Growth performance of broiler chickens fed diets containing *Amorphophallus companulatus* fermented with *Bacillus subtilis*

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Abstract. This study aims to investigate the effect of the utilization of fermented *Amorphophallus campanulatus* (FAC) by *Bacillus subtilis* in ration on growth performance of broiler. One hundred and twelve broilers aged eighth days were randomly allocated to four dietary treatments (four replication with seven birds per replicate pen) and feed containing 0, 5, 10 and 15% FAC. Diets and drinking water were provided *ad libitum* for 5 weeks. The obtained data were statistically analyzed using one way ANOVA. Duncan's new multiple range tests were subsequently used to separate data with a significant difference. The result showed utilization FAC until 15% in ration had no effect on feed intake, body weight and feed conversion ratio. These results suggest that fermented *Amorphophallus campanulatus* (FAC) by *Bacillus subtilis* can be used until 15% in broiler's ration.

1. Introduction

Maize is the main source of energy in poultry feed, which contributes 50 to 70%. In Indonesia, fifty-one percent of corn was used in the animal feed industry [1]. Domestic maize production is smaller than consumption so it is imported from other countries, and corn is also used for food, this causes the price of feed to be increased. Therefore, used unconventional energy sources such as *Amorphophallus* tubers could be the alternative.

Amorphophallus sp. tubers is a wild plant and have not been cultivated. Koni et al. [2] stated that *Amorphophallus* sp. has a crude protein content of 7.33%, crude fiber content 15.71%. It has gross energy content 3570.60 kcal/kg and has a production 3 to5 kg / tree [3]. However, *Amorphophallus* sp. tuber has anti-nutrient content such as calcium oxalate. The calcium oxalate content of *Amorphophallus companulatus* is 0.6 to 0.78% [4] ; oxalate 318.51 ± 3.2 mg / kg, tannin 0.456% [5]. Oxalate is a secondary metabolism in plants, an anti-nutrient that can bind some minerals such as calcium, magnesium to form insoluble oxalates [4]. Consumption diets containing high oxalate caused hypocalcemia. Deficiency of calcium causes decreased growth, muscle activity disruption and abnormal growth of bone.

Oxalate content of *Amorphophallus* sp tuber can be reduced through a fermentation. Bacteria can degrade oxalate such as *Bacillus subtilis* [6]. The ability to degrade oxalate because microorganisms produced enzyme oxalate decarboxylase and oxalate oxidase. This study aimed to study the effect of level of *Amorphophallus* campanulatus tubers fermented by *Bacillus subtilis* which can provide the the best growth performance of broiler chickens.

2. Materi Dan Metode

2.1.Material

A total of 112, eight-day-old male New Lohmann, MB-202 Platinum broiler chickens were and randomly allocated to 4 groups of 7 birds each, comprising four replicates per treatment. The birds were fed on the experimental diets from eight-day-old to 35 days old. Feed and water were provided *ad libitum*.

Different level of fermented *Amorphophallus companulatus* (FAC) in broiler's diet as a treatment. The dietary treatments were: 1) basal diet (control), 2) basal with 5% FAC, and 3) basal with 10 % FAC 4) basal with 15% FAC. The chicks were fed with the treatments diets from d 8 to 35. Diets were formulated with crude protein 21.02 to 21.39% and metabolized energy 3027.17 to 3044.77 kcal/kg. The ingredient and chemical compositions of the experimental diets used in this study are shown in Table 1.

Table 1. Ingredients and chemical composition of dietary treatments

Ingredient	Dietary treatment (FAC inclusion) (%)			
	0	5	10	15
Corn	53.00	50.50	48.00	45.50
Rice bran	13.00	10.50	8.00	5.50
Meat bone meal	7.35	7.35	7.35	7.35
Soybean meal	25.00	25.00	25.00	25.00
Vitamin and trace element premix[1)]	0.50	0.50	0.50	0.50
dl-Methionine	0.30	0.30	0.30	0.30
Lysine hydrochloride	0.60	0.60	0.60	0.60
Salt	0.25	0.25	0.25	0.25
FAC	0.00	5.00	10.00	15.00
Total	100.00	100.00	100.00	100.00
Calculated values				
Dry matter (%)	86.77	86.43	86.08	85.73
Crude protein (CP) (%)	21.39	21.29	21.18	21.07
Metabolizable energy (kcal/kg)	3027.20	3044.80	3062.40	3079.90
Crude fibre (%)	4.25	4.06	3.86	3.66
Crude fat (%)	4.24	3.97	3.71	3.45
Calcium (%)	0.91	0.95	0.98	1.02
Phosphorus (%)	0.48	0.48	0.48	0.48
Lysine (%)	1.02	1.01	1.00	1.00
Methionine (%)	0.53	0.53	0.52	0.52
Oxalate (mg/kg)	0.00	4.84	9.69	14.53

FAC: fermented *Amorphophallus companulatus*

2.2. Methods

Preparation tubers of *Amorphophallus sp.* tubers are cleaned with tap water to remove soil on the tuber peels. Then, tubers were sliced ± 7 cm with thickness ± 3 cm. Then sliced tuber was sun dried for ± 2 days. Dried tubers were as milled. Amorphophallus sp. tubers were fermented by solid fermentation method.

Amorphophallus companulatus meal was inoculated with 20% *Bacillus subtilis* on the basis of dry matter. *Amorphophallus companulatus* meal was mixed with Bacillus subtilis until homogenous. Then, placed in a plastic bucket with a capacity of 8 kg as a silo, then compacted and fermented at room temperature for seven days. Body weight gain (BW gain) were measured weekly, and feed intake (FI) per pen were measured daily and used to calculate feed conversion ratio

2.2.1 Statistical analysis All the data were statistically analyzed by one-way ANOVA procedure. Duncan's multiple range test was further performed, when significant differences were found ($P<0.05$). Statements of significance were based on $P < 0.05$ [7]. The data were expressed as the mean ± SD.

3. Results and Discussion

3.1 Feed intake

Feed intake of birds did not different between the dietary treatments (Table 2). Fermented by *Bacillus subtilis* can decrease oxalate content of *Amorphophallus* sp. and it was positively impacted on feed intake. The high oxalate content in feed can decrease feed intake however increase water consumption [8]. Fermentation by *Bacillus subtilis* can decrease by 58% to 65% oxalate content of *Amorphophallus* sp. corms [5]. Utilization of aroids such as *Amorphophallus* is limited because of the acrid nature that causes irritation to the mouth, and reduced feed intake [9]; irritation caused by raphide-shaped calcium oxalate crystals stuck on tuber tissue [10]; raphide is a long-shape calcium oxalate with sharp edges like needles [11].

Oxalate content of fermented *Amorphophallus* sp. as treatments are 4.84, 9.69 and 14.53 mg/kg (Table 1) and it hasn't caused a decrease in feed intake. Broiler feed using *Artocarpus heterophyllus* with oxalate content are 0.12, 0, 24, 0.36 and 0.48 g / kg caused decrease feed intake 732, 720, 705 and 594 g / bird [12].

Table 2. Effect of levels of dietary fermented *Amorphophallus companulatus* tubers on growth performance in broiler chickens

Growth performance	FAC inclusion (%)			
	0	5	10	15
Feed intake (g/bird/day	2,994.28 ± 46.96	2,962.78 ± 36.47	2,936.00 ± 34.91	2,930.10 ± 56.38
Weight gain (g/bird/day)	1,525.37.± 43.31	1,504.00 ± 37.37	1,495.32 ± 33.87	1,456.13 ± 32.81
FCR (kg feed/kg weight gain)	1.96 ± 0.05	1.97 ± 0.03	1.96 ± 0.04	2.02 ± 0.18

FAC: Fermented *Amorphophallus companulatus*, Mean±SD, four pens per diet treatment.

3.2 Body weight

Ranged of body weight of broilers is 1456 to1525.37 g/bird reared for five weeks. The results showed that the treatments diet used fermented *Amorphophallus* sp. have no significant affected on broiler's body weight. This means that fermented *Amorphophallus* sp. can be used up to 15% in broiler feed. This is because oxalate in fermented *Amorphophallus* sp. has been reduced by *Bacillus subtilis* so that feed intake higher than non-fermentation *Amorphophallus* sp. Feed intake in control same as broiler who given fermented *Amorphophallus* sp. Oxalate consumption in the group which given fermented *Amorphophallus* sp. have ranged from 0.41 to 1.21 mg. Oxalate content in the monogastric diet should be less than 0.5% [8]. Utilization of fermented cottonseed flour by *Bacillus subtilis* in broiler chicken feed 15 and 20% to replace soybean meal, resulted in higher weight gain than unfermented cottonseed flour ie 84.5 and 85.7 while unfermented 82 and 79, 2 g / bird/day [13]. The fermentation process by *Bacillus subtilis* can reduce the oxalate content of *Amorphophallus* sp. Broiler who given fermented *Amorphophallus* sp. tubers have feed consumption and body weight gain higher than unfermented. [14] stated that supplementation soybean fermented by *Bacillus subtilis* in male Tsukuba chickens cause increased body weight ie 3.53 on control, to 3.63 kg on 2% supplementation. [15] stated that in pigs fed fermented feed by mixed cultures of *Bacillus subtilis, Lactobacillus fermentum* and *Saccharomyces cerevisiae*, had body weight gain 443 g/tail while 392 g/tail in unfermented feed

3.3 Feed conversion.
The results showed that using fermented *Amorphophallus* sp. not significantly affected to feed conversion of broiler chicken. The fermentation process can reduced antinutrients, increased nutrient consumption and improving feed conversion. Feed conversion on broiler chickens fed rapeseed fermented by mixed cultures of *Bacillus subtilis*, *Lactobacillus fermentum*, *Enterococcus faecium*, and *Saccharomyces cerevisiae* of 1.67 was not different from those of control feed, which was 1.63 but lower than fermented rapeseed 1.72 [16]. Fermentation tuber by *Bacillus subtilis* can be improved digestibility so that more nutrients can be digested. *Bacillus subtilis* utilizing both for probiotics and fermentation of broiler feedstuff can increased protein so that it can improve feed conversion value [17]. [18] stated that giving *Bacillus subtilis* 0, 100, 150, 200 mg/kg in broiler chicken feed can improved broiler chicken feed conversion ration namely 1.91, 1.86, 1.81 and 1.78.

4. Conclusion
Fermented *Amorphophallus* sp. tubers by *Bacillus subtilis* up to 15% in broiler feed did not affect on consumption, body weight and feed conversion value. It is recommended that before being used as chicken feedstuff, it is better *Amorphophallus* sp. tubers to remove the anti-nutrient content by the fermentation process.

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