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HIGH FIBER DIET AS MOLT INDUCERS FOR COMMERCIAL LAYERS UNDER DEEP LITTER SYSTEM IN BHUTAN

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ABSTRACT: A study was conducted with the objective to evaluate the effects of high fiber diets as molt inducers on production performance of 72 weeks old Hyline Brown layers under deep litter system. The four treatment diets were layer ration, cracked yellow maize, whole oat grain and tapioca. A total of 108 hens were randomly assigned to four treatments. Each treatment was replicated three times and each treatment was allotted nine hens. High fiber diets (maize, oat, tapioca) were fed *ad libitum* with 8 hours of light during molting period of two weeks. After molting period, birds were then fed with layer diet *ad libitum* for next two weeks (recovery period), except for non-molted. The parameters measured were live body weight, egg production and mortality. A significant body weight loss was observed in tapioca molt group, followed by oat and maize. A complete egg cessation in tapioca and oat molt group was recorded on day 13. On day 5 and 7 post molt period, the birds in oat and tapioca molt group restarted laying egg, respectively. Hen day egg production was slightly higher for birds fed with maize than those hens fed with oat. On the other hand, egg production from tapioca fed birds was close to non-molted hens. The lowest hen mortality was in oat diet group, compared to other treatments. The study recommends the use of oat grain as molt inducer.

Keywords: Egg production; feed; high fiber diet; layer; molting; poultry.

1. INTRODUCTION

Poultry farming has gained momentum in Bhutan over the recent years. Bhutan is self-sufficient in eggs (DoL 2014). However, poultry farmers are reluctant to cull spent hens because of social stigma and religious sentiment. Rearing old hens despite low production incurs loss to poultry farmers, which may eventually discourage farmers from rearing poultry. Although, poultry farming is a success, there is an issue of spent layers being retained, causing extra burden to poultry farmers. One promising solution to addressing the issue is molting. Molting is a periodic shedding and replacement of plumage, decrease in reproductive function and re-laying of egg. Since 1930s, induced molting has been exploited in layer farms to maximize profits (Gongruttananun et al. 2013; Bland et al. 2014). In US, a poultry farmer who practice induced molting has been reported to make at least 30% higher profit than purchasing pullets (Bell 2003).

Traditionally, the total feed withdrawal or restriction is a popular practice because it is simple, less expensive and has a satisfactory post-molt

performance (Santos et al. 2014). However, this method involves fasting and results in serious welfare issues as the birds are exposed to physical stress (Bland et al. 2014; Santos et al. 2014). In addition, the complete feed withdrawal method empties the gastrointestinal tract, which leads to *Salmonella enteritidis* infection in birds (Ricke et al. 2013). Alternatively, the use of high fiber diets was found successful in inducing molting in old layers (Gongruttananun et al. 2013; Santos et al. 2014; Bland et al. 2014) and prevent *Salmonella enteritidis* colonization (Ricke et al. 2013). Although, such alternatives are available, no research has been conducted in Bhutan to assess the effectiveness of locally available fiber diets to initiate molt. Therefore, the objective of this study was to evaluate the fiber diets as viable molt inducers in poultry farms in Bhutan.

1. MATERIALS AND METHOD

2.1 Rearing conditions

Animal care protocols and experimental procedures in this feeding trial were approved by the Research Committee, College of Natural Resources, Royal University of Bhutan, on 4th September, 2015. Birds were reared as per FAO standard of feed and space requirement for layers (1 m^2 for 5 hens). Tungsten bulbs (100-volt) were installed in the shed to meet photoperiod of birds from day old chicks till culled (Hyline International 2014).

Commercial complete rations based on age were provided to birds (Table 1). Clean and fresh water was made available to birds at all times. Birds were vaccinated against Marek's disease before the trial, Infectious Bursal disease on day 21 and 30, and Newcastle disease on day 56 and 112. Moreover, disinfectant dip was placed in front of the shed.

2.2 Experimental design and molting program

Seventy-two weeks old Hyline Brown birds were procured and reared under deep litter system at the poultry farm of College of Natural Resources. The molting trial commenced for 140 days from February to June 2016, including 14 days of induced molting. A total of 108 spent layers were leg-tagged and randomly assigned to four treatment diets. The first treatment was layer ration 27 as control, second treatment was cracked yellow maize 27, third treatment was whole oat grain 27, and the fourth treatment was tapioca 27. Each treatment was replicated three times. Birds were housed in the same shed but were partitioned with off-planks and bamboos. The shed was divided into 12 compartments. The size of each compartment was 250 cm long, 100 cm high and 180 cm wide, to accommodate nine birds per compartment. Feeders and drinkers were placed inside the compartments.

Table 1: Types of ration and nutrient content.

Ration	Crude Protein (CP) (%)	K cal kg^{-1}	Ca (%)
Starter	19.0	2,800	1
Grower	18.0	2,800	1
Layer	16.5	2,750	4

All three molt diets (maize, oats and tapioca) are commonly grown by the Bhutanese farmers. The diets were purchased from farmers. The fresh tapioca tubers were peeled and chopped into fine cubic particles, which were then sun-dried on clean and dry concrete floor for 3-4 days. Maize was cracked by milling machine. The molt diets were analyzed for their basic nutrient content (Table 2). Neither vitamins nor minerals were provided to the birds.

Molting program was executed as per procedure of Gongruttananun et al. (2013) and Bland et al. (2014). We did not use feed additive. Non-molted birds were fed 120 g of layer ration and water *ad libitum* and the lighting program of 16 hrs of light per day was ensured throughout the experiment. High fiber diets and water were provided *ad libitum* for 14 days, which was the molting period. To regulate targeted 8 hrs of photoperiod during molting period, 9 compartments were covered with cartons and opaque tarpaulins. We aimed to achieve complete egg cessation within 14 days of induced molting period (Gongruttananun et al. 2013; Bland et al. 2014). After cessation of egg production, hens were fed with layer ration *ad libitum* for first two weeks, and 120 g per bird per day were offered on consecutive days. Lighting hours was increased by 30 mins in the first week, and then increased at the rate of one hour per week until 16 hrs photoperiod was attained.

2.3 Data Collection

To estimate the body weight loss, the hens were weighed at the beginning and at the end of the molting period on 14th day, using electronic weighing machine. Birds were weighed weekly for each treatment. Daily feed intake by bird was recorded to estimate egg feed ratio for each treatment. The egg feed ratio was calculated with the following formula.

$$Egg\ feed\ ratio = \frac{Price\ obtained\ from\ eggs}{Cost\ of\ feeding\ hens}$$

Table 2: Nutrient content of different molt diets.

Molt diet	Dry matter (%)	Ash (%)	ODM (%)	Crude protein (%)	Crude fat (%)	Crude fiber (%)
Tapioca	87.80	1.86	98.14	3.86	9.1	15.63
Maize	87.34	1.08	98.92	6.81	9.97	7.95
Oat	89.17	3.21	96.79	12.56	14.3	22.35

Egg production and mortality were recorded daily during molt and post-molt period. Prior to induced molting, egg production was recorded for two weeks to confirm pre-trial uniformity among different treatment diets. Egg production cessation and day of re-laying were also recorded. Hen day egg production was estimated weekly with the following formula.

$$Hen\ day\ egg\ production = \frac{Total\ egg\ laid\ in\ a\ day}{Total\ number\ of\ hens\ present\ that\ day} \text{x}100$$

2.4 Data Analysis

Dataset was tested for normality prior to analysis. One-way ANOVA was used to test differences in measured parameters between treatment diets. Treatment diet was an independent variable. The dependent variables were body weight loss, post-molt live body weight, feed intake, hen day egg production and egg weight. Differences between treatment diets were considered significant when p values were less than 0.05. The entire dataset was analyzed with SPSS version 23.

2. RESULTS AND DISCUSSION

3.1 Live body weight

The effect of different high fiber diets on the birds' live body weights is presented in Figure 1. The average body weight loss was higher for birds fed with tapioca, followed by oat. The live body weights of hens fed with tapioca and oat in our feeding trial were close to 1573.2 g of body weight of birds fed with tapioca in Thailand (Gongruttananun et al. 2013). From our results, tapioca and oat may effectively be used to induce molting because birds weighed within the recommended range of 1470g–1570g after complete cessation of egg production (Hyline International 2014). The higher body weight loss of birds fed with tapioca and oat might be attributed to poor palatability as they have high fiber content compared to maize. However, it is important to further estimate the hen day egg production and egg feed price ratio to confirm the claims made using live body weight information.

3.2 Egg cessation and relaying

The day hens stopped laying egg and the day hens started relaying egg after cessation for each treatment diet are shown in Table 3. The lowest average body weight loss was observed in non-molted group at the end of the molting period. Birds fed with oat and tapioca diet lost significant body weight compared to maize and layer diet groups, which is similar to the finding of Gongruttananun et al. (2013). Birds fed with maize diet did not stop laying egg, which is similar to the finding of Gongruttananun et al. (2013). Birds receiving tapioca diet stopped laying eggs on the 10th day of feeding, while birds fed with oat stopped on 12th day. On 13th day, all birds fed with tapioca and oat stopped laying.

At post-molt, all birds were fed *ad libitum* with layer diet for two weeks. The birds receiving tapioca diet consumed the highest layer feed per day, followed by birds fed with oat. In the second week, oat and tapioca group continued to consume comparatively higher layer feed than non-molted and maize group. The greater post-molt feed consumption might be due to high body weight loss during the molting period. Tapioca feed assigned birds lost higher body weight than those fed with oat.

After molting, the hens in oat diet group restarted laying eggs on 5th day and hens in tapioca diet group

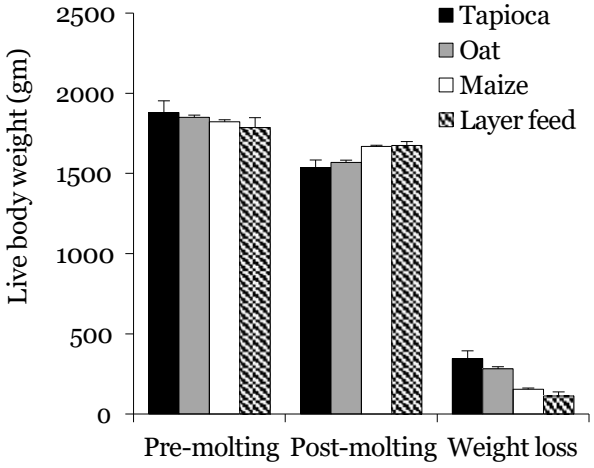

Figure 1: Pre- and post-molting live body weights of hens fed with different diets.

on 7th day. Egg cessation in our study was slower than the one reported by Aygun and Yetisir (2013) and Gongruttananun et al. (2013). This could be due to slow body weight loss during molting period (Hyline International 2014).

3.3 Egg production

The hen day egg production was used as an indicator of production performance of different molt diet groups. Egg production from birds fed with high fiber diets declined drastically in the second week of molting (Table 4). The average hen day egg production is lower than the egg production of birds reported by Gongruttananun et al. (2013). On the other hand, the average hen day egg production in tapioca diet group was higher than that reported by Gongruttananun et al. (2013).

Towards the end of post-molt period, diet treatments did not differ significantly among each other in mean hen day egg production. The highest hen day egg production was in birds fed with maize, followed by oat diet group, tapioca diet group and layer feed group. The egg production of birds fed with tapioca and oat increased during post-molt period (Figure 2). Hens fed with oat ration laid slightly more eggs than tapioca group. This could be explained by the adequate recovery feeding duration (Hassanien 2011) and thus, it suggests the importance of adjusting feeding regime based on molt diets.

3.4 Mortality

The mortality among treatments was not significantly different (Figure 2). During molting

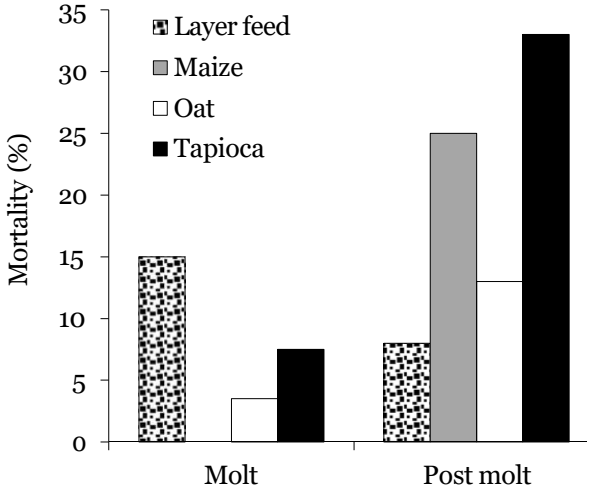

Figure 2: Mortality during molting and post-molting period.

Table 3: Body weight loss, feed intake per bird per day and egg cessation (mean±standard error). Means with different letters within columns differ significantly ($p \leq 0.05$).

Treatment	Body weight loss (%)	Day when egg laying ceased	Intake of layer ration after cessation of egg laying		Day when egg laying restarted
			Week 1	Week 2	
Layer feed	6.15±2.22 b	Did not cease	120.00±6.20 a	120.00±9.19 a	-
Maize	8.44±1.09 b	Did not cease	114.74±6.19 a	114.66±8.82 a	-
Oat	15.17±0.74 a	12	140.21±3.22 b	132.22±8.64 ab	5
Tapioca	18.32±0.99 a	10	145.74±1.20 b	136.53±1.15 b	7

Table 4: Hen day egg production for each treatment (mean±standard error).

	Treatment				
	Non-molted	Maize	Oat	Tapioca	p value
Molting period					
Week 1	56.0±4.0 a	35.0±7.0 ab	18.0±8.0 b	40.0±10.0 ab	**
Week 2	50.0±5.0 a	4.00±2.0 b	3.00±2.0 b	3.00±2.0 b	***
Post-molt period					
Week 1 - 4	48.0±2.0 b	36.0±2.0 b	61.0±2.0 a	32.0±3.0 b	***
Week 5 - 8	63.0±2.0	62.0±2.0	62.0±2.0	57.0±1.0	ns
Week 9 - 12	62.0±2.0 b	78.0±2.0 a	74.0±1.0 a	63.0±2.0 b	***
Week 13 - 16	60.0±2.0 c	79.0±2.0 a	67.0±1.0 b	71.0±1.0 b	***
Week 17 -19	43.0±2.0 b	71.0±4.0 a	63.0±3.0 a	58.0±6.0 ab	***
Average	56.0±2.0	65.0±4.0	62±4.0	57.0±4.0	ns

**$p \leq 0.01$, ***$p \leq 0.001$, ns-nonsignificant

period, the mortality was higher for non-molted bird, followed by those fed with tapioca and oats. There was no mortality in maize-fed birds. Mortality of birds in our study is similar to the findings of Gongruttananun et al. (2013). Pecking amongst the birds appears to be the main cause of mortality in our study. In the post molt period, the highest mortality was recorded for birds in tapioca diet group, followed by maize and oat. The lowest mortality was found for birds in non-molt group.

3. CONCLUSION

The study findings show that oat can be effectively used as molting inducer. Although, hens fed with oat diet laid less number of egg, as compared to maize, the post-molt mortality was lowest. The study recommends inducing molting at younger age (less than 72 weeks of age) in order to achieve higher egg production.

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