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Research Article
Growth Performance of Pekin Ducks under Full Confinement System Fed Diets with Various Nutrient Concentrations

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Abstract

Background and Objective: There is enormous scope of meat type duck farming but limited feeding and management guidelines hampering to harvest the potentiality. Therefore, the current study was carried out to evaluate the growth performance of meat type Pekin ducks reared in complete confinement system for 56 days by feeding diets of various nutrient concentrations. **Materials and Methods:** To achieve the goal, a total of 272 day old ducklings of mixed sex were used. Four different experimental diets were considered as treatment groups having four replications/treatment and 17 ducklings in each replicate group. The diets were formulated using locally available feed ingredients. **Results:** Highly significant differences ($p<0.0001$) were found in final body weight, weight gain, feed intake and FCR of Pekin ducks fed various levels of metabolizable energy (ME) and crude protein (CP). Best results were observed in feeding high ME-low CP diet followed by low ME-high CP diet group than that of both increased ME and CP level in the diets. However, dressing percentage and survivability were found non-significant ($p>0.05$). **Conclusion:** Therefore, it can be concluded that diet containing high ME-low CP can be used for optimum growth performance of meat type duck (Pekin) under intensive rearing system.

Key words: Growth performance, pekin duck, intensive system, management guidelines, nutrient concentrations

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Duck meat, an important source of animal protein in human diet, has gaining momentum as food items in modern life. Duck population in the country has been reported to be 55.85 million[1]. The total area of inland water bodies in Bangladesh is estimated to be around[2] 6.7 million ha which may provide a congenial environment for duck production. Despite enormous advantages of duck farming[3] compared to chicken in the country, this species has always been neglected. Many poultry development activities have done concentrating chicken species but little attention has been given on improving feeding guideline of ducks in a well-planned way for its commercial production. Most of the farmers usually rear indigenous non-descriptive type of ducks, popularly known as Desi Black and Desi White while few exotic breeds like Pekin, Indian Runner, Jinding and Khaki Campbell are also common in the country. Ducks are mainly reared for egg production purpose by the poor village people in coastal belts and low-lying areas under scavenging system with little or no supplemental diets[4]. But, improved feeding system of ducks was suggested by Huque *et al.*[5] to achieve optimum production. However, Pervin *et al.*[6] conducting an experiment up to 18 weeks at household farming condition in the coastal region of Bangladesh under scavenging system suggested medium nutrient density (MND) diet for optimum growth performance of indigenous (desi) ducks. They supplemented half of the total daily requirement of feed to indigenous (desi) ducks basically to improve feeding practices under existing management system. But, this indigenous duck species are not suitable for meat production purpose due to its slower growth rate[7]. Besides, meat duck farming for optimum production within short rearing duration under full confinement or intensive system yet to start in the country. Although fully intensive confinement rearing system for ducks, similar to that used for chickens is very common in the USA and many European countries[8]. In developed countries, however, there are genetically fast growing highly potential heavy meat type ducks species. Pekin duck is one of the potential well known ducks and they have been genetically enhanced to obtain a higher meat yield and lower rate of carcass fat deposition[9-11]. Therefore, researchers developed feeding guidelines accordingly. But, in most of the developing countries, heavy duck breeds are not available. Even the performance is not up to the mark if found available due to purity of breeds, environment, management practice and other unavoidable reasons. Besides, there are limitations of proper feeding and management guidelines for existing or available moderate growing duck species to produce meat under intensive system. White Pekin ducks are available in Bangladesh and this variety is genetically superior for weight gain compared to indigenous (desi) ducks and therefore considered for meat production[12]. Considering the above facts, the present study was therefore designed to investigate the growth performance of meat type Pekin ducks under full confinement system fed diet with various nutrient concentrations.

MATERIALS AND METHODS

Study site: The present research was conducted at Bangladesh Agricultural University (BAU) Poultry Farm during March and April in 2014 for a period of 56 days.

Bird collection and distribution: A total of 272 day old ducklings of meat type Pekin ducks were collected from the government duck breeding station-Regional Duck Breeding Farm, Feni. After equalizing body weight, ducklings were randomly distributed equally in four treatment groups having four replications in each (17 ducklings per replication).

House preparation and brooding management: Four rooms in open sided house were used in the study. Before staring the experiment, all rooms were properly washed and cleaned by using tap water. Ceiling, walls and floor were thoroughly cleaned with Timsen (n-alkyl dimethyl benzyl ammonium chloride and urea; 1 g L^{-1}). After proper drying, each room of the house was divided into 4 separate pens to make a total of 16 equal size pens by using wire net and bamboo materials. Each pen was 9.5ft×5.5ft and was allotted for 17 birds. Therefore, floor space for each duck was 3.0 ft^2. Separate brooding was done up to 21 days. Then, brooding materials were removed and fresh and well dried sand with one and half inch depth was placed over the floor as litter material.

Ration formulation and management practices: According to the study plan, four separate mash feeds were formulated using locally available feed ingredients (Table 1) and provided to the respective diet group. The birds were provided with identical care and management in all treatment groups throughout the experimental period. Adequate number of feeders and waterers were provided according to age of the birds and these were thoroughly washed and cleaned twice daily. The birds were fed *ad-libitum* basis while fresh water was made available at all the times. Litter was stirred to break its compactness and maintain moisture in a regular interval of thrice a week and replaced by fresh and well dried sand when

necessary. The birds were always exposed to natural lighting in day time. During night time, adequate electric bulbs were used to provide necessary light. Temperature and relative humidity were recorded thrice in a day using automatic hygro-thermometer (Model AR 867, Taiwan). All the birds were vaccinated with Duck Plague and Duck Cholera vaccines as per recommendation of the vaccine manufacturers (Livestock Research Institute, Bangladesh). Measurement of parameters: Several weekly records on related parameters were kept up to 56 days of age described by many researchers[7,13]. Initial individual body weight of duckling was recorded before distribution of the birds to specific pens and thereafter body weight and feed intake measurements were determined at weekly intervals before morning feeding. Body weight gain was calculated as the difference between the final and initial bird weight during each of the weighing periods. Feed intake was calculated as the difference between the amount of feed supplied to the birds and the amount of feed that remained at the end of each feeding period. Feed conversion ratio (FCR) was calculated as the ratio between feed intake and body weight gain for each period. At the end of the experiment, three birds from each replication were slaughtered applying Halal method[14] to observe carcass yield. Dressing percentage was calculated through dividing the carcass weight (without viscera) by live body weight.

Table 1: Composition of the experimental diets

	Amount (kg) in 100 kg mixed feed			
Ingredients	Diet-1	Diet-2	Diet-3	Diet-4
Maize (%)	45.60	40.00	47.00	50.00
Rice polish (%)	19.18	19.48	19.48	18.00
Soybean meal (%)	22.50	25.00	22.00	20.50
Protein concentrate (%)	8.30	8.50	8.50	6.25
Wheat bran (%)	2.40	5.00	1.00	3.23
Methionine (%)	0.15	0.15	0.15	0.15
Lysine (%)	0.05	0.05	0.05	0.05
Oil (%)	0.10	0.10	0.10	0.10
DCP (%)	0.75	0.75	0.75	0.75
Limestone (%)	0.35	0.35	0.35	0.35
Grower premix (%)	0.25	0.25	0.25	0.25
Common salt (%)	0.37	0.37	0.37	0.37
Total	100.00	100.00	100.00	100.00
Nutrients	Calculated composition			
Metabolizable energy (kcal kg^{-1})	2900.00	2800.00	2950.00	2900.00
Crude protein (%)	22.00	23.00	22.00	20.00
Calcium (%)	0.65	1.20	0.85	1.20
Available phosphorus (%)	0.40	0.50	0.40	0.45
Lysine (%)	0.90	1.20	1.15	1.15
Methionine (%)	0.30	0.50	0.48	0.45

Each 2.5 kg Grower premix contains: Vitamin A: 12000000 IU, Vitamin D: 2000000 IU, Vitamin E: 16 g, Vitamin K3: 2 g, Vitamin B1: 1 g, Vitamin B2: 4 g, Vitamin B6: 3 g, Vitamin B12: 10 mg, Nicotinic acid: 25 g, Calcium-d pantothenate: 12 g, Folic acid: 500 mg, Biotin: 50 mg, Cobalt: 250 mg, Copper: 8 g, Iron: 32 g, Iodine: 500 mg, Manganese: 50 g, Zinc: 40 g, Selenium: 150 mg, DL-methionine: 50 g, L-lysine: 30 g and Calcium: 773.65 g

Statistical analysis: The recorded data were analyzed for the completely randomized design (CRD) using open source R software[15]. The *post-hoc* test among the significant observations were done using Tukey's honestly significance difference (Tukey's HSD) test[16] on R.

RESULTS

Body weight and weight gain: At the end of the experiment, highly significant differences ($p<0.0001$) were found in body weight and weight gain of Pekin ducks (Table 2) in four dietary treatment groups fed diets with various level of ME and CP. According to the present study results, higher body weight was found in the diet groups with high ME-low CP (Diet-4) followed by low ME-high CP (Diet-2) treatment group.

While comparing weight gain, the present study results indicated (Fig. 1) fluctuating pattern especially after 4 weeks of age in all four diet groups. Better weekly weight gain was recorded in Diet-4 treatment group.

Feed intake: Feed intake pattern of Pekin ducks under this study was presented in Table 2. The present study revealed significantly ($p<0.0001$) lowest feed intake in high ME-low CP (Diet-4) treatment group while highest feed intakes were observed in Diet-1 and Diet-3 groups containing both increased ME and CP level.

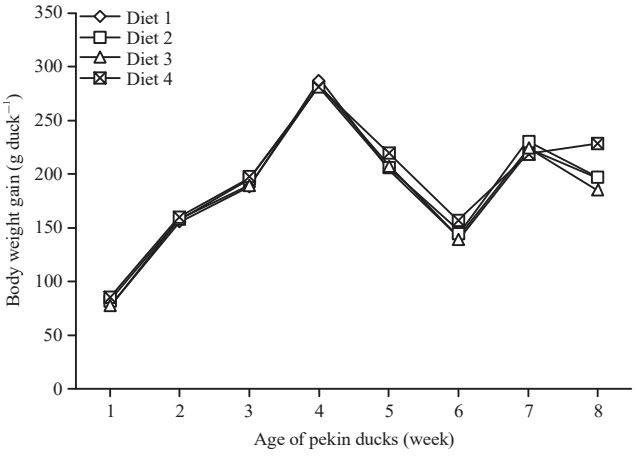

Fig. 1: Weekly body weight gain (g duck^{-1}) at different ages of Pekin ducks receiving different dietary treatments

Diet-1contains 22% CP and 2900 Kcal ME kg^{-1}, Diet-2 contains 23% CP and 2800 Kcal ME kg^{-1}, Diet-3 contains 22% CP and 2950 Kcal ME kg^{-1} and Diet-4 contains 20% CP and 2900 Kcal ME kg^{-1}

Table 2: Growth performance of pekin ducks fed diets with different nutrient concentrations

Parameters	Diet-1	Diet-2	Diet-3	Diet-4	SEM	p value	Level of significance
Initial body wight (g birds^{-1})	45.50	45.27	45.07	45.17	0.13	0.737	NS
Final body weight (g birds^{-1})	1530.91^{c}	1546.35^{b}	1518.62^{d}	1595.13^{a}	7.57	0.0001	***
Body weight gain at 8 weeks (g birds^{-1})	1485.41^{c}	1501.08^{b}	1473.55^{d}	1549.96^{a}	7.57	0.0001	***
Total feed intake (g birds^{-1})	4967.76^{a}	4947.05^{b}	4972.06^{a}	4909.62^{c}	6.39	0.0001	***
FCR	3.34^{b}	3.29^{c}	3.37^{a}	3.16^{d}	0.20	0.0001	***
Survivability (%)	100.00	100.00	100.00	100.00	0.00	1.00	NS
Dressing (%)	64.50	64.60	64.47	64.85	0.11	0.709	NS

***Means p<0.0001, NS: Not significant p>0.05, Value indicates mean of observations, SEM indicates standard error of means, ^{abc}means with dissimilar superscripts are significantly different (p<0.0001), Diet-1: 22% CP and 2900 Kcal ME kg^{-1}), Diet-2: 23% CP and 2800 Kcal ME kg^{-1}, Diet-3: 22% CP and 2950 Kcal ME kg^{-1}, Diet-4: 20% CP and 2900 Kcal ME kg^{-1}

Feed conversion ratio (FCR): The FCR of Pekin ducks under this study was presented in Table 2. The current research work found significantly best (p<0.0001) FCR in Diet-4 treatment containing high ME and low CP while poorest result was observed in both increased ME and CP containing dietary group. Higher FCR value was also observed in low ME-high CP treatment group in the present study.

Dressing percentage: As shown in Table 2, the present study found non- significant differences (p>0.05) in case of dressing percentage of Pekin ducks provide varying levels of ME and CP for a period of 56 days under full confinement or intensive system, although significant variations were found in other considered parameters.

Survivability: The present study found non-significant (p>0.05) results (Table 2) regarding survivability of Pekin ducks under full confinement system of rearing for a period of 8 weeks fed diet with various levels of ME and CP.

DISCUSSION

In the present study, body weight and weight gain of Pekin ducks were improved significantly with the increased level of dietary energy (ME) and lowering the CP in the diet. Findings of Fan *et al.*[17] supported the present study result who reported that increasing ME level for higher growth performance of Pekin ducks. Rearing Pekin ducks for 8 weeks under intensive system, Azahan and Mokhtar[8] also found higher body weight fed a diet containing high ME (2940 Kcal kg^{-1} ME from 0-3 weeks and 2983 Kcal kg^{-1} ME from 4-8 weeks). In addition, Wickramasuriya *et al.*[18] suggested increasing energy level to maximize productive performance of white Pekin ducks. Similar type of finding was reported by some other research groups[19,20]. Again, low CP level had significant influence on growth[8,20] which coincided the current result but disagreed by some scienetists[19,21]. On the other hand, some previous works[6,22] on native duck species had suggested improved body weight and weight gain by increasing both ME and CP levels in the diet. But, these were differed with the present study results. In contrast, Niu *et al.*[23] and some other researchers[24,25] observed that varying ME and CP level in broiler ducks had no significant effect on live body weight and weight gain. Besides, fluctuating weekly weight gain pattern was observed in the present study but many researchers[17,26-30] stated that weight gain of Pekin ducks at varying stages of life had improved while receiving various levels of ME and CP. These previous statements mismatched with the current study results.

Nevertheless, irrespective of statistical differences, most of the previous studies with little exceptions[12,21] found higher numeric value of live body weight and weight gain than that of the present study for varying levels of ME and CP in the diets. These might be due to the compensatory growth of relatively lower genetically potential Pekin ducks available in the country, influence of environment, feeding and management differences during the study.

The present study results indicated greater feed intake by meat type Pekin ducks in increased energy combined with low protein containing diet group than both increased levels of the two major contents of diet. Moderate intake was noticed in low energy-high protein group. The current findings were agreed by many research groups[17,31,32] who stated that feed intake of Pekin ducks decreased significantly (p<0.05) as dietary energy increased while some other scientists[18,33,34] reported the opposite results. They suggested when the ME level increased, daily feed intake was significantly decreased in a non-linear manner. Birds fed high CP containing diet had significantly higher feed consumption, reported by Suliaman *et al.*[35] that supported the present findings although Awad *et al.*[22] disagreed with it. On the other hand, Pervin *et al.*[6] and Awad *et al.*[22] stated that increasing both ME and CP levels in the diet had significant effect on decreased feed

intake but this was not resembled with the present findings. However, some scientists[19,25] reported that there were no significant differences (p>0.05) in feed intake with increasing ME and CP level in the diet. The variation of present results with previous observations might be due to compensatory growth of Pekin ducks throughout the experimental period where birds satisfied their energy and protein requirements by adjusting feed consumption. In addition, genetic potentiality, rearing and management system and use of diverse feed ingredients in the experimental ration might affect in feed intake of Pekin ducks.

In this study, significantly improved FCR was found in higher energy-low protein containing diet groups than that of opposite and both increased nutrient ratio groups. Azahan and Mokhtar[8] found improved FCR fed a diet with increasing ME to Pekin ducks for 8 weeks under intensive system of rearing. The FCR of ducks significantly improved when the ME level was increased in the experimental diets reported many other previous findings[17,18,32] which supported the current results. Generally, improve FCR of ducks appears due to the improvement in weight gain and the decrease in feed intake by increasing the dietary energy in the feed[22]. Similar supporting results were also reported by many scientists[26-28]. Therefore, live body weight and efficiency in feed utilization of Pekin ducks could be improved by high-energy diets[36], which was confirmed by the present research work. In contrary, the current findings were in disagreement with few researchers as they stated that increasing dietary CP[35,37,38] level and both ME and CP content in the diet[6,22] had significantly improved FCR. However, some findings[25,33,39] reported non-significant variation of FCR who applied reducing CP or varying levels of ME in the diet of Pekin ducks during the study period. The FCR variation experimental ducks with previous works might be due to difference of species, experimental environment, study duration, management and rearing system, growth pattern and genetic potentiality of birds.

Although the current research work found statistically non-significant results, the value of dressing percentages were almost similar to the findings of Azahan and Mokhtar[8] who found 65.3% carcass yield rearing Pekin ducks for eight weeks under intensive system. The numeric values of present study were higher than that of Islam *et al.*[7] who used three egg type duck species including desi or indigenous one available in Bangladesh while some other scientists[22,24,40] reported greater dressing percentage using Pekin ducks for varied duration. These indicated that Peking ducks available in the country had different growth pattern.

Interestingly, zero mortality of Pekin ducks was reported in the present study. Pekin ducks are very hardy and less attacked by diseases, however, Pervin *et al.*[6] and Seet and Yeong[40] reported over 8 and 3% mortality respectively in their study. The present outstanding no mortality case was happened might be due to maintain good and identical management practices, biosecurity, vaccination schedule and also adaptive capability of these duck species under intensive system.

CONCLUSION

Meat type duck farming might be a solution to reach huge protein gap in the coming days with over increasing population load in the country. Therefore, meat type Pekin duck farming under full confinement or intensive system as like as broiler chicken, with high ME-low CP diet (Diet-4) can be a viable solution for optimum meat duck production. Repetition of the study with the diet and measure for cost effectiveness are needed to conduct for sustainable production.

SIGNIFICANCE STATEMENT

The study has demonstrated potentiality of meat type Pekin duck farming under full confinement or intensive system with various levels of nutrient concentration in the diet and found high ME-low CP diet can be beneficial for optimum production. Many previous works used a variety of duck species with different levels of dietary nutrient ratio, also different production systems. This study will help the researchers to uncover the critical areas of meat type duck farming within shortest possible time beyond traditional feeding, management and rearing systems that many researchers yet to explore. The study will also hope to give a lead to the researchers to develop a feeding standard for moderately growing meat type ducks.

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