HEN-DAY EGG PRODUCTION AND EGG QUALITIES OF PHILIPPINE MALLARD DUCK (*Anas platyrhynchos domesticus* L.) WITH VARYING PLUMAGE COLORS

Julie Ross M. Datuin and Veneranda A. Magpantay

ABSTRACT

The study was conducted to determine the egg production performance of Philippine Mallard ducks (PMD) with black, brown, dark brown and light brown plumage colors. A total of 1100 ready-to-lay (22 weeks old) PMD housed in an elevated housing system with ponds were used in the study. There were three replicates for black, brown and dark brown and two replicates for light brown with 100 ready-to-lay ducks per replicate. Egg production and egg quality parameters (egg weight, shell thickness, albumen height and yolk color) were taken and subjected to ANOVA and Least Significant Difference test. Linear contrast analysis was also performed to compare black plumage color and those with shades of brown plumage. Results showed that PMD with black plumage had higher ($P<0.05$) hen-day egg production compared to PMD with shades of brown plumage throughout the experimental period. However, egg weight, albumen height, yolk color and shell thickness were not different ($P>0.05$). This study indicates that PMD with black plumage had better hen-day egg production performance over the brown and its intermediate. Genetic characterization, particularly identification of possible DNA polymorphism among PMD, is recommended.

Key words: egg production, egg quality, Philippine Mallard duck, plumage color

INTRODUCTION

Duck raising in the Philippines is primarily for production of egg that is processed into *balut* or cooked embryonated egg and salted egg. Local duck industry is a PhP5 billion industry and is being controlled by small and medium scale producers (Chang *et al.,* 2003; Varona, 2010). The Philippine mallard duck (*Anas platyrhynchos* Linn.) (PMD), locally known as Pateros duck, is the most predominant species raised. In 2010, the estimated population of ducks for both the commercial and backyard farms in the country is 10.1 million heads (BAS, 2011).

The primary problem of the duck industry at the present is the lack of quality breeding stocks (FAO, 2004). This is because there are no organized duck breeding and selection programs in the Philippines. Whenever there is a surplus of eggs for

Animal and Dairy Sciences Cluster, College of Agriculture, University of the Philippines Los Baños, Laguna, Philippines (email: julierossdatuin@yahoo.com).

balut, producers are hatching the eggs and ducklings are being raised as the replacement stocks. As a consequence, stocks of PMD raised in the country have heterogeneous characteristics caused by indiscriminate breeding practiced by local farmers. Physical appearance such as body conformation and plumage color are very diverse. Plumage color would range from black (Pateros-type) to brown (Khaki-type), with intermediate-type pattern. This variation is hypothesized to be a consequence of their mating with exotic stocks (Lambio, 2010.) Diversity in plumage color could be an indication of the differences in the genetic make-up of the animals in a particular area. Moreover, their production and reproductive performance also vary. The average age at first lay is 20-24 weeks with average egg weight of 65-70 g (Santiago, 2011). Egg production performance ranges from 48-68%. While these data were obtained under different management conditions, it is also hypothesized that these ducks have different genetic make-up (Romjali, 2006).

Despite these glaring differences in appearance and performance, no studies have been conducted on determining and comparing egg production of local ducks with varying plumage colors, hence this study. Results of this study could serve as basis for future endeavors in the conservation of duck genetic resources and in the development of sound breeding program for the PMD.

The objective of this study is to compare the egg production performance of the PMD with varying plumage colors. Specifically, this study determined and compared the daily egg production and egg quality parameters (egg weight, shell thickness, albumen height and yolk color) of the PMD with black, brown, light brown and dark brown plumage colors.

MATERIALS AND METHODS

On farm trial

The on-farm trial was conducted from September 1 to December 9, 2011 at Alcasid's Farm, a cooperator farm, located at Barangay Pansol, Calamba, Laguna. A total of 1100 heads of ready-to-lay PMD (22 weeks old) housed in an elevated housing system with ponds were used. The four plumage colors (*i.e.* black, brown, dark brown and light brown) were used as treatments. These were replicated three times for black, brown and dark brown and two replicates were used in light brown. All experimental units had 100 ready-to-lay ducks.

The ducks were fed twice a day with approximately 125-128 g/duck of duck layer pellets every morning and late afternoon and were also given *kuhol* or snails as an additional feedstuff. Provision of *kuhol* was done once a day with approximately 166 g/duck. Clean and fresh drinking water was also provided *ad libitum.* Proper sanitation in each of the house was maintained.

Data collection

Data gathered include hen-day egg production, egg weight, shell thickness, albumen height, and yolk color. Hen-day egg production was computed as follows:

$$\% \text{ Hen-day egg production} = \frac{\text{Number of eggs produced}}{\text{Number of layers present}} \times 100$$

Three eggs per replicate were obtained and collected on a bi-weekly basis. Eggs collected from the layer ducks were weighed. Eggs collected during the period of the study were properly labeled and evaluated to determine the yolk color, albumen height and shell thickness. Yolk color of each broken egg was determined using the Roche yolk color fan. On the other hand, an egg shell microcaliper was used to measure the tip (small end), middle and butt (large end) portions of each egg shell after the shell membrane has been removed for determination of shell thickness. The albumen height was determined using an albumen height meter. The average of the albumen height of the three eggs was computed. All of these parameters were measured in a bi-weekly basis for three months.

Data analysis

Yolk color scores were transformed using square root function. All the data gathered in the experiment were subjected to analysis of variance (ANOVA) following a completely randomized design (CRD) at P=0.05. Treatment means were compared using Least Significant Difference (LSD) test. Orthogonal linear contrast analysis was also employed to compare the egg production performance and egg qualities of ducks with black plumage color versus the ducks with shades of brown plumage color (*i.e.* brown, dark brown, and light brown).

RESULTS AND DISCUSSION

Egg production

Table 1 shows the average egg production performance of the PMD with different plumage colors. Results showed that there were differences (P<0.05) on the average egg production among plumage colors. PMD with black plumage color

Table 1. Average hen-day egg production of Philippine Mallard ducks with varying plumage colors.

Period of Egg Production, (month)	Treatments[1]					C.V. %
	Black	Brown	Dark Brown	Light Brown	Linear Contrast[2]	
1st	63.97[a]	51.85[ab]	43.38[b]	48.80[ab]	*	8.42
2nd	83.40[a]	77.42[b]	77.60[b]	76.69[b]	*	1.44
3rd	83.96[a]	76.68[b]	77.51[b]	74.76[b]	*	1.44
4th	85.48[a]	74.11[b]	75.98[b]	74.85[b]	*	1.26

Means within row with different superscripts differ (P<0.05).

had the highest (P<0.05) hen-day egg production compared to other plumage colors. This observation was consistent throughout the course of the study.

Results of linear contrast analysis showed similar trend. Hen-day egg production of PMD with black plumage color was better (P<0.05) than ducks with shades of brown plumage color. This shows that PMD with black plumage color is superior in terms of egg production compared to ducks with other plumage colors. It is hypothesized that PMD with black plumage color (*i.e*. Pateros-type) is indigenous in the country. Therefore, they are more adapted to the environmental condition and, thus, able to produce more eggs compared to ducks with other plumage colors.

Egg weight

The average egg weight of PMD with varying plumage colors is shown in Table 2. ANOVA and linear contrast analysis showed that there were no differences (P>0.05) in egg weight throughout the study. This observation did not conform to the study conducted by Saatcu *et al*. (2005) who found that geese' egg weights were significantly affected by feather color. Differences in the results can be attributed to the differences in species, age of the animals used and in the management conditions.

Table 2. Bi-weekly average egg weight (grams) of Philippine Mallard duck with varying plumage colors.

Bi-weekly period	Treatment[1]					C.V. %
	Black	Brown	Dark Brown	Light Brown	Linear Contrast[2]	
1st	67.50	71.67	71.67	71.25	ns	4.99
2nd	72.22	68.89	73.33	70.00	ns	4.27
3rd	76.11	72.22	72.78	72.5	ns	4.07
4th	72.78	74.44	74.45	75.00	ns	2.95
5th	77.22	72.78	73.89	75.00	ns	5.33
6th	78.89	74.44	76.11	75.00	ns	4.68

[1]No significant differences.

The heritability estimate (h^2) for egg weight ranges from 0.51 to 0.53 (Zhang *et al*., 2005), making it highly heritable. This suggests that egg weight can be improved through selection. Therefore, improvement of the egg weight can be achieved by choosing parental stocks with heavy egg weight characteristics.

Albumen height

The average albumen height is presented in Table 3. There was no difference (P>0.05) on the albumen height in all periods among treatments except on the 3rd bi-weekly period where dark brown had higher (P<0.05) albumen height than light brown. Egg albumen height from the group with brown, dark brown and black plumage colors were comparable (P>0.05). These results conformed to the

Table 3. Bi-weekly average egg albumen height of Philippine Mallard duck with varying plumage colors.

Bi-weekly period	Treatment [1]					C.V. %
	Black	Brown	Dark Brown	Light Brown	Linear Contrast[2]	
1st	6.27	6.65	7.33	8.20	ns	14.27
2nd	7.98	7.09	7.46	6.30	ns	14.58
3rd	7.35^{ab}	6.71^{ab}	7.89^{a}	6.35^{b}	ns	9.23
4th	6.53	6.56	5.70	6.39	ns	12.77
5th	6.80	6.46	6.96	6.37	ns	9.94
6th	6.57	5.77	6.77	5.77	ns	11.17

Means within row with different superscripts differ (P<0.05).

results obtained in the study conducted by Yilmaz *et al.* (2011) who found that albumen height is affected by plumage pattern.

However, results of linear contrast analysis showed that there were no differences (P>0.05) in the egg albumen height of mallard ducks with different plumage colors. The observed significant differences during the 3rd bi-weekly period which is also the same as start of the 2nd month of laying can be attributed to the inherent genetic variability in the partitioning of the nutrients prior to the peak of egg production which was the 3rd month of laying.

Heritability estimate (h^2) of albumen height is 0.51 (Zhang *et al*. 2005), which is highly heritable. Therefore, to improve the albumen height of the PMD in the country, selection could be done. The animal's phenotype will be a good indicator of its genetic merit or breeding value. It can also be hypothesized that the light brown plumage color is the admixture caused by indiscriminate breeding practiced by the local farmers.

Egg yolk color

Table 4 presents the average egg yolk color of layer ducks with different plumage colors. Results showed that there were no differences (P>0.05) observed in the egg yolk color of the ducks with different plumage colors except for the 3rd bi-weekly period. Ducks with light brown plumage had the lowest egg yolk score obtained and was different (P<0.05) from that obtained from the ducks with black, brown and dark brown plumage colors. This observation confirms the results observed in the study of Orheruata *et al*. (2006) wherein indigenous breeds have higher yolk color score compared to the exotic breeds. Ducks with black plumage (*i.e.* Pateros-type) are regarded to be the indigenous or native breed in the country.

On the other hand, results from the linear contrast analysis revealed that there were no differences (P>0.05) on egg yolk color score of PMD with varying plumage colors. Yolk color is mainly affected by the diet of the animal specifically the amount of carotenoid present in the feed of the animal.

The period where the significant difference on egg yolk color was observed

Table 4 . Bi-weekly average egg yolk color score of Philippine Mallard duck with varying plumage colors.

Bi-weekly period	Treatment[1]					C.V. %
	Black	Brown	Dark Brown	Light Brown	Linear Contrast[2]	
1st	12	12	13	12	ns	7.60
2nd	13	13	12	13	ns	2.61
3rd	13[a]	13[a]	14[a]	11[b]	ns	2.15
4th	12	12	12	11	ns	5.30
5th	11	12	12	13	ns	6.36
6th	11	11	11	10	ns	6.68

Means within row with different superscripts differ (P<0.05).

coincides with the start of the peak of production of the layer ducks. Therefore, this observation might be due to genetic variability in partitioning of the nutrients in preparation to the peak of egg production of the ducks.

Yolk color was found to be a lowly heritable trait with heritability estimate ($h^{2)}$ ranging from 0.08-0.14 (Deeden, 2005). This suggests that improvement of the yolk color of the PMD will not be dependent on the genotype of the animal but will be greatly affected by different factors like nutrition, production system and management practices to be implemented during the rearing period.

Egg shell thickness

The average egg shell thickness of layer ducks with varying plumage colors is presented in Table 5. Based on the data gathered, there was no significant difference observed in the average shell thickness except for the 2nd bi-weekly period. For the 2nd bi-weekly period, values for egg shell thickness obtained from the layer ducks with black, dark brown and light brown plumage colors are comparable with each other but are different (P<0.05) from the value obtained from the layer ducks with brown plumage color. Value for egg shell thickness obtained from the layer ducks with brown plumage color is lowest among the other treatments. This supports the claim of Orheruata *et al.* (2006) that egg shell thickness is influenced by plumage color.

However, linear contrast analysis revealed that there were no differences (P>0.05) on the egg shell thickness of PMD among plumage colors. The observed significant difference can be also be attributed to the changes on the layer duck's body in preparation for the peak of its egg production. Egg shell thickness is moderately heritable with a heritability estimate ($h^{2)}$ of 0.30 to 0.42 (Cordts *et al*., 2002). This implies that to improve egg shell thickness, interplay of genetics, good environmental conditions and management practices should be implemented.

This study tends to show that egg production performance, particularly the rate of lay (*i.e.* hen-day egg production), differs among ducks of varying plumage colors with black (Pateros-type) showing superiority (P<0.05) compared with the

Table 5. Bi-weekly average shell thickness (mm) of eggs of Philippine Mallard duck with varying plumage colors.

Bi-weekly period	Treatment[1]					C.V. %
	Black	Brown	Dark Brown	Light Brown	Linear Contrast[2]	
1st	0.58	0.59	0.58	0.59	ns	7.69
2nd	0.50[a]	0.45[b]	0.50[a]	0.52[a]	ns	2.94
3rd	0.57	0.57	0.59	0.56	ns	4.20
4th	0.55	0.56	0.56	0.55	ns	3.57
5th	0.54	0.53	0.56	0.53	ns	2.45
6th	0.54	0.56	0.55	0.53	ns	3.71

Means within row with different superscripts differ (P<0.05).

brown (Khaki-type) and its intermediate. However, egg quality characteristics of PMD showed no differences (P>0.05). The results of this study could be a basis for future endeavors on the conservation and improvement of the PMD in the Philippines. Further studies on genetic characterization, particularly the identification of possible DNA polymorphism in PMD with varying plumage colors, are strongly suggested to support these findings.

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