



## **FERMENTATION OF KEPOK BANANA PEEL-CORN HOMINY MIXED SUBSTRATE FOR DIETARY INCLUSION IN BROILER RATION**

### **Fermentasi Substrat Campuran Kulit Pisang Kepok dan Ampok Jagung dalam Ransum Ayam Pedaging**

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#### **ABSTRACT**

*To reduce broiler production cost, a study was carried out on utilisation of alternative, less costly feed components, namely kepok banana peel and corn hominy which were mixed and fermented using the fungus *Rhizopus oryzae*. The fermented substrate was added into commercial feed in order to determine its influence on the poultry's production performance. This study employed a completely randomized design (CRD) with four treatments: one using 100% pure commercial feed, and the other three commercial feed mixed with the fermented feed component at the levels of 5%, 10% and 15%. All treatments were repeated four times during 25 days growth period. The results showed that supplementation of the fermented ingredient in the broiler ration at the levels of 5%, 10%, or 15% had no significant effect ( $P>0,05$ ) on the feed consumption, body weight gain, feed conversion ratio, and the final body weight of the animals. Although mixing the fermented feed ingredient up to 15% in the commercial feed promoted the growth of the broilers, the growth performance were not yet comparable to pure commercial feed.*

**Keywords:** *Corn hominy, broiler, fermentation, kepok banana peel, *Rhizopus oryzae**

#### **ABSTRAK**

Untuk mengurangi biaya produksi ayam pedaging, dilakukan pengkajian penggunaan bahan penyusun pakan alternatif yang lebih murah, yaitu kulit pisang kepok dan ampok jagung yang dicampur dan difermentasi menggunakan jamur *Rhizopus oryzae*. Hasil fermentasi tersebut lalu ditambahkan pada pakan komersial ayam pedaging dengan tujuan mengetahui pengaruhnya terhadap penampilan produksi ayam pedaging. Penelitian ini menggunakan Rancangan Acak Lengkap (RAL) dengan empat perlakuan, yaitu satu perlakuan 100% pakan komersial murni, dan tiga perlakuan pakan komersial yang dicampur bahan pakan hasil fermentasi tersebut dengan kadar 5%, 10%, dan 15%. Seluruh perlakuan diulang empat kali selama 25 hari masa pemeliharaan. Hasil penelitian menunjukkan bahwa penambahan bahan pakan terfermentasi ke dalam ransum ayam pedaging pada kadar 5%, 10%, atau 15% tidak memberikan pengaruh nyata ( $P>0,05$ ) terhadap konsumsi pakan, pertambahan bobot badan, nilai koversi pakan, dan bobot badan akhir hewan. Meskipun penambahan bahan pakan fermentasi tersebut hingga 15% dalam pakan komersial mendukung pertumbuhan ayam pedaging, namun capaian pertumbuhannya belumlah sebaik pakan komersial.

**Kata kunci:** Ampok jagung, ayam pedaging, fermentasi, kulit pisang kepok, *Rhizopus oryzae*

## INTRODUCTION

Poultry production requires up to 70% of the total production cost to be spent in feeds (Goodarzi Boroojeni et al. 2016). Thus, reducing the production cost, hence increasing profit margin, can be done by utilising alternative feed ingredients derived from agroindustrial wastes and byproducts, as well as abundantly available local resources (Ditjennakkeswan 2014). Such potential feed components that have been experimented for use in broiler diets include sago pith (Ab Jalil et al. 2014), palm kernel cake (Alshelmani et al. 2016), orange and banana peel (Siyal et al. 2016), cassava (Boonsinchai et al. 2016; Nsa et al. 2016), olive cake (Al-Harhi 2016), rice milling waste (Yusuf et al. 2015), mushroom waste (Camay 2016), brewer dried grains (Okpanachi et al. 2014), apple peel (Heidarisafer et al. 2016), ginger waste meal (Pati et al. 2015), corn husk waste (Ningrumsari and Budiasih 2015), sunflower meal (Alagawany et al. 2015), grape by-product (Brenes et al. 2016), and guava fruit meal (Bikrisima et al. 2016).

There are, however, some problems associated with feed ingredients derived from agroindustrial origin. The relatively high content of antinutrients such as lectins, polyphenolic compounds, toxic amino acids, saponins, cyanogenic glycosides, protease inhibitors, and oxalates (Martens et al. 2012) limit the inclusion rate of the feed components in the poultry diet (Schedle 2016). Efforts to reduce the antinutritional factors, thus increasing the digestibility and nutrient availability, have been undertaken using a number of techniques including treatments using heat, chemicals, machineries, enzyme supplementation, as well as fermentation (Pasaribu 2007; Martens et al. 2012; Ravindran 2013; Schedle 2016).

Solid fermentation, owing to being simple and low cost, has been employed in various studies to develop potential poultry feed components of plant origin. As the fermenting agent, the edible fungi *Rhizopus* spp. have been used on such substrates as sago pith (Ab Jalil et al. 2014), banana peel (Martaguri 2010; Koni 2013), cassava bagasse (Purnomo et al. 2015), *Jatropha curcas* meal (Sumiati et al. 2011; Yusriani et al. 2011) and soybean meal (Qudri 2001).

In this study, solid fermentation of mixed substrate comprising *Kepok* banana peel and corn hominy using *Rhizopus oryzae* (Biotech Laboratory Culture Collection) was carried out to prepare an alternative feed ingredient. Once prepared, this fermented feed component was subsequently mixed at different inclusion levels with commercial poultry basal diet. Subsequent feeding experiment was carried out with the aim of investigating its effect on broiler growth performance.

## MATERIALS AND METHODS

### Feed fermentation

Fermentation was carried out at the Feed Biotechnology Laboratory-BPPT, Serpong, Banten and feed test on broiler chickens in Pabuaran, Gunung Sindur, Bogor, West Java. Fermentation substrates consisted of *kepok* banana peel (BP) and corn hominy (CH). BP was diced into small size, homogenised using a blender to produce a brown mash texture. This BP mash was mixed with CH at the weight ratio of 4:1, sterilised at 121°C for 15 minutes. Having cooled to room temperature, the substrates were mixed with starter powder of *R. oryzae* ( $3.3 \times 10^7$  cfu/g) at the concentration of 1-1.5 g/100 g substrate, and moisturised to 70% using a mineral solution consisting of (per 1000 mL solution): 2.7 g  $\text{KH}_2\text{PO}_4$ , 8.0 g  $(\text{NH}_4)_2\text{SO}_4$ , and 13.4 g urea. Incubation was then carried out at 28-30°C or at room temperature for 24-48 hours.

Once the fermentation was successful, indicated by the substrate physically being transformed into cottony white cake with soft cheesy texture, the fermented substrate was sliced into small cubes, approximately 1 cm<sup>3</sup>, and dried at 60°C for 24 hours. The dried fermented feeds were subjected to proximate analyses.

### Feed treatment

Four feeds were prepared by mixing the basal diet of BR 11 (Charoen Pokphand Ltd.) commercial poultry feed with the fermented feed at different inclusion levels of 0, 5, 10, and 15%, respectively. The two feed components were firstly homogenized separately, mixed, and then made into crumble forms in Indo Feed animal feed factory, Bogor, West Java.

## Birds and housing

Ninety six one day old (broiler) chickens (DOC) (Kerta Mulya Sejahtera Ltd, Sukabumi, West Java) were randomly allotted to 16 squarely-fenced pens, six birds per pen (1 m<sup>2</sup>/pen). The pens were located inside a closed-sided, above-ground house insulated by bamboo wood with gaps which allowed natural ventilation, and bedded with rice husks. In each pen, a drinker and a plastic feeder were equipped to provide water and feed *ad libitum*.

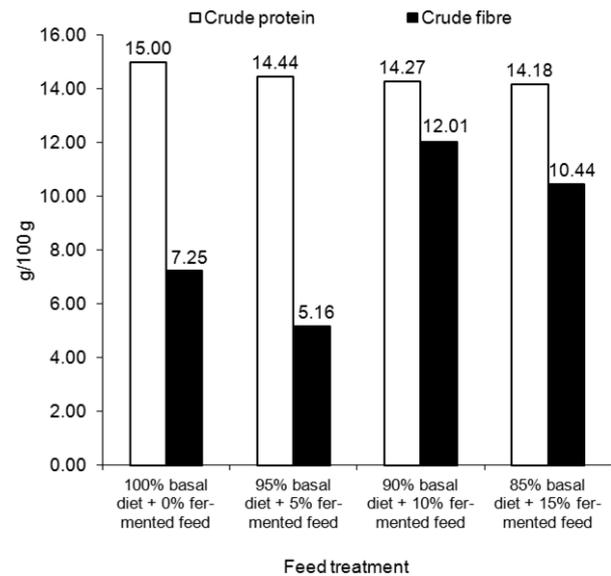
## Feeding test

Feeding test on the chickens was undertaken in a completely randomized design with four replications per treatments, and a 25-day rearing period. Four feeding treatments were carried out using four different types of ration as mentioned previously. Parameter measured included feed consumption, body weight gain, and feed conversion ratio (FCR). Data obtained were processed using Statistical Package for the Social Science (SPSS) 20.

## RESULTS AND DISCUSSION

Supplementing the fermented feed into the commercial basal diet up to 15% inclusion level lowered the protein content to less than 14.5% from the initial value of 15%. The crude fibre content, however, increased for those feeds containing 10 and 15% fermented feed. Interestingly, the treatment feed added with the 5% fermented feed contained less fibre content than the pure 100% commercial feed. This impossible result could be due to experimental error, since the banana peel contain about 21-50% crude fibre (Agustono et al. 2011; Yosephine et al. 2012). Addition of the peel should have made the crude fibre content higher than the initial value of 7.25%.

Both basal diet and treated diets in this study did not meet the standard requirement of crude protein content of at least 19.0% for broiler starter (Badan Standar Nasional 2006a) and minimum 18.0% for broiler finisher diets (Badan Standar Nasional 2006b), as well as crude fibre content of maximum 6.0% (Badan Standar Nasional 2006a; Badan Standar Nasional 2006b). This protein content was also much lower than those reported in other similar studies involving banana peels in broiler diets, in which the values ranged from 20.16 to 23.08% (Martaguri 2010; Koni et al. 2013; Koni 2013; Siahaan et al. 2014; Sunu et al. 2014;



**Figure 1.** Crude protein and fibre content of the broiler feed made from commercial-feed basal diet (BD) combined with the fermented feed (FF) at different proportion

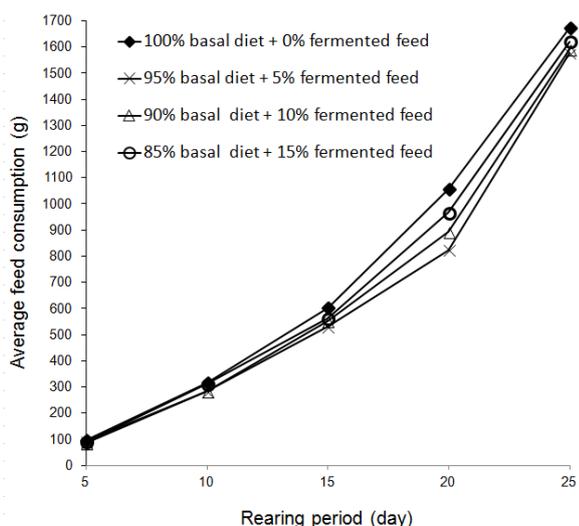
Zahra et al. 2014; Hudiansyah et al. 2015). In two of these studies (Sunu et al. 2014; Zahra et al. 2014), the crude fibre content was exceeding the recommended maximum values of 6.0% as well.

The presence of the fermented feed component in the broiler ration brought no advantage over fermented feed-free ration in terms of feed intake (Figure 2) and growth profiles (Figure 3) during the 25-day rearing period. Both average feed consumption and average body weight were always higher for the broilers fed with 100% commercial feed than those fed with fermented-feed added diets. This was likely due to the lower protein content of the latter. Inadequate amount of protein would negatively impact bird growth as, apart of being main component of the biologically active molecules in the body, it plays important roles in the body tissue synthesis and renovation (Beski et al. 2015).

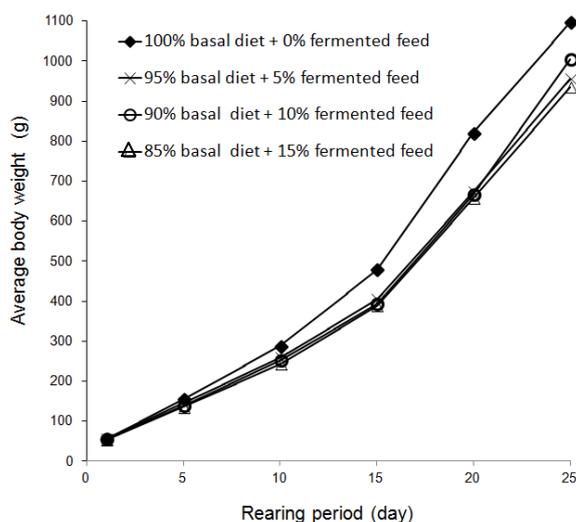
Further data analysis at the end of rearing period (25<sup>th</sup> day) on the average final feed consumption ratio, average final body weight gain, FCR, and average final body weight (Table 1) confirmed the superiority of 100% commercial basal diet compared to all the other treated feeds. Statistic analysis, however, gave no significant difference ( $P > 0.05$ ) across all the average final weight and FCR values as a result of fermented feed treatment. Amongst all the feeds added with the fermented ingredient, combination of 90% commercial basal diet plus 10% fermented feed gave the best results, indicated by the values of average final body weight gain,

**Table 1.** Growth performance of broiler chicken for 25 days rearing period

Feed treatment	Average final feed consumption (g)	Average final body weight gain (g)	Feed conversion ratio (FCR)	Average final body weight (g)
100% basal diet + 0% fermented feed	1673.7 ± 12.8	1041.3 ± 76.7	1.53 ± 0.93	1097.6 ± 76.1
95% basal diet + 5% fermented feed	1576.7 ± 42.4	901.5 ± 65.7	1.65 ± 0.80	956.2 ± 64.6
90% basal diet + 10% fermented feed	1591.3 ± 82.5	950.0 ± 113.1	1.59 ± 0.10	1005.0 ± 113.4
85% basal diet + 15% fermented feed	1621.2 ± 106.9	881.6 ± 57.0	1.74 ± 0.19	935.6 ± 57.6



**Figure 2.** The effect of fermented feed inclusion level on the feed consumption of broilers



**Figure 3.** The effect of fermented feed inclusion level on the growth profile of broilers

FCR, and average final body weight.

Based on the obtained data (Table 1), the feed consumption rates were 66.9, 63.1, 63.7, and 64.8 g.day<sup>-1</sup> per bird as the fermented feed was added at the levels of 0, 5, 10 and 15%, respectively. Such negative influence on daily average feed consumption was also reported in other similar studies using *Rhizopus*-fermented banana peels (Martaguri 2010; Koni 2013). The much more adverse effect of *Rhizopus*-fermented feed stuff was demonstrated when *Jatropha curcas* was used as the substrate, where 9% inclusion of the fermented feed in the ration caused the overall feed consumption during grower-finisher period decreased to less than 20% (Sumiati et al. 2011).

The lower consumption rate explained why the values of FCR in basal diet fed broilers (1.53) were much better compared to those fed with fermented feed-added rations (1.59-1.74). These results are compa-

table with similar works previously reported (Martaguri 2010), despite the fact that equi-protein principle was considered during formulation of the diets. Hence, the discrepancy was most probably caused by the protein quality (adequate and balanced amino acid composition) and the presence of antinutrient components in the diets (Beski et al. 2015).

## CONCLUSION

Inclusion of *R. oryzae* fermented feed ingredient based on the mixed substrate consisting of *kepok* banana peels and corn hominy reduced the crude protein content of basal diet. Although promoting broiler growth, supplementing 5, 10, and 15% of the fermented feed in the diets had no advantage to the birds in term of the feed consumption, growth performance, and productivity.

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