa and Tinay, 1994). The given 30% FBP had significantly (P<0.05) lower feed intake than other treatments at a total age consumption of 1-8 weeks. Giving banana peel silage up to 30% shows a tendency to decrease the consumption of crossbred native chicken diet, this is because there is still a tannin content contained in the fermented banana peel so that it can reduce the level of feed consumption, because of the astringent taste. According to Salombre et al. (2018) tannins in banana peels can cause a decrease in feed consumption due to the astringent taste for livestock. Nuraga et al. (2018) who explained the low consumption of feed was due to the blacker color of the feed using banana peel silage than the color of the feed without banana peel silage.

Feed conversion ratio (FCR) is a comparison between the total feed consumption and body weight gain in a certain time (Scott et al., 1982). The smaller the feed conversion value means the feeding is more efficient, but if the feed conversion is larger, then there is waste. Feed conversion value at 5-8 weeks of age and overall, at 1-8 weeks of age had no significant effect (P>0.05). This is due to high feed consumption followed by high chicken body weight. This is in accordance with the opinion Yaman et al. (2009) which states that the value of feed conversion is influenced by feed consumption and body weight gain.

CONCLUSIONS AND RECOMMENDATIONS

Based on the discussion it was concluded that anaerobic fermentation using 10% tapioca for 21 days was able to improve the nutritional value of banana peels, the higher the use of fermented banana peels in chicken feed, the

consumption, body weight gain decreased. Fermented banana peels can be used up to 20% in crossbres native chicken diet up to 8 weeks.

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NOVELTY STATEMENT

The use of Kepok banana peel can be increased up to 20% in crossbred native chicken feed after anaerobic fermentation with the addition of 10% tapioca and fermented for 21 days.

AUTHOR'S CONTRIBUTION

TNIK: Contribute in creating research ideas, designing experiments, analyzing the data, and wrote this article. YB,WW: Contributed data collection. CS, MDSR, and YYR: Assisting with data analysis, and proofreading articles. TAYF: helps in writing articles.

Conflict of interest

The authors have declared no conflict of interest.

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