Feeding Diets Containing Different Forms of Duckweed on Productive Performance and Egg Quality of Ducks

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INTRODUCTION

Ducks, known as water fowl, a type of poultry that has a considerable contribution in providing animal protein sources. In the year 2007, duck eggs production could supply as much as 14.66% of national needs (DGLS, 2008). The duck eggs are mostly obtained from the traditional rearing in wet rural areas. Improvement of rearing ducks in a confined housing model to be a large scale has been limited by the low selling value of eggs which is not able to offset the cost of production. The unavailability of local feed/feedstuffs at low prices is one reason that brings about the farmers more reliant in feeding their ducks with commercial feed although the production cost get higher.

A possible effort can be alternatively selected to reduce production cost is that by feeding a mixture of rice bran and a commercial feed. However, it has a negative

ABSTRACT

The present experiment was undertaken to study the feeding effect of diets containing different forms of duckweed for local ducks on their productive performance and egg quality or egg yolk pigmentation. A total of 90 birds of 24 wk old ducks were randomly divided into 18 experimental units of 2.0 x 1.0 m² of cages. The experiment was assigned in a completely randomized design (3 treatments with 6 replicates, 5 birds each). There were 3 dietary treatments, namely P1= ducks fed a complete diet containing 20 % of dried duckweed and given in the form of dry-mash; P2= a complete diet in P1 but it was offered in wet form (slurry); and P3= ducks were offered basal diet in the form of dry-mash and fresh duckweed was offered separately ad libitum. Diets were formulated to have similar nutritional contents. Feed consumption, feed conversion ratio (FCR), and egg yolk pigmentation were measured. The result of the study showed that these three parameters were affected by the feeding different forms of duckweed. Feeding diet with fresh duckweed brought about the best pigmentation than did the dry one. Fresh duckweed offers a promise as a potential feedstuff for ducks and has a good implication in reducing feed processing cost.

Key words: local duck, duckweed, egg production, yolk pigmentation

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impact on egg quality, especially the yellow pigmentation of egg yolk. The low level of β-carotene in the diet, due to the low content of yellow corn, is the main cause of low egg yolk pigmentation. The use of duckweed, a potential local feedstuff with low price, is one alternative to overcome the problem, because it contains high β-carotene (111.24 mg/kg dry matter) and crude protein (29.05%) (Anderson et al., 2011) and it can be cultivated to produce high biomass (Cheng & Stomp, 2009).

Duckweed that grew in wastewater contains protein of 35 to 45% on dry matter basis with high availability of essential amino acids (Islam, 2002; Khamam et al., 2005). Duckweed grows well in the water with low N content, (Leng et al., 1995; Islam, 2002; Goopy & Murray, 2003). It has rapid vegetative reproduction, easily adapt to unfavorable environmental conditions, and it has detoxication ability (Czerpak & Szamrez, 2003). Lysine content of duckweed as an animal feed also met the standard recommended by FAO and it is generally higher than that found in grain (Cheng & Stomp, 2009). Feeding duckweed has been studied in broiler chickens (Syamsuhaidi, 1997; Kabir et al., 2005), native chickens (Khang & Ogle, 2004; Thuy & Ogle, 2007), laying hens (Anderson et al., 2011), breeding ducks (Men et al., 2001a), growing ducks (Men et al., 2001b), and in laying ducks (Tamsil & Indarsih, 2003; Khandaker et al., 2007).

Feeding duckweed in laying hens up to 40% in the diet did not interrupt egg production and considerably increased egg yolk pigmentation (Islam, 2002). In growing crossbred ducks, fresh duckweed could completely replace roasted soya beans and a vitamin-mineral premix in broken rice based diets without reduction in growth performance (Men et al., 2001b). In broiler chickens, inclusion of duckweed up to 15% in diet did not reduce growth rate (Syamsuhaidi, 1997; Ahammad et al., 2003). According to Thuy & Ogle (2007), when native chickens were offered a selection to paddy rice, fish meal and duckweed in confined and scavenging treatments up to 20 wk of age, duckweed intakes (g Dry Matter= DM/ day) was higher in confined than scavenging chickens (8.40 and 4.84). However, fish meal intakes (g DM/day) were almost similar in both systems of rearing (7.95 and 7.64). Hen-day production was 3.4% significantly higher in confinement than scavenging (25.4% and 22.0%), with egg weight and egg yolk color were similar. It means that duckweed was more preferable and also able to be a supplementary crude protein source in confinement rearing. The inclusion of 20% duckweed into the rations of laying ducks did not hamper egg production, but increased feed conversion due to a large amount of feed scattered on the drinking water bucket (between 10% to 15%). Therefore, duckweed was suggested to be provided in fresh or dry pelleted form (Tamsil & Indarsih, 2003). Duckweed could replace up to 6% of sesame oil cake in broilers diet offered until 42 d of age (Ahammad et al., 2003). Ducks which consumed fresh duckweed grew well (Burkmar, 2003; Forbes, 2003). However, the information concerning feeding fresh duckweed in relation to productive performance and egg yolk pigmentation is not available. Therefore, this study was carried out to confirm the potential of fresh duckweed as a feed ingredient and as a source of pigments for ducks.

### MATERIALS AND METHODS

#### Birds and Management Procedure

The total of 24 wk old local ducks (average body weight was 1401±29 g) were used to study the response in terms of productive performance and egg yolk pigmentation due to the feeding effect of diets containing different forms of duckweed. A total of 90 ducks were randomly divided into 18 goups reared in bamboo cages of 2.0 x 1.0 m in size with 5 birds each. Each cage was equipped with one round plastic bucket 25 cm in diameter and 20 cm in deep for drinking water and one circular feeder except that for the groups fed fresh duckweed, another type of feeder was used. Body weight of birds and feed were weighed weekly.

#### Dietary Treatments and Feeding Programs

Three dietary treatments (Table 1) composed of different forms of duckweed and formulated to have similar nutritional contents (calculated values). Dietary treatment of P1 was the basal diet containing 20% of duckweed and was provided in the form of dry mash representing a control diet used in the previous study (Tamsil & Indarsih, 2003). Dietary treatment of P2 was similar to that of P1, but the diet was offered in a wet form (slurry). Dietary treatment of P3 was the diet with similar composition as that of P1, but duckweed was offered separately ad libitum in fresh form three times per day to minimize spillage. The scattered feed in drinking

<table>
<thead>
<tr>
<th>Ingredients (%)</th>
<th>P1</th>
<th>P2</th>
<th>P3</th>
</tr>
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<tbody>
<tr>
<td>Yellow corn</td>
<td>41.0</td>
<td>41.0</td>
<td>41.0</td>
</tr>
<tr>
<td>Soybeans</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Rice bran</td>
<td>26.0</td>
<td>26.0</td>
<td>26.0</td>
</tr>
<tr>
<td>Local fish meal</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>CaCO₃</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Premix</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Duckweed</td>
<td>20.0</td>
<td>20.0</td>
<td>offered fresh ad libitum</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Note: P1=diet with 20% dried duckweed was given in the form of dry-mash; P2=diet with 20% dried duckweed was given in the form of a wet (slurry); P3= diet was given in the form of dry-mash and fresh duckweed was offered separately ad libitum.
water was filtered, dried and weighed for correction of the actual feed intake.

Data Collection

Feed intake, feed conversion, egg production, and egg weight were observed. In case of P3, feed intake of the basal diet was weekly calculated, while consumption of fresh duckweed was calculated daily, and it was further converted into dry weight basis and summed with the consumption of basal diet without duckweed to obtain the cumulative feed intake (Table 3). Egg production was recorded daily until 8 wk of laying period. The egg quality data was collected weekly.

Experimental Design and Statistical Analysis

The present experiment was assigned in a completely randomized design with 3 dietary treatments (P1, P2, and P3) and 6 replications each. Data were subjected to analysis of variance, and significant differences among treatment means were separated using Duncan’s multiple range test at 5% probability (Steel & Torrie, 1993)

RESULTS AND DISCUSSION

Productive Performance

Feed intake of birds offered the diet containing duckweed in wet form (slurry) was lower than those offered dry-mash (P1) or dry-mash with fresh duckweed (P3) (P<0.05) (Table 2). Feeding dry-mash form in P1 and P3 might change the eating behavior of the ducks. The eating behavior had an impact on the number of waste feed which was associated with the anatomy of the beak (Adeola, 2006). Tamsil & Indarsih (2003) suggested that feeding pellets or slurry form was beneficial. Forbes (2003) showed that wet feeding for laying hens can improve egg production from 58.6% to 76% and improved feed efficiency from 0.28 to 0.35. The present result was similar to the previous study reported by Tamsil & Indarsih (2003) that egg production of local Lombok ducks was 26.3% to 31.3% in the first 3 mo of egg-laying period. The present result was similar to the previous study reported by Tamsil & Indarsih (2003) that egg production of local Lombok ducks was 26.3% to 31.3% in the first 3 mo of egg-laying period.

Egg Quality

Feeding of diets containing duckweed did not affect egg production and egg weight (P>0.05). However, egg production in this study was quite low (38.7% to 39.7%), whereas normal egg production when ducks were raised in traditional systems ranged from 26.9% to 41.3% (Ketaren, 2007). However, in an intensive rearing system, egg production could reach 55.6%, even Prasetyo & Susanti (2000) reported that egg production of dry system of raising ducks, regardless of genotype, was able to reach 66.75 eggs (73%) in the first 3 mo of laying period. The low egg production in this study was due to the period of data collection was only 2 mo and the egg production would increase in the rest of laying period. The present result was similar to the previous study reported by Tamsil & Indarsih (2003) that egg production of local Lombok ducks was 26.3% to 31.3% in the first 3 mo of egg-laying period.

Table 2. Actual feed intake, egg production, egg weight, and feed conversion of ducks at 8 wk of production period

<table>
<thead>
<tr>
<th>Variables</th>
<th>Dietary treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P1</td>
</tr>
<tr>
<td>Feed intake (g/bird/d)</td>
<td>154.6±4.00a</td>
</tr>
<tr>
<td>Feed conversion</td>
<td>7.65±0.51a</td>
</tr>
<tr>
<td>Egg production (%)</td>
<td>38.7±4.50</td>
</tr>
<tr>
<td>Egg weight (g/egg)</td>
<td>64.6±5.00</td>
</tr>
</tbody>
</table>

Note: P1= diet with 20% dried duckweed was given in the form of dry-mash; P2= diet with 20% dried duckweed was given in the form of a wet (slurry); P3= diet was given in the form of dry-mash and fresh duckweed was offered separately ad libitum. Means in the same row with different superscript differ significantly (P<0.05).
than those observed by Anderson et al. (2011) where inclusion 12.6% duckweed containing 61.360 mg/lb carotenone resulted lower yolk color. Thus, efficacy of duckweed as a natural pigmentation was affected by the level used in the diet and the dietary inclusion of 20% dried duckweed offered reasonable yolk pigmentation. High inclusion was due to low yellowness value of duckweed than the synthetic pigments (Santos-Bocanegra et al., 2004). However, duckweed species is a promising sources of pigments (Chantaritakul et al. 2010).

CONCLUSION

Feeding a diet containing duckweed in wet (slurry) form improved feed conversion ratio. However, feeding ducks allowing to free access of fresh duckweed improved egg yolk color.

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Table 3. Egg characteristics as responses to feeding systems of diets containing duckweed

<table>
<thead>
<tr>
<th>Variables</th>
<th>Dietary treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P1</td>
</tr>
<tr>
<td>Egg shell weight (%)</td>
<td>13.3±2.0</td>
</tr>
<tr>
<td>Egg white weight (%)</td>
<td>50.3±3.7</td>
</tr>
<tr>
<td>Egg yolk weight (%)</td>
<td>34.3±2.2</td>
</tr>
<tr>
<td>Egg shell thickness (mm)</td>
<td>39.0±2.0</td>
</tr>
<tr>
<td>Egg yolk color</td>
<td>12.5±1.5</td>
</tr>
</tbody>
</table>

Note: P1=diet with 20% dried duckweed was given in the form of dry-mash; P2=diets with 20% dried duckweed was given in the form of a wet (slurry); P3= diet was given in the form of dry-mash and fresh duckweed was offered separately ad libitum. Means in the same row with different superscript differ significantly (P<0.05).


