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SHORT COMMUNICATION

Evaluation of the Effects of a Combination of Silicate Minerals in Duck Diets on Growth Performance and Litter Quality

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Abstract

An experiment was conducted to evaluate the efficacy of a mixture of bentonite and illite as feed additives on the growth performance and litter quality of 90 Pekin ducks. The ducks were individually weighed and randomly divided into two treatments (control and 1% combination of silicate minerals), with three replicate pens per treatment, and 15 ducks per pen. Growth performance was not significantly affected ($p>0.05$) by the combination of bentonite and illite, but a trend of increased growth performance was observed in the control groups. Total nitrogen content and pH in the litter decreased following supplementation with the combination of bentonite and illite ($p<0.05$) when compared with the control group. This data indicates that the dietary supplementation with the combination of bentonite and illite (1% level) has no positive effect on the growth performance and litter quality of Pekin ducks.

Key words : Growth performance, Litter quality, Combination of bentonite and illite, Duck

1. Introduction

During the last 50 years, many efforts have been made to decrease the cost of poultry production and increase feed efficiency (Louw et al., 2013). One strategy has been the use of feed additives such as silicate minerals (kaolin, bentonite, peat, zeolite, and illite), which may increase poultry growth or the nutritional value of feed. Several studies have reported that silicate minerals can be used effectively as feed additives in poultry (Pasha et al., 2007; Safaei et al., 2014) or for improving litter quality (Safaeikatouli et al., 2014). Silicate minerals have adsorbent capabilities, including high cation exchange, which can be effective in improving poultry performance (Safaeikatouli et al., 2010).

As mentioned above, it is possible that adding a combination of silicate minerals to duck diets would have positive effects on growth performance and litter quality. However, research on the combination of silicate minerals (bentonite and illite) on growth performance and litter quality in ducks is limited. Thus, the objective of this study was to evaluate the efficacy of a mixture of bentonite and illite as feed additives for improving the growth performance and litter quality in ducks.

2. Materials and Methods

2.1. Experimental design

The animal care and study protocols were approved by the Animal Care Guidelines of Animal

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Table 1. Growth performance in ducks fed diets with a 1% combination of silicate minerals after 38 days

Treatment[1]	Initial body weight (at 7 d, g)	Final body weight (at 38d, g)	Weight gain (from 7 – 38 d, g)	Feed intake (from 7 – 38 d, g)	Feed conversion ratio
Control	160.67±2.33[2]	3,079.67±31.14	2,919.00±29.07	5,282.67±31.86	1.81±0.02
T1	155.67±1.56	3,012.33±13.34	2,856.67±16.37	5,236.33±42.02	1.83±0.01
Significance	NS[3]	NS	NS	NS	NS

[1]Control: basal diets; T1: basal diets + 1% combination of silicate minerals.
[2]Means ± SE (standard error).
[3]NS: not significant.

Policy at Gilhong Farm (Geochang, South Korea). Ninety 0-day-old Pekin ducks (45 male and 45 female) were obtained from a commercial hatchery and fed a pre-starter diet (21% crude protein, [CP]) for a 7-day brooding period. At 7 days old, the ducks were individually weighed and randomly divided into two treatments groups; the control group, fed with the basal diet and test group, fed with a 1% combination of silicate minerals (T1).There were three replicate pens per treatment and 15 ducks per pen. Birds were fed a starter pellet diet (21% CP, 0.40% Ca, and 1.50% P) from days 7 - 21, and a finisher pellet diet (17% CP, 0.40% Ca, and 1.0% P) from days 22 - 38. All ducks were housed in a room that was temperature and ventilation controlled. Feed and water were freely available. The growth performance and feed intake were recorded weekly and body weight was measured on days 7 and 38. The feed conversion ratio was calculated as the ratio of feed intake to weight gain. Each pen was covered with a mixture of rice hulls and duck manure of 10 cm depth.

2.2. Litter quality

At the end of the experimental period (38 days), duck litter samples were collected at four random sites from each pen. The litter samples from each pen were mixed immediately. Then, 100 g of each sample was taken for pH and Total Nitrogen (TN) testing. All samples were stored in plastic bags in a refrigerator. For litter pH, 20 g of litter samples was extracted and mixed with 200 mL of deionized water in a 250 mL polycarbonate centrifuge tube for 2 h using a mechanical shaker (Moore et al., 1995). The TN was measured using the Kjeldahl distillation method (AOAC, 1990).

2.3. Statistical Analysis

All data were analyzed by ANOVA using SAS (SAS Institute Inc., 2002). The pen was used as the experimental unit, and treatment means were compared using a *t*-test at a probability level of less than 0.05.

3. Results and Discussion

The results on the growth performance of duck diets with 1% combination of silicate minerals after 38 days are presented in Table 1. Initial body weight, final body weight, weight gain, feed intake, and feed conversion ratio were not significantly affected ($p>0.05$) by the combination of bentonite and illite, but growth performance tended to increase in the control groups. There are reports in the literature of the effects of a natural mixture of illite, montmorillonite, and kaolinite (MIMK) on the growth performance of broilers (EFSA FEEDAP Panel, 2016). For example, the feed-to-gain ratio of control groups (1.43) was higher than that of MIMK-

Table 2. Litter quality in ducks fed diets with a 1% combination of silicate minerals

Treatment[1]	pH	Total nitrogen
Control	8.19±0.33[2]	1.40±0.18
T1	8.22±0.05	1.33±0.04
Significance	*	*

[1]Control: basal diets; T1: basal diets + 1% combination of silicate minerals.
[2]Means ± SE (standard error).
[3]NS: not significant.
*$p<0.05$.

treated groups, by 2% (1.47) and 5% (1.48) (EFSA FEEDAP Panel, 2016). In contrast, several researchers reported that the supplementation of silicate minerals (clinoptilolite and attapulgite) to poultry and pig diets resulted in improved growth performances (Ly et al., 2007; Zhang et al., 2013). According to Zhou et al. (2014), the inclusion of a combination of zeolite and attapulgite has some benefits for broilers that could partially improve growth performance (by increasing body weight gain and feed intake). These different results may be associated with the type, purity, particle, and level of silicate minerals used in animal diets (Zhou et al., 2014). At present, the reason why a combination of silicate minerals did not affect the growth performance in ducks is unknown.

Table 2 shows the litter quality in ducks fed a diet supplemented with 1% combination of silicate minerals after 38 days. The TN content and pH were slightly decreased with supplementation of a combination of bentonite and illite ($p<0.05$) compared to those in the control groups. These findings disagree with the results of Safaeikatouli et al. (2014), who showed that using kaolin and zeolite increased the TN in the litter. The same study showed no significant difference in pH between the control and kaolin and zeolite-treated litter. In general, increasing the nitrogen content in poultry litter or houses can cause increased NH_3 levels, which can lead to decreased poultry production. Silicate minerals with cation-exchange capacity can absorb NH^{4+} ions due to their hydration properties (Slamova et al., 2011). In our study, the decrease in total nitrogen in duck litter may have resulted in a higher litter pH due to the basic nature of the combination of bentonite and illite.

4. Conclusion

In conclusion, the results of this study indicate that duck diets with a 1% combination of silicate minerals did not result in an improvement in the growth performance or litter quality of ducks. However, the reason why this combination of silicate minerals did not affect the growth performance and litter quality in ducks is unknown.

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