Growth performances and digestability in Pekin ducks fed on a diet containing fermented agro-industrial by-products

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Abstract. Poultry industries in Indonesia develop rapidly in line with the increasing demand for poultry meat and eggs. However, fluctuations in availability and the high price of commercial feed bring about a serious problem for traditional farmers. The objective of this study was to evaluate the effect of feeding a diet containing a fermented mixture of water hyacinth leaves (Eichornia crassipes), rice bran, and blood (WRPS) on the production performance and nutrient digestibility of Pekin ducks. This research was conducted for 6 weeks using 100 Pekin ducks (unsex) aged 2 weeks. This study was conducted using a completely randomized design consisting of 4 treatments and 5 replications. The dietary treatments were T0 (control), T1 (30% WRPS), T2 (40% WRPS), and T3 (50% WRPS). At the end of the feeding trial, one duck from each replicate was put in a metabolic cage for digestibility study, adopting the total collection method. Incorporating WRPS in the diet brought significant differences (p<0.05) in feed intake, body weight gain, feed conversion, and digestibility. It can be concluded that the fermented mixture of water hyacinth leaves, rice bran, and protein of slaughtered waste as much as 30% can be used in the diet of Pekin ducks.

1. Introduction
Poultry industries in Indonesia develop rapidly in line with the increasing demand for poultry meat and eggs. High feed costs and poultry competing with humans for feed ingredients suggest strongly that alternative nonconventional and locally available feed sources should be investigated. Agro-industrial waste such as rice bran, water hyacinth leaves, and protein of slaughtered house waste, namely blood, offer great potency to be used partially or totally to replace the traditional animal feed component in poultry diets.

Rice bran is an agricultural by-product commonly used in poultry diet rice-producing countries. However, its use is limited because of its high fiber content and anti-nutritional substances (e.g., phytic acid and β-glucans). Debi et al. [1] reported that the NDF content was reduced by fermentation. The nutritional value of this agricultural by-product for ducks [2] and broiler chicken [3] increased after fermentation using saccharomyces as a fermentor.

Water hyacinth (Eichhornia crassipes) is an aquatic plant that plays an important role in absorbing chemical elements that pollute the aquatic environment [4]. Yet, its rapid and uncontrolled growth and development can damage the environment of lakes, rivers, depletion of oxygen, and clog irrigation channels [5, 6]. Its use as animal feed can not only turn waste into valuable resources, but it can also solve the problem of its growth. Therefore, it can reduce the costs incurred to deal with the negative impacts of its breeding [6, 7]. Nevertheless, water hyacinth leaves as poultry feed is limited [8, [9]
probably due to its high fiber content which impairs the digestibility of nutrients. Fermentation of water hyacinth leaves increases protein content and reduces crude fiber content [10] but, the degree of alteration depends on fermentation methods [11–13].

Another local feed ingredient that needs to be assessed for potential is the protein from the Slaughterhouse waste (PS), namely blood. PS is a potential source of dietary protein for poultry because of its high protein content [14, 15]. The availability of PS is abundant, but its use in poultry feeding is limited to only up to 5% [16, 17]. One way to increase its amount in a diet is by adopting fermentation technology before diet formulation [18].

A study was conducted to evaluate the effect of the levels of incorporating a fermented mixture of WRPS on the production performances and digestibility of Pekin ducks.

2. Materials and methods

2.1. Research materials

This research was conducted in the Gopala Farm at Kuranji Village, Labuapi District, West Lombok Regency. Meanwhile, the chemical composition of feed samples was carried out at the Laboratory of Animal Feed Science and Nutrition University of Mataram.

Two weeks-old unsexed Pekin ducks were used in this study. Water hyacinth leaves were obtained from Batujai Dam, Central Lombok, and fresh bovine blood (protein of slaughterhouse waste = PS) was collected from the local slaughtered house. Other feed ingredients were rice bran, milled corn, mineral mix, and a probiotic (EM-4).

2.2. Research methods

The research was conducted in two stages, namely the feed preparation and feeding trial. The first activity in feed preparation was collecting water hyacinth leaves, chopping, sun drying up to a constant weight, and ground it to pass a 5 mm screen. Meanwhile, a fermenter was provided by mixing 500 ml EM4 into a plastic container filled with 25 liters of water, 1 kg of molasses, and 250 g of vitamin/mineral mix, sealed and stored for 3 days. Next, water hyacinth leaf flour is mixed with rice bran and bovine fresh blood (=WRPS) with a weight ratio of 1:1:1. The mixture is sprinkled with the fermenter so that the water content is about 60%, stirred until evenly distributed. Anaerobic fermentation was carried out in plastic containers with a capacity of 100 kg and incubated for 21 days. Then, the fermented material was sun-dried and analyzed for the chemical composition according to the standard method [19].

In a feeding trial, one hundred two weeks-old Pekin ducks were randomly distributed into four iso-energetic and iso-protein diets with different amounts of fermented WRPS, i.e., T0 (control), T1(30%), T2(40%), and T3(50%). The feed ingredients and the chemical composition of the diets are presented in Table 1.

All diets were pelleted and provided ad libitum. Feed intake was recorded daily, and ducks were weighed weekly for 6 weeks.

2.3. Nutrient digestibility

At the end of the sixth week of observation, one duck was taken at random from each experimental unit and placed in metabolic cages. Each duck was given 140 g of feed every day for 7 days, and drinking water was always available. Feed intake and the excreta produced were recorded in the last four days. The feces were cleaned from spoiled feed and feathers then sun-dried until the sample reached a constant weight. Feed and fecal samples were analyzed for their chemical composition.
Table 1. The feed ingredients and the chemical composition of dietary diets.

| Feed Ingredients                  | Treatment |
|-----------------------------------|-----------|
|                                   | TO       | T1       | T2       | T3       |
| Yellow Corn (%)                   | 50       | 40       | 37       | 30       |
| Rice bran (%)                     | 19       | 13       | 10       | 10       |
| Soybean meal (%)                  | 27       | 15       | 11       | 8        |
| Fermented WRPS (%)               | -        | 30       | 40       | 50       |
| Crude Palm Oil (%)                | 2        | -        | -        | -        |
| NaCl (%)                          | 0.3      | 0.3      | 0.3      | 0.3      |
| CaCO3 (%)                         | 0.7      | 0.7      | 0.7      | 0.7      |
| Mineral Premix (%)*               | 1        | 1        | 1        | 1        |
| Total                             | 100      | 100      | 100      | 100      |

*Each 1 kg contained: vitamin A 12.000.000 IU, vitamin D3 2.000.000 IU, vitamin E 8.000 IU, vitamin K3 2.000 mg, vitamin B1 2.000 mg, vitamin B2 5.000 mg, vitamin B6 500 mg, vitamin B12 12.000 μg, vitamin C 25.000 mg, Ca-D-pantothenate 6.000 mg, Niacin 40.000 mg, Cholin chloride 10.000 mg, methionine 30.000 mg, lysine 30.000 mg, manganese 120.000 mg, iron 20.000 mg, iodine 200 mg, zinc 100.000 mg, cobalt 200 mg, copper 4.000 mg, santoquin (antioxidant) 10.000 mg, zinc bacitracin 21.000 mg.

2.4. Data analysis

The data obtained in the study were analyzed using PROC ANOVA [20], and the significant difference between treatment means was tested using Duncan's test.

3. Results and discussion

Pekin ducks are well known for their fast growth. Feed intake, body weight gain, and feed conversion ratio in Pekin ducks fed on a diet with different levels of fermented WRPS are presented in Table 2.

Table 2. Feed consumption, body weight gain and ration conversion ratio

| Parameter                   | Treatment | P-value |
|-----------------------------|-----------|---------|
|                             | T0       | T1     | T2     | T3     |
| Feed intake (g)             | 4.999±±0.204 | 5.559±±0.118 | 5.558±±0.171 | 5.736±±0.101 | 0.0001 |
| Body weight gain (g)        | 1.346±±0.065 | 1.332±±0.033 | 1.205±±0.055 | 1.144±±0.038 | 0.0001 |
| Feed Conversion Ratio       | 3.78±±0.213 | 4.17±±0.075 | 4.54±±0.156 | 5.02±±0.112 | 0.0001 |

Different superscripts in the same raw indicate a significant difference (p<0.05).

Feeding fermented WRPS increased feed intake (p<0.05), but there was no significant difference amongst levels of fermented WRPS. On the other hand, the body weight gain of the ducks given a diet with 30% WRPS was not different from those fed on the control diet. However, increasing the use of fermented WRPS in the Pekin duck diet beyond 30% resulted in lower weight gain and higher feed conversion ratio (FCR), which might have been associated with the elevation of dietary fiber concentration (Table 1). Sutrisna [22,23] reported that rations with high crude fiber significantly increased feed consumption and deteriorated FCR [24]. Since FCR is a measure of how well a bird converts feed consumed into live weight, a slight alteration in FCR at any given feed price will have a substantial impact on financial margins [23] The FCR reported here is in a range with those reported in other studies [25], but lower than those reported by [26].

Digestibility of dry matter (DM), organic matter (OM), fat, crude fiber (CF), and crude protein (CP) is shown in Table 3. No significant difference was observed in digestibilities in Pekin ducks fed on a
diet containing up to 40% fermented WRPS. However, at the inclusion level of 50%, digestibility decreased (p<0.01). This indicates that fermented WRPS can be included up to 30 in Pekin ducks diet.

**Table 3.** Effect of different amounts of fermented WRPS in duck diet on digestibility of DM, OM, fat, CF, and CP

| Digestibility (%) | Treatment | P-value |
|-------------------|-----------|---------|
|                   | T0        | T1      | T2      | T3      |
| DM                | 0.81±0.017| 0.82±0.067| 0.79±0.038| 0.67±0.050| 0.0003 |
| OM                | 0.83±0.015| 0.84±0.060| 0.81±0.034| 0.70±0.040| 0.0003 |
| Fat               | 0.85±0.027| 0.93±0.028| 0.87±0.040| 0.81±0.073| 0.0085 |
| CF                | 0.61±0.070| 0.60±0.109| 0.59±0.079| 0.39±0.043| 0.0008 |
| CP                | 0.79±0.021| 0.85±0.052| 0.79±0.056| 0.71±0.033| 0.0012 |

*Different superscripts in the same row show significantly different (p<0.05).*

Digestibility observed in this study is in line with those reported in a previous study in which the average DM digestibility in ducks reared for 2 to 10 weeks given 5-10% fermented water hyacinth ranged from 79.36-80.38% [27]. Apart from types of diet, DM digestibility is also influenced by the digestibility of OM components contained in the material itself, such as protein, carbohydrates, fat, and ash [27]. In addition, it is also caused by changes in the nutritional quality of feed due to the fermentation process.

It is believed that the dominant factor causing inferior growth performance and digestibility in ducks in this study is the high concentration of dietary fiber contributed by water hyacinth leaves and rice bran. Fermentation of WRPS with fermenter capable of breaking down more fiber needs to be examined.

### 4. Conclusion

The fermented mixture of water hyacinth leaves (*Eichhornia crassipes*), rice bran, and protein of slaughtered house waste can be included in ducks diet up to 30% without affecting growth performance and digestibility.

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