LAYING PERFORMANCE AND EGG QUALITY TRAITS OF ITIK PINAS (IP)-KAYUMANGGI (*Anas platyrhynchos*) UNDER INTENSIVE AND SEMI-INTENSIVE FARMING SYSTEM

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ABSTRACT

This study was conducted to assess the laying performance, egg quality, fertility rate, and egg classification of Itik PINAS (IP)-Kayumanggi under the intensive and semi-intensive farming system. A total of 240 heads of IP-Kayumanggi were divided into two treatments with 15 replications per treatment. Each pen consists of one drake and seven ducks. Laying performance was compared between treatments from 29 to 42 weeks of age using t-test. Results demonstrated that IP-Kayumanggi ducks under semi-intensive farming systems have significantly higher livability rate (99.57%), average egg weight (70.76 g), average albumen weight (41.69 g) and darker yolk color. The fertility rate at 10th and 15th days of candling were significantly higher in semi-intensive (87.74% and 82.38%) than intensive farming (77.64% and 67.37%). Extra small and small sizes of eggs are mainly produced under intensive systems while more medium and large sizes eggs are under semi-intensive systems. Therefore, this study suggests the production advantages of IP-Kayumanggi under semi-intensive farming system.

Keywords: farming system, laying performance, egg quality traits, fertility rate, IP-Kayumanggi

INTRODUCTION

Itik PINAS (IP) is a genetically superior breeder duck developed in 2016 by the National Swine and Poultry Research and Development Center (NSPRDC) of the Bureau of Animal Industry (BAI). It was produced by continuous selection and breeding of the traditional Pateros duck. IP-ducks show good performance compared to the Pateros ducks in terms of higher egg production (260 vs. 200 eggs/duck/year), egg production of 80% that weighs 65 g or more, predictable egg production, and high uniformity in body weight (DOST-PCAARRD, 2017). Performance of Itik PINAS recorded from previous studies were 77-85% (Berdos *et al*., 2019), 68-78% (Martin *et al*., 2020), 70.30% (Santiago *et al*., 2022). Egg production of IP can be variable depending on several factors.

In the Philippines, the common production system for ducks is through traditional

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practices or grazing. Farmers herd ducks at a rice farm after harvest to scavenge for snails, worms and insects, resulting in lower feed costs. Despite requiring little input, it has various limitations, including the threat of acquiring diseases, predators, and a slow growth rate (Mutayoba *et al*., 2012). Meanwhile, an intensive farming system requires intensive management practices and high input costs (Singh *et al*., 2018). However, not every breed and commercial lines are suitable for each production system in terms of productivity and quality of eggs because systems do not always meet the natural needs of birds. These factors have an effect on the profitability of poultry production, which is the main criterion determining the choice of a system by the producer (Sosnówka – Czajka *et al*., 2010). Since IP- ducks were newly introduced, limited studies were carried out concerning the influence of production on the laying performance and egg qualities of IP-ducks under the intensive and semi-intensive farming system, thus this study was conducted.

MATERIALS AND METHODS

The experimental ducks were raised at the experimental site of the Department of Animal Science, College of Agriculture, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines. This study was conducted in compliance with the requirements of the Institutional Animal Care and Use Committee (IACUC) of Central Luzon State University with reference number 20220512-02.

A total of 210 female and 30 male IP-Kayumanggi ducks were randomly housed in each pen. Ducks were grouped following a male-to-female ratio of 1:7 per pen. Treatments were randomly assigned to each pen with fifteen replication per treatment.

To evaluate the influence of farming systems, a duck house was subdivided into different pens of different sizes. For the intensive farming system, a pen with a shed measuring 3m^2 without access to run was constructed (Figure 1). Ducks spent 24 hours in the pen. Each pen was equipped with adequate feeder and waterers. Feeding of animals was done at 5:00-6:00 a.m. and 3:30-4:00 p.m. Only commercially prepared layer diet was offered in pellet form on *ad libitum* basis. Table 1 shows the nutrient analysis of the commercial layer diet. On the other hand, for a semi-intensive system, ducks were reared in an open-sided house and with a deep litter floor measuring 3 m^2 per pen and were given 8 hours per day to the grazing area with a dimension measuring 17 m^2 per replicate (Figure 2). This grazing area has vegetation and access to a swimming area. Snails and other insects are also available. Ducks were also fed *ad libitum* commercial feeds and supplemented with clean water.

Feed intake was measured by deducting total feed refusal from the total feed given per week. Feed conversion ratio was calculated per kilogram of egg produced. Hen-day production rate was calculated by dividing the total number of eggs harvested per day to total live ducks, multiplied by 100. Monitoring of mortality was done daily.

Evaluation of external and internal quality of egg was done every 2 weeks by getting two sample eggs per replicate. The egg and egg's component weights were measured. Shell thickness and albumen height were also included. The average of the shell thickness was taken at three sites around the egg equator of the cracked shell using a digital caliper in units of 0.01 mm. Albumen height was measured with the use of a digital caliper and was taken as the average of three points taken at the level of the thick albumen. Yolk color was determined using the DSM yolk color fan with scores ranging from 1 being the lightest, up to 15 on the other extreme. Haugh unit (HU) is the measure of egg quality that correlates albumen

Figure 1. Intensive Farming System.

Figure 2. Semi- Intensive Farming System.

Table 1. Nutrient analysis of commercial layer diet.

Item	Amount
Crude Protein	not less than 18.50%
Crude Fat	not less than 5.00%
Crude Fiber	not more than 5.00%
Moisture	not more than 12.00%
Calcium	3.30-3.70%
Phosphorus	not less than 0.70%

Commercial layer diet ingredients: Corn, wheat, soybean meal, fish meal, animal protein, wheat pollard, rice bran D1, DDGS, vegetable oil, limestone, salt, inorganic phosphate, lysine, DL-methionine, threonine, vitamin and mineral premix, antioxidant, antimold, multienzymes, phytase

height and egg weight with values ranging from 0 to 130. Higher HU values indicate better egg quality relative to potential shelf life and freshness. Computed HU values of eggs are rounded to whole numbers for classification purposes as indicated: AA (72 or more), A (60-71), B (31-59) and C (30 or less). Haugh Unit was calculated using the formula (Haugh, 1937):

$$HU = 100 \log10 (h-1.7w0.37+7.6)$$

Where: H - is albumen height
W - is egg weight

Evaluation of the fertility rate was conducted at the 10th and 15th days of incubation. Fertility rate was the number of fertile eggs divided by the number of eggs produced, multiplied by 100.

Eggs collected on a daily basis were recorded and classified according to their individual weight. Patterned after the seven (7) classes for chicken eggs based on the Philippine National Standard (PNS, 2005), the range of values for duck eggs was set in 10-gram intervals. The proposed egg size classification was as follows:

Extra Small (XS/)Peewee	-	<45 g
Small (S)	-	46-56 g
Medium (M)	-	57-68 g
Large (L)	-	69-79 g
Extra Large (XL)	-	80-91 g
Jumbo (J)	-	>92 g

The data gathered included production performance, egg quality, and hatchability. Data were analyzed following a T-Test of Statistica (StatSoft, Inc., v7). The level of significance was set at $P<0.05$.

RESULTS AND DISCUSSION

The influence of the production system on the production performance of IP-Kayumanggi and the quality of eggs produced are shown in Table 2. Data revealed that semi-intensive farming has a higher livability of ducks (99.57%) compared to ducks raised under an intensive farming system (97.71%). It has been shown that broilers that were raised under an intensive production system exhibit high mortality rates, musculoskeletal disorders, increased susceptibility to thermal and nonthermal stress, and behavioral restrictions (Sánchez-Casanova*et al*., 2020). Possibly, outdoor access allows them to express their natural behavior by providing more space, which helps improve environmental conditions, reduce stress and improve the health and performance of animals (Fanatico, 2006; Abouelezz *et al*., 2012).

Although there is no difference in terms of hen-day production rates between treatments, the influence of rearing IP-ducks under a semi-intensive system was prominent with egg quality traits such as egg weight, albumen weight, yolk color and fertility rates (10th and 15th day) (Table 2). These parameters were important economic traits in the balut industry. The nutrient intake of ducks is directly involved in the development of egg quality components (Galea, 2011). Although the average feed intake of ducks under the different farming systems is comparable, ducks that grazed are expected to feed on the available feedstuff in the area. Depending on the availability of the range area and also the intensity of vegetative growth, the requirement of supplemental feed varies between 25 and 50 g/bird/day (Singh *et al*., 2018). An additional nutrient intake of ducks from the grazing area may result in higher egg weight components (Ekweozor *et al*., 2002). For example, a golden snail that may be present in the field contains 14% crude protein and 35% calcium (Serra, 1997). These

Table 2. Production Performance, Egg Quality Traits and Fertility Rate of IP-Kayumanggi under different farming systems.

Parameter	Intensive	Semi-Intensive	*P*-value
Production Performance			
Ave. Daily Feed Intake, g	142.97±0.67	142.01±0.91	0.47
Hen-day Production, %	80.89±8.68	78.58±1.34	0.17
Feed Conversion Ratio	3.02±0.40	3.21±0.13	0.19
Livability, %	97.71±0.29[b]	99.57±0.28[a]	<0.001
Egg Quality			
Egg Weight, g	70.42+0.16[b]	70.76+0.21[a]	<0.001
Yolk Weight, g	22.16±0.12	22.04±0.13	0.49
Albumen Weight, g	40.83±0.17[b]	41.69±0.19[a]	<0.001
Shell Weight, g	7.13±0.04	7.16±0.04	0.60
Yolk Color, DSM	6.96±0.06[b]	7.58±0.08[a]	<0.001
Albumen, Height, mm	10.39+0.09	9.55+0.10	0.48
Shell, thickness	0.36±0.005	0.36±0.004	0.903
Haugh Unit	98.37+0.48	94.50+0.51	0.60
Fertility Rate			
10th Day, %	77.64±2.44[b]	87.74±1.69[a]	0.001
15th Day, %	67.37±2.81[b]	82.38±1.79[a]	<0.001

Means in the same row with different superscripts differ significantly (*P*<0.05).

nutrients influence the albumen and eggshell thickness of eggs. However, available feedstuff was not measured in the present study, thus this needs further verification.

The darker color yolk color (*P*<0.001) is associated with the carotene content of the yolk. Darker eggs were produced by birds under semi-intensive farming. This could be attributed to the ingested feed materials, farm residues, insects, and snails that abound in their scavenging area. A similar finding was reported by Van Den Brand *et al*. (2004) where they observed darker yolk coloration of eggs laid by hens that were given access to outdoor foraging areas.

One of the most important parameters in "balut" production is the fertility rate. A higher fertility rate in the balut industry is a good indication of income since balut can be sold at a higher price compared to fresh eggs. About 80% of the total duck egg production is being processed for balut making (Dagaas and Chang, 2004; Boquet, 2017) while the remaining 20% was allotted for the selling of fresh duck eggs, penoy, and salted eggs. In this study, data showed that a semi-intensive farming system increases the fertility rate of eggs significantly for both the 10th day (87.74%) and the 15th day (82.38%) of incubation. The fertility rate is affected by many factors that include the internal and external environment of animals, and the genotype. Possibly, the increased weight of albumen influenced the higher fertility rate of eggs. According to King'ori (2011), the most significant internal factors that influence fertility includes weight, shell thickness and porosity, shape index, and consistency of the contents. Moreover, high environmental temperature causes a decrease in the reproduction efficiency of male and female poultry (Widiyaningrum *et al*., 2016) which might affect the success of fertilization. Therefore, the presence of a swimming pool in the grazing area under semi-intensive farming possibly reduced the body heat temperature of ducks and consequently decreased heat stress during day time when mating usually happens.

Unlike chicken eggs, duck eggs have no established egg classifications. Locally, eggs were only sorted as good, reject, and small. However, classifying eggs based on egg weight is important for marketing balut and ducklings production, since both require a minimum weight of 60g. Table 3 shows the influence of production systems on egg classification produced by IP-Kayumanggi. Egg classification was patterned after the six (6)-sizes classification system for table eggs based on the Philippine National Standard (2005), meanwhile, the range of values for duck eggs was set in 10-gram intervals. Ducks raised under intensive farming systems mainly produced Extra Small (XS)/ Peewee at 1.84% and Small (S) size eggs at 40.22%. On the other hand, Medium (M) and Large (L) egg sizes were significantly higher in ducks under the semi-intensive system with 68.19% and 27.70%, respectively. In a similar study, Itik Pinas breed raised in a semi-intensive farming system mainly produced large-size eggs at 55.37% and medium-sized eggs at 24.76% (Bondoc *et al*., 2021). The higher number of medium and large sizes eggs has no negative impact on the hen-day production rate, contrary to the negative correlation between egg weight and egg production rate mentioned by Niknafs (2012). One of the major contributing factors to egg weight is the body weight of the animal (Ledvinka *et al*., 2012). However, it was not measured in the present study. It seems that ducks under a semi-intensive system have a heavier body weight since they have additional scavenged feeds coming from the range area. With a greater proportion of M and L size eggs under the semi-intensive system, this will give more premium and higher net income to the duck farmers when raising IP-Kayumanggi.

In conclusion, results favored a semi-intensive production system in terms of livability rate, egg quality components, fertility rate, and egg classification. Results suggest production advantages of the newly developed IP-Kayumanggi performs under a semi-intensive system. Also, the improved fertility rate of eggs produced by IP-Kayumanggi ducks under a semi-intensive system will be beneficial to the production of balut.

Table 3. Egg Classification of IP-Kayumanggi under different farming systems.

Egg Classification (%)	Intensive	Semi-Intensive	*P*-value
Extra Small/ Peewee (<45g)	1.84±0.45[a]	0.15±0.05[b]	<0.001
Small (46-56g)	40.22±2.94[a]	3.72±0.52[b]	<0.001
Medium (57-68g)	56.33±3.13[b]	68.19±2.61[a]	0.01
Large (69-79g)	1.43±0.37[b]	27.70±2.86[a]	<0.001
Extra Large (80-91g)	0.09±0.04	0.18±0.06	0.22
Jumbo (<92g)	0.09±0.05	0.05±0.04	0.53

Means in the same row with different superscripts differ significantly ($P<0.05$).

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