The Duck Responses to the Diets Containing Fermented Palm Kernel Meal with Bacillus subtilis

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Abstract. This research aimed to study the effect of the use of fermented palm kernel meal (FPKM) with Bacillus subtilis in the ration on the performance of broiler ducks. This study used 100 DOD of Mojosari and Alabio crossbred ducks. The types of cages used were 20 units of box cages measuring 80x80x60 cm and each unit was filled with 5 ducks. This research used a completely randomized design (CRD) experimental method with five ration treatments and four replications. The diet treatments were given 0, 20, 25, 30 and 35% FPKM respectively. The ration was prepared with an 18% protein, and 2700 kcal/kg energy. The variables were observed: feed consumption, body weight gain, feed conversion, body weight, carcass percentage and abdominal fat percentage. The results of variance analysis showed that the utilization of FPKM with Bacillus subtilis in the ration had a significantly different effect (P<0.05) on feed consumption, body weight gain, body weight and carcass percentage, but not significantly different (P>0.05) on feed conversion and percentage of ducks abdominal fat. From the results of this research it can be resumed that the utilization of FPKM with Bacillus subtilis can only be used up to 30% in duck rations seen from the consumption of rations 689.48 g/head/week, weight gain 145.50, conversion of 4.75 rations, body weight of 1158.50 g/head, the percentage of carcasses was 61.85% and the percentage of abdominal fat was 0.88%.

1. Introduction
Ducks are very potential and strategic to be developed as a source of animal food. One type of ducks that have the potential to be developed as meat producers is male ducks from crossing Mojosari and Alabio. The advantages of Mojosari Alabio ducks according to Ref. [1] are the first age to lay eggs earlier, high egg production, better production consistency, growth faster, male children can be used as broiler or cut ducks when compared to Mojosari and Alabio ducks. The problem of ration often becomes an obstacle for poultry farms because the cost of feed reach 60% -70% of the total production cost. Many breeders only provide rations of sub-standard quality. Most ducks that are kept in the community are only given food such as a mixture of rice bran and the remnants of household waste so that the production and quality of duck performance is still very low.

Overcoming this requires cheap and high quality alternative feed ingredients. Providing alternative feed ingredients from the by-products of the food and agriculture industry is the right way to remember the agricultural industry in Indonesia is experiencing rapid growth, especially the palm oil processing industry which also produces oil palm cake as a by-product of the industry.

According to data from Ref. [2] Indonesia has an area of oil palm plantations reaching 12.30 million hectares with total palm oil production reaching 34.47 million tons. Every ton of oil palm fruit can produce 35 kg of oil palm cake [3] thus palm oil cake has a great potential to be utilized as animal
feed ingredients. According to [4] the nutritional content of palm kernel meal (PKM) is 87.30% dry matter, crude protein 16.07%, crude fiber 21.30%, crude fat 8.23%, Ca 0.27% and P 0.94%. Although the crude protein content of PKM is quite high but the crude fiber is also very high so that its utilization is still limited especially in poultry diet. The high crude fiber content causes low palatability of feed ingredients so that the application of the PKM is less optimal if given immediately without any prior processing [5,6].

The reason of low use of palm kernel meal is the high level of Mannan from palm kernel meal. Inappropriate with the notion [7] which states that 56.40% of palm kernel meal is composed of β-mannan. The high level of β-mannan in palm kernel meal is one of the restrictions on the use of the PKM because poultry cannot remodel mannan properly. For this reason, PKM fermentation is carried out using microorganisms that are mananolytic [8].

One of the technologies that used to repair the feed ingredients quality is fermentation. [9] had fermented the PKM with three mananolytic molds that produced mananase (Aspergillus niger, Eupenicilum javanicum and Sclerotium rolfsii). From the results it was found that fermented PKM with Sclerotium rolfsii produced higher mananase activity compared to other molds which was 67.5 U/ml and had better nutritional content, 26.96% crude protein, 12.72% crude fiber, crude lipid 0.22%, Ca 0.75%, P 0.85%, retention of nitrogen 57.16%, and energy metabolism 2511 kcal/kg. Even PKM fermentation with Sclerotium rolfsii can already be applied in 25% broiler diet [8].

Besides mould there are also bacteria that are mananolytic, one of which is Bacillus subtilis WY34, [10]. Bacillus is one of the bacteria which produce several types of enzymes that remodel feed matter as carbohydrates, fats and proteins into simpler compounds [11]. [12] had fermented PKM with Bacillus subtilis which obtained 41.23% dry matter content, crude protein 24.65%, nitrogen retention 68.47%, crude fiber content 17.35%, crude fiber digestibility 53.25%, metabolic energy 2669.69 kcal/kg, mannanase activity 6.27 U/ml, cellulase activity (16.11 U/ml), and protease activity (10.27 U/ml). ducks are more tolerant of crude fiber, it is expected that the provision of FPK in duck rations can be more.

2. Materials and Methods
This experiment used 100 male DOD Mojosari-alabio ducks from the Anak Berjaya Children's Farm, Batipuh Panjang, Padang. The cages used are box-shaped cages with a wire, as many as 20 units measuring 80x80x60 cm. Each unit is occupied by five ducks, equipped with a place to eat and drink, and a 60 watt incandescent lamp for heating and lighting. In this study a complete randomized design with five treatments and four replications was used. The treatment ration was distinguished by the level of use of FPKM with Bacillus subtilis namely T1, T2, T3, T4 and T5 using 0, 20, 25, 30 and 35% FPKM, respectively. The treatment ration was set with 18% isoprotein and 2700 kcal/kg metabolic energy. The content of feed substances and metabolic energy can be looked in Table 1.

| Feedstuff   | Treatment rations |
|-------------|-------------------|
|             | T1    | T2    | T3    | T4    | T5    |
| Corn        | 58    | 48    | 47.6  | 43    | 44    |
| Rice bran   | 4     | 3.5   | 2.3   | 2.8   | 0     |
| Soybean Meal| 23    | 13.5  | 10.3  | 8.7   | 6.5   |
| FPKM        | 0     | 20    | 25    | 30    | 35    |
| Fish meal   | 12    | 12    | 12    | 12    | 12    |
| Coconut oil | 2.5   | 2.5   | 2.3   | 3     | 2     |
| Top Mix     | 0.5   | 0.5   | 0.5   | 0.5   | 0.5   |
| Total       | 100   | 100   | 100   | 100   | 100   |
Table 2. Feed Substances (%) and energy metabolism (kcal/kg) of the treatment ration

| Feed Substances                  | Treatment rations |
|----------------------------------|-------------------|
|                                  | T1    | T2    | T3    | T4    | T5    |
| Crude Protein                    | 18.05 | 18.08 | 18.13 | 18.17 | 18.39 |
| Crude protein                    | 5.09  | 4.62  | 4.64  | 4.64  | 4.11  |
| Crude Fiber                      | 5.64  | 8.22  | 8.90  | 9.52  | 9.95  |
| Calcium                          | 1.15  | 1.09  | 1.08  | 1.07  | 1.05  |
| P                                | 0.53  | 0.66  | 0.69  | 0.73  | 0.77  |
| Energy Metabolism                | 2703.98 | 2704.94 | 2701.41 | 2712.11 | 2737.24 |

Procedure for making FPKM: The substrate is a mixture of palm kernel cake and rice bran with a ratio of 80%: 20%. Furthermore, the substrate is sterilized using an autoclave for 15 minutes. After the cold, the inoculum was inoculated for 7%, substrate thickness 2 cm, then incubated for 6 days. Then it is harvested, dried and ground as a fermented palm kernel cake product.

Data collection: Data measured were feed consumption, body weight gain, feed conversion, body weight, carcass percentage and percentage of abdominal fat from the broiler ducks.

Data Analysis: Data is taken every week to specify the effect of treatment. The data that has been collected is processed statistically with analysis of variance. Differences between treatments were tested with the Duncan Multiple Range Test (DMRT) according to [13].

3. Results and Discussion

The influence of the use of FPKM with Bacillus subtilis on feed consumption, body weight gain, feed conversion, body weight, carcass percentage and abdominal fat of percentage in ducks was seen in Table 3.

Table 3. Average feed consumption, body weight gain, feed conversion, body weight, carcass percentage, and abdominal percentage of ducks.

| Parameter                      | Treatment rations | SE   |
|--------------------------------|-------------------|------|
|                                | T1 (0%) | T2 (20% FPKM) | T3 (25% FPKM) | T4 (30% FPKM) | T5 (35% FPKM) |      |
| Feed consumption (g/head)      | 697.50^a | 695.83^a | 691.42^a | 689.48^a | 670.22^b | 6.07          |
| Body weight gain (g/head)      | 148.19^a | 146.56^a | 146.17^a | 145.50^a | 140.51^b | 1.44          |
| Feed Conversion                | 4.71    | 4.75    | 4.73    | 4.75    | 4.77    | 0.08          |
| Body weight (g/head)           | 1170.95^a | 1165.90^a | 1161.38^a | 1158.50^ab | 1137.09^b | 7.22          |
| Carcass Percentage (%)         | 62.34^a | 62.32^a | 62.28^a | 61.85^a | 58.25^b | 1.12          |
| Abdominal fat Percentage (%)   | 0.95    | 0.90    | 0.88    | 0.88    | 0.85    | 0.04          |

Note: The same superscript shows insignificant different effects (P> 0.05)
SE : Standard error.
3.1. Feed Consumption

Based on ration consumption data the use of FPKM up to 30% in the ration can match the control ration (T1), whereas if the user is increased to 35% it causes a decrease in feed consumption. The difference was not apparent in the consumption of rations in the treatment T1 to T4 of duck. Because the rations in treatments T1 to T4 due to the utilize of fermented products (FPKM) in rations which fermented products have palatability or are preferred by livestock due to physical changes such as taste, aroma and easily digested from the original ingredients. This is inappropriate with the assumption of [14] stating that the material was fermented has better quality than the original material because it can increase the aroma and taste preferred by livestock. In line with this opinion, it was also conveyed that the quantity of livestock consumed is affected by palatability, digestibility and composition of feed matter [15], [16], [17].

The decrease in ration consumption in the treatment T5 (FPKM 35%) is thought to be caused by the high crude fiber in diet, where elevated crude fiber in the ration can degrade palatability so the livestock quickly fills up and ration consumption is reduced. This is supported by the idea of [18] that the high crude fiber level in the ration causes the broiler to feel full quickly because the fiber is voluminous, so that its use in poultry rations is limited to around 3-6% for broilers. [19] added that undigested crude fiber is thought to bring some food out with excreta, so that the availability of nutrients such as protein, vitamins and others including energy will be reduced.

The average consumption of duck rations obtained in this study ranged from 689.48 g/head/week to 697.50 g/head/week. Feed consumption obtained in this study is almost the same as the results of the study of [20] who reported the average consumption of growing dairy rations with 15% FPKM treatment at 8 weeks of age was 708.14 g/head/week. However, the average consumption obtained in this study is lower when compared with the results of the study of [21], it was reported that the average consumption of Mojosari-alabio crossing ducks for 8 weeks ranged from 905.27 g/head/week to 954.47.

3.2. Body Weight Gain

Based on statistical analysis shows that the use of fermented palm kernel cake up to 35% in duck rations has a significantly different effect (P<0.05) on weight gain of the duck. DMRT test results showed that body weight gain in treatments T1, T2, T3 and T4 were non-significantly effected (P>0.05), but were significant different (P<0.05) higher than the T5 ration treatment. This shows that the use of FPKM up to the level of 30% in the ration of body weight gain can match the control ration, while the use of FPKM up to the level of 35% although it does not have a negative impact on duck performance but shows a decrease in duck body weight gain.

Unlike the unreality of duck weight gain in treatments T1, T2, T3 and T4 due to fermentation products in the ration has good nutritional content and can increase the digestibility of the ration thereby increasing body weight gain. This is supported by the opinion of [22] that the final product of fermentation contains compounds that are simpler and easier to digest from its original ingredients, so as to increase growth. In contrast, the apparent weight gain of ducks in T1, T2, T3 and T4 treatments is also thought to be due to high nitrogen retention in FPKM where [8] stated that FPKM nitrogen retention with Bacillus subtilis was 68.47%. There is a relationship between the amount of nitrogen that is detected in the body of livestock with body weight gain so that nitrogen retention can be used to portend growth [23]. The decrease in duck body weight gain in treatment T5 (FPKM 35%) was caused by the consumption of rations obtained in treatment T5 in this study also decreased. This is what causes the weight gain produced is also low. This is supported by the opinion of [24] that body weight gain is strongly influenced by ration in terms of quantity and is related to ration consumption which, if disturbed, will interfere with growth.

3.3. Feed Conversion

Based on the results of diversity analysis showed that use of FPKM up to the level of 35% had non-significant effected (P>0.05) on the conversion of duck rations. No real effect on ration conversion in every treatments due to the consumption of rations and the resulting weight gain was also not significantly different, so the ratio between ration consumption with body weight gain also showed the same thing, where the conversion was determined by the large amount of feed consumption and...
body weight gain. The value of feed conversion is influenced by the feed consumption and body weight gain [25]. The low percentage of feed conversion indicates the efficient use of feed, because the more efficient feed consumption for growth [26].

The average conversion of duck rations obtained in this study ranged from 4.71 to 4.77. This result is not much different from the results of the study of [20] who reported growing duck conversion with 15% FPKM treatment in maintenance for 7 weeks is around 4,683 up to 4,875 g/head/week.

### 3.4. Body Weight

Based on the results of variance analysis showed that PKM fermented with Bacillus subtilis in the diet had a significantly effected (P<0.05) on the body weight of ducks. The Duncan Multiple Range Test (DMRT) it was found that the weight of body of male MA ducks in the treatments of T1, T2, T3, and T4 were non-significantly different (P> 0.05), but significance effected (P<0.05) with treatment T5. Based on analysis the body weight of male MA ducks with the use of FPKM up to the level of 30% in the ration equals the weight body of male MA ducks in the control ration (T1), but if the use is increased to 35% there is a decrease in the body weight of male MA ducks.

In contrast, the fact that T1, T2, T3 and T4 were treated against the body weights of male MA ducks was due to the fermentation containing PKM rations in which fermentation products were of good quality and the digestibility of the rations increased so as to affect body weight. In accordance with the statement [27] In the fermentation process chemical changes occur in organic compounds (carbohydrates, fats, proteins, crude fiber and other organic materials) through the work of enzymes produced by microbes so that the fermented material will have better quality.

Besides that, the difference in life weight in the treatments of T1, T2, T3 and T4 was also caused by the consumption of rations in the treatments of T1, T2, T3 and T4 which were also unsignificantly effected. This causes the amount of substances consumed is relatively the same so it produces the same life weight. in accordance with [28] opinion that the quantity of diet consumed will determine the body weight resulted, the more diets consumed the higher the resulting body weight.

The decrease body weight in the treatment T5 (35% FPKM) in the ration due to the high level of crude fiber ration that is 9.95%, because high crude fiber in the ration will cause cattle to quickly feel full and reduce palatability thereby reducing the body weight of ducks. [19] that undigested crude fiber is thought to bring some of the food out with excreta, so that the availability of food substances such as protein, vitamins and others including energy will be reduced.

The average weight of male MA ducks obtained in this study ranged from 1137.09 to 1170.95 g/head. This result is lower than the [21] study which reported the average weight gain of male MA ducks with the addition of santoquin and vitamin E at 8 weeks ranged from 1391.12–1466.32 g/head. This difference is thought to be caused by differences in composition and nutrients contained in the feed.

### 3.5. Carcass Percentage

Based on the results of variance analysis showed that fermented PKM with Bacillus subtilis in the ration had a significantly effected (P<0.05) on the percentage of male MA carcasses. Based on the results of the Duncan Multiple Range Test (DMRT) it was found that the percentage of male MA carcasses in T1, T2, T3 and T4 treatments was unsignificantly different (P> 0.05), but significance effected (P<0.05) with treatment T5. Based on the analysis the percentage of male MA carcasses with FPKM use up to 30% in the ration equalled the percentage of male MA carcasses in the control ration (T1), but if the use was increased to 35% there was a decrease in the percentage of male MA carcasses.

The difference in the percentage of carcass in the treatment of T1, T2, T3 and T4 was caused by the different body weights. A high life weight will be followed by a high percentage of carcasses as well. This is not contrary with the opinion of [29] which states that carcass is closely related to life weight, if life weight increases, then carcass also increases.

The decrease in carcass percentage in the T5 treatment (FPKM 35%) in the ration was due to the low carcass weight. The carcass percentage is obtained by comparing the weight of the carcass with the weight of life then multiplied by 100%. The lower the carcass weight, the percentage of carcasses obtained is also lower. This is in accordance with the opinion of [30] that carcass production is closely
connected to life weight, where the more life weight increases, the carcass production will increase and the same body weight will give the same carcass weight.

3.6. Abdomen Fat Percentage

Based on the results of variance analysis showed that fermented PKM with Bacillus subtilis up to 35% in the ration had a non-significant effect (P>0.05) on the male MA duck abdominal fat percentage. The percentage of abdominal fat is obtained by comparing the weight of abdominal fat with life weight multiplied by 100%. In contrast, the fact that T1, T2, T3, T4 and T5 are treated against the percentage of abdominal fat is because the rations are arranged with iso energy so that the level of energy accumulation in the body will form the same body fat. The formation of body fat in male MA ducks occurs because of the excess energy consumed. In accordance with the opinion of [31] that difference in abdominal fat percentage is partly due to the nutritional content of rations, energy levels and amino acids. Furthermore, the difference in the percentage of abdominal fat in the treatment of T1, T2, T3, T4 and T5 is not due to the consumption of rations, where the high consumption of rations will also increase the absorption of nutrients as well as fat. This is in accordance with the opinion of [32] that the higher the consumption of ration, the nutrients absorbed are also high including fat as well as energy and vice versa.

4. Conclusion

From the results of the study it can be concluded that the used of fermented palm kernel meal with Bacillus subtilis can only be used up to 30% level in duck rations. This can be seen from the consumption of rations 689.48 g/head/week, body weight gain 145.40 grams/head/week, feed conversion 4.75, body weight 1158.50 g/head, percentage of carcass 61.85% and abdominal fat percentage 0.88%.

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