Research Article

Reproductive Performance of Local Noi Chicken over Two Generations in the Mekong Delta of Vietnam

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Abstract | Noi chicken is one of the indigenous chicken breeds commonly raised in the Southern of Vietnam for the purpose of fighting games and food because its firm and crispy skin. Nowadays, there are not many surveys on the reproductive performance of this breed. The study aimed to evaluate some indicators of reproductive performance of Noi chicken over two generations (G0 and G1 generations). A total of 300 hens and 60 cocks at the 21 weeks old local Noi chickens were used in this experiment. They were randomly distributed into two treatment groups of 5 replicates (30 hens and 6 cocks) in a completely randomized design. Treatment 1 (G0 generation – beginning generation) included 150 hens and 30 cocks and treatment 2 (G1 generation – the offspring of G0 generation) with 150 hens and 30 cocks. Mating cocks and hens of G0 generation and collecting eggs to incubate for getting G1 generation. Some reproductive indicators and other performance characteristics were collected from 21-72 weeks old in each generation and the association between generations and productive traits was analyzed based on One way Analysis of Variance (ANOVA) with Minitab software version 16.0. The results showed that G1 generation had the highest average egg production rate (34.6%) and the lowest average FCR (4.60 g feed/g egg) ($P<0.05$). At 42 weeks old, the Noi hens reached peak egg production as follow 45.7% in G0 generation and 48.6% in G1 generation. The G1 generation had average feed intake for 10 eggs (3.29 kg) lower than G0 (3.53 kg). Egg production increased in G1 (125.8 eggs/hen) compared to G0 (117.5 eggs/hen), and also FCR improved in G1 (4.60 g feed/g egg) to compare with that of G0 (4.96 g feed/g egg). In concluded that the reproductive performance of Noi hens in G1 generation was better than that of G0 generations and these findings can be applied in the breeding of Noi chickens towards egg production.

Keywords | Egg production, Generation, Native chickens, Noi chickens, Reproductive traits.

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INTRODUCTION

Vietnam is a country with many domestic chicken breeds, especially Noi chickens (Phuong *et al.*,2015). Among the local chicken breeds in the Mekong Delta, Noi chicken are the most common and have been raised for a long time (Phuong *et al.*,2019). Beside, Noi chickens have good meat quality, so consumers accept the higher price than other chicken breeds. In recent years, there have been a few studies on the biological characteristics and genetic diversity of the Noi chicken in the Southern of Vietnam (Ngu *et al.*, 2016). The results indicated that the body weight of adult chickens were 2.89 kg/cock and 1.77 kg/hen. The common feather color for roosters were black-red (42%) and hens were brown (55.6%). Molecular genetic research identified polymorphisms in Noi chickens relate to growth (GH, GHR, GHSR gene) (Khoa *et al.*, 2013) and reproduction (PRL, VIP, VIPR-1, BMPR-IB, MTNR1C, NPY, DRD2 gene) (Vu and Ngu, 2016). The results of study by Ngu *et al.* (2015) showed that Noi chickens carrying DD (NPY/*Dra*I), CC (VIPR-1/*Taq*I) and CC (VIPR-1/*Hha*I) genotypes had highest egg production

with 50.9, 49.8 and 50.4 eggs/hen/20 laying weeks, respectively. In general, these studies focused on investigating genetic polymorphisms and their association with egg productivity, but they did not select across generations.

Additionally, breeding stock is still a major obstacle due to poor breeder quality, unstable yield, and egg production has not reached its potential. In Vietnam, some recent studies focused on nutrition to improve the growth performance of Noi chickens (Thuy and Ha, 2017; Hien *et al.,* 2018; Linh *et al.,* 2020; Hung *et al.,* 2020; Dong and Thu 2021a, 2021b; Nha *et al.,* 2021; Giang *et al.,* 2023). Currently, there is no scientific information about surveying and selecting this breed to improve egg productivity over many generations. Therefore, this study aims to survey some indicators of reproductive performance on Noi chickens over two generations (G0 generation – beginning generation, G1 generation – the offspring of G0 generation) in the Mekong Delta, thereby evaluating the effectiveness of selection through two generations.

MATERIALS AND METHOD

Experimental animal

The present study was carried out in a local chicken farm, Phong Dien district, Can Tho city (the geographical coordinate: 9°57'46.2"N 105°36'16.2"E) from January 2023 to April 2024. From 21-72 weeks old, Noi chickens were kept in pens (Figure 1), mix feed pellet of Emivest Feedmill Vietnam Company Limited (Emivest 9806) consisting of 17% crude protein (CP) and 2,750 kcal/kg metabolized energy (ME) (Table 1), and a 16 hours/day lighting regime at 40-60 lux (Hoa et al., 2021). The hens had *ad libitum* access to feed and water throughout the experiment. This study chose feed with the above protein and energy levels because some previous studies on domestic chicken breeds in Vietnam with high reproductive productivity used feed containing 17.6% CP and 11.3 ME on Ac chickens (Thuy and Ha, 2022), 17% CP and 2,850 ME on Ac chickens (Phuong et al., 2023),16% CP and 12.6 ME on Noi chickens (Thuy and Ha, 2017), 16% CP and 2650 ME on Noi chickens (Hoa et al., 2022).

The G0 generation origined of farms in Cho Lach district, Ben Tre province (Vietnam). The G0 treatment group consisted of 150 hens and 30 cocks at 20 weeks of age with satisfactory phenotype (Smooth feather, no deformities, body weight greater than 1,500 g/hen and 2,100 g/cock). In G0 generation, randomly arranged 30 hens and 6 cocks into each pen with a density of 0.67 m^2/bird in an opened housing system (area = 4 m x 6 m = 24 m^2). Each pen corresponded to one repetition, so there were a total of 5 repetitions. Mating cocks and hens of G0 generation at 21 weeks old and collecting eggs to incubate, hatch for getting G1 generation. Raised and took care of G1 generation from 1 to 19 weeks old. At 20 weeks old, selected 150 hens and 30 cocks from G1 generation that satisfly phenotype standards as selected for the G1 generation. Then, randomly arranged 30 hens and 6 cocks into each pen. The pens size and repetitions number of G1 generation was similar to G0 generation. Thereby, evaluating the reproductive performance of the G0 generation and G1 generation. One month before the arrival of the chicks, the house was cleaned and sprayed by water, detergent, antiseptic and lime. All experimental chickens were vaccinated and treated according to the procedures of Emivest Feedmill Vietnam.

Table 1: Chemical composition of diet for Noi chickens.

Chemical composition	Content
Moisture (%)	13.0
Crude protein (%)	17.0
Metabolizable energy (kcal/kg)	2,750
Crude fiber (%)	5.00
Calcium (Min-Max) (%)	3.7-4.0
Phosphorus (Min-Max) (%)	0.5-1.2
Lysine (Min) (%)	0.85
Methionine + Cystein (Min) (%)	0.65
Ash (Max) (%)	9.0

(Source: Emivest Feedmill Vietnam)

Figure 1: Noi chickens (A) G0 generation and (B) G1 generation at 21 weeks old

Table 2: Methodology for characterization

Items	Data collection methods	References
Egg weight (g)	Collected eggs at 5 P.M. and weighed egg with the electronic scale.	Phuong et al. (2023)
Shape index (SI) (%)	Using the digital caliper to measure the small diameter and large diameter of the egg. SI = (Small diameter/large diameter of egg) x 100	Sandi et al. (2013)
Eggs number (EN) (eggs/bird/52 laying weeks)	Recorded the total number of eggs everyday from 21 to 72 weeks old. EN = Total number of eggs/hens number	Phuong et al. (2023)
Laying rate (LR) (%)	LR = (Eggs number per week/hens number presented) x 100	Phuong et al. (2023)
ADFI (g feed/hen/day)	Weighed amount feed provide per day and amount feed remain per day. ADFI = (Amount feed provide per day - amount feed remain per day)/30 hens	Thuy and Ha (2022)
FCR (g feed/g egg)	Recorded average daily feed intake, then calculated the total amount of feed per week. Weighed the total egg weight everyday, then calculated the total egg weight per week. FCR = (Total feed intake per week/Total egg weight per week)	Thuy and Ha (2022)

During the experimental period, egg number was recorded daily to calculate egg production as a percentage of eggs produced per bird (laying rate). In addition, some reproductive indicators were followed, sush as: average eggs weight, eggs shape index, average daily feed intake (ADFI) and feed conversion ratio (FCR). List out the reproductive indicators were recorded on generations and methods to collect and record data is described in Table 2. Everday, eggs were collected at 5 P.M. and numbered to monitor treatments yield. The weight of the eggs and their shape index were measured every day throughout the entire experiment.

Statistical analysis

The data were recorded by using Excel software. The association between generations and productive traits was analyzed based on One way Analysis of Variance (ANOVA) with Minitab software version 16.0 (2016). The significant differences between mean values within and between treatments were determined according to Tukey with alpha <0.05. Experimental model according to the formula: $Yij = \mu + Gi + \xi ij$ (where Yij: traits observed; μ: general mean, Gi: influence of genotype; ξij: random error). A probability value of less than 0.05 was considered to be significant. Mean ± standard deviation (SD) was used to measure all the parameters. All pairwise comparisons among levels of generations.

RESULTS AND DISCUSSION

Reproductive performance

Table 3 presented the total number of eggs, egg production rate and FCR significant differences were noted between the two generations for these two parameters (p<0.05).

Table 3: The value of reproductive performance of Noi chickens at 21-72 weeks old

Terms	G0 generation (n = 150)	G1 generation (n = 150)	P
	Mean±SD	Mean±SD	
	95% CI	95% CI	
Egg weight (g)	46.1±5.04	46.2±5.08	0.962
	45.5-46.8	45.6-46.8	
Egg shape index (%)	75.5±2.57	75.4±2.55	0.595
	75.2-75.8	75.1-75.7	
Total number of eggs (eggs/52 laying weeks)	117.5±1.21	125.8±1.17	0.001
	116.2-118.7	124.5-127.0	
Laying rate (%)	32.3±0.33	34.6±0.32	0.001
	31.9-32.6	34.2-34.9	
ADFI (g feed/hen/day)	73.7±0.34	73.3±0.34	0.059
	73.4-74.1	72.9-73.6	
FCR (g feed/g egg)	4.96±0.24	4.60±0.21	0.036
	4.73-5.19	4.37-4.83	

CI: Confidence intervals; ADFI: Average daily feed intake; FCR: Feed conversion ratio

From 21 to 72 weeks old, the G1 generation had the average egg production (34.6%) higher than G0 generation (32.3%). For egg yield, the total number of eggs in the G1 generation (125.8 eggs/hen) was higher than G0 generation (117.5 eggs/hen). This result indicated the egg number in the G1 generation was 8.3 eggs/hen higher than G0 generation (corresponding to an increase of 7.1%). In addition, the G0 generation had the average daily feed intake (73.7 g feed/hen/day) higher than G1 generation (73.3 g feed/hen/day). The FCR of the G1 generation (4.60 g feed/g egg) was lower than G0 generation (4.96 g feed/g

egg). The improvement in feed intake/10 eggs and FCR of G1 generation compared to G0 generation was very meaningful and brought economic benefits to chicken farmers in the direction of egg production.

Egg production, accumulated eggs and feed intake

Table 4, **Figure** 2 and Figure 3 showed the egg production of chickens that was low in first weeks (1.6% in G0 generation and 1.7% in G1 generation). However, the egg production of two groups increased gradually in the following weeks and peaked at 42 weeks old. At the age of 42 weeks old, the G1 generation had a peak egg production rate of 48.6% that was higher than G0 generation (45.7%). Besides, the G1 generation had average egg production (34.6%) higher than G0 generation (32.3%). At 72 weeks old, the G1 generation had a cummulative total egg number (125.8 eggs/hen) higher than G0 generation (117.5 eggs/hen). The research of Hoa et al. (2021) on 600 Noi laying hens at 23-50 weeks old with feed containing 16% crude protein, 2,650 Kcal/kg metabolic energy showed that the cumulated eggs per hen were 74.3 eggs (black Noi chickens) and 77.9 eggs (dark brown Noi chickens). Moreover, the egg production at peak were 58.8% in black Noi chickens and 65.8% in dark brown Noi chickens.

This result indicated that the egg production at peak of Noi chickens in Hoa et al. (2021) was higher than the current study. This might be due to differences in care conditions and breed origins. In general, the higher reproductive performance of G1 generation than G0 generation may be due to the effect of selection on phenotype characteristics related to egg productivity.

These characteristics may be linked to genes that function to increase reproductive performance in chickens. In other words, the potential biological mechanisms might be genetic factors that influence reproductive performance. However, the study did not examine the association between genetic polymorphisms and yield traits, so this could be a research direction that should be expanded in the future. Moreover, intensive rearing systems using mixed feed and appropriate lighting were both important factors in achieving relatively high egg production in this experiment for both generations.

Additionally, at 21 weeks old, feed intake for 10 eggs of hens was the highest (38.2 kg in G0 generation) because this early stage had the low egg production. At 42 weeks of age, G1 generation had the least feed intake (1.61 kg) because hens had the highest egg production during this period. Similarly, the feed intake of G0 generation were 1.71 kg. The G1 generation had average feed intake/10 eggs (3.29 kg) lower than G0 generation (3.53 kg).

Table 4: Laying rate, egg number and feed intake/10 eggs of Noi hens during 21-72 weeks old.

Weeks old	G0 generation			G1 generation		
	LR (%)	EN (eggs)	FI (kg)	LR (%)	EN (eggs)	FI (kg)
21	1.6	0.1	38.2	1.7	0.1	36.3
22	3.0	0.3	20.4	3.5	0.4	17.8
23	7.0	0.8	8.96	7.3	0.9	8.60
24	10.4	1.5	6.16	10.9	1.6	5.88
25	13.3	2.5	4.92	13.8	2.6	4.73
26	15.0	3.5	4.46	16.1	3.7	4.16
27	17.8	4.8	3.82	18.8	5.0	3.62
28	19.5	6.1	3.53	21.0	6.5	3.29
29	22.9	7.7	3.04	24.8	8.2	2.80
30	25.6	9.5	2.78	27.2	10.2	2.62
31	27.9	11.5	2.59	30.3	12.3	2.38
32	31.7	13.7	2.31	34.0	14.7	2.15
33	33.3	16.0	2.21	35.7	17.2	2.06
34	35.6	18.5	2.07	37.9	19.8	1.94
35	36.6	21.1	2.02	38.9	22.5	1.88
36	38.8	23.8	1.96	41.0	25.4	1.85
37	42.6	26.8	1.81	45.0	28.5	1.71
38	42.4	29.8	1.83	45.2	31.7	1.72
39	42.9	32.8	1.82	45.7	34.9	1.70
40	43.7	35.8	1.79	46.9	38.2	1.66
41	44.8	39.0	1.76	47.8	41.5	1.64
42	45.7	42.2	1.71	48.6	44.9	1.61
43	44.1	45.2	1.77	47.0	48.2	1.66
44	42.2	48.2	1.85	45.0	51.4	1.73
45	40.2	51.0	1.93	43.0	54.4	1.80
46	39.6	53.8	1.99	42.5	57.4	1.84
47	39.0	56.5	1.99	41.9	60.3	1.85
48	38.8	59.2	2.00	41.6	63.2	1.85
49	39.0	62.0	2.00	41.8	66.1	1.86
50	39.8	64.7	1.95	42.7	69.1	1.82
51	38.7	67.4	2.00	41.9	72.1	1.84
52	38.6	70.1	2.03	41.4	75.0	1.87
53	38.2	72.8	2.03	41.0	77.8	1.88
54	38.3	75.5	2.00	41.1	80.7	1.86
55	37.6	78.1	2.06	40.5	83.5	1.91
56	38.0	80.8	2.03	40.9	86.4	1.87
57	37.5	83.4	2.10	39.9	89.2	1.95
58	37.8	86.1	2.04	40.2	92.0	1.91
59	36.0	88.6	2.10	38.4	94.7	1.97
60	35.0	91.0	2.11	37.4	97.3	1.98
61	34.2	93.4	2.14	36.6	99.9	2.02
62	33.3	95.8	2.20	35.9	102.4	2.05

63	32.5	98.0	2.25	34.9	104.8	2.09
64	31.9	100.3	2.27	34.3	107.2	2.10
65	31.2	102.5	2.30	33.6	109.6	2.13
66	31.5	104.7	2.29	33.9	112.0	2.13
67	30.5	106.8	2.38	32.9	114.3	2.18
68	30.1	108.9	2.39	32.5	116.5	2.19
69	30.5	111.0	2.34	32.9	118.8	2.16
70	30.8	113.2	2.31	33.1	121.2	2.15
71	30.7	115.3	2.30	33.0	123.5	2.14
72	30.3	117.5	2.27	33.0	125.8	2.07
Average	32.3	-	3.53	34.6	-	3.29

LR: Laying rate; EN: Cummulative egg number; FI: Feed intake/10 eggs

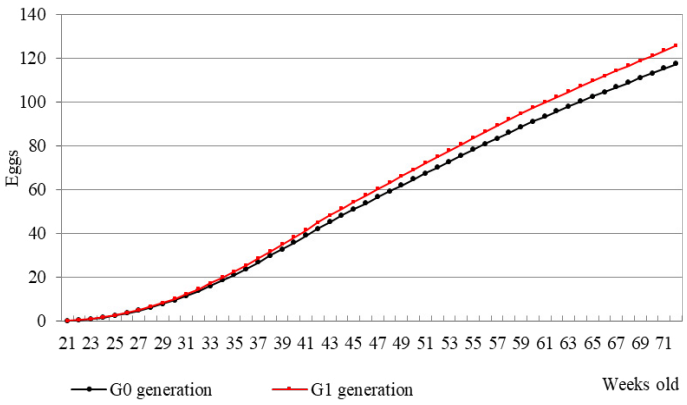

Figure 2: The cummulated egg number of Noi chickens

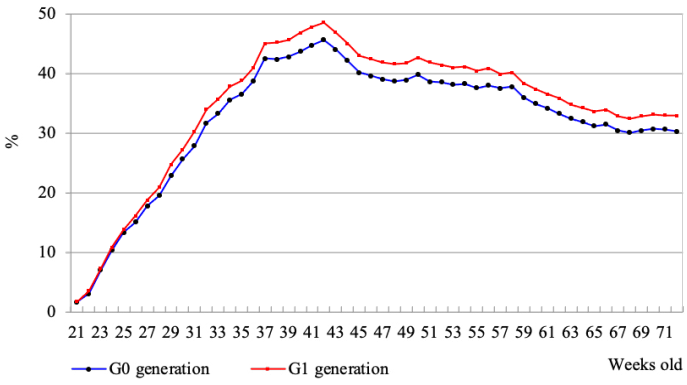

Figure 3: The laying rate of Noi chickens

Egg weight and egg shape index

Table 5 and Figure 4 presented the egg weight of the G0 and G1 generations increased from 21 to 72 weeks old. Hens in the G1 generation had average egg weight (46.2 g/egg) higher than G0 generation (46.1 g/egg). However, this result was lower than the egg weight of black Noi hens (48.3 g/egg) and dark brown Noi hens (49.7 g/egg) (Hoa *et al.*,2021). The egg weight were much higher than other local chickens inVietnam such as Ri chickens (the indigenous chicken breeds in the Northern of Vietnam) (41.7 g/egg) and Mia chickens (44.7 g/egg) (Moula *et al.*,2012), Ac chickens (41.6 g/egg) (Linh *et al.*,2022), Ac chickens at 23-37 weeks old (31.2-36.2 g/egg) (Thuy and Ha, 2022), but smaller than H'mong chickens (51.4 g/egg) (Phuong *et al.*,2017). The improvement in egg weight of G1 generation compared to G0 generation was positive and brought economic benefits to farmers.

Table 5: The egg weight and egg shape index of Noi hens at 21-72 weeks old.

Weeks old	G0 generation (n = 260)		G1 generation (n = 260)	
	EW (g/egg)	ES (%)	EW (g/egg)	ES (%)
21	32.9	72.3	32.9	72.3
22	34.2	73.0	34.3	73.2
23	35.7	73.2	35.9	73.0
24	37.6	73.5	37.1	73.5
25	38.7	73.9	38.3	73.0
26	39.8	74.6	39.8	74.7
27	44.3	74.4	44.3	75.5
28	44.6	74.6	45.5	76.1
29	46.2	74.5	46.3	76.2
30	49.0	75.4	46.5	75.2
31	47.7	74.7	47.8	74.6
32	47.9	75.6	47.9	76.5
33	46.5	74.3	47.2	74.5
34	47.1	75.2	47.7	76.0
35	47.7	74.7	47.4	76.5
36	49.2	76.0	48.2	77.1
37	47.6	76.5	48.4	77.1
38	47.3	77.4	48.4	75.8
39	48.4	77.1	48.4	75.1
40	48.3	78.0	48.9	76.0
41	48.3	75.8	49.0	75.5
42	48.9	75.1	50.3	78.0
43	50.6	76.0	50.6	76.2
44	50.1	75.5	50.2	75.0
45	49.4	76.2	49.4	75.8
46	49.9	75.0	49.9	76.9
47	48.8	75.8	48.9	74.3
48	48.4	78.0	48.4	76.4
49	48.2	76.2	49.7	75.8
50	49.1	76.4	49.1	75.2
51	49.6	75.8	48.2	74.7
52	48.6	75.2	48.6	76.8
53	48.0	76.5	48.0	75.1
54	48.3	76.8	48.4	75.5
55	48.2	75.1	48.2	75.1
56	48.1	75.5	47.0	75.3
57	48.0	75.1	48.0	74.5
58	47.7	75.3	48.0	74.8

59	47.5	74.5	46.9	74.7
60	47.9	74.8	46.1	75.4
61	46.9	75.3	47.0	76.6
62	46.9	76.8	47.7	75.7
63	46.1	76.6	46.3	74.0
64	46.2	75.7	46.7	75.9
65	46.7	75.9	46.4	77.4
66	46.3	77.4	47.5	74.6
67	47.0	75.0	44.8	75.0
68	44.7	74.8	45.8	74.8
69	45.2	74.6	45.2	74.6
70	43.5	76.4	43.5	76.4
71	43.4	76.6	43.4	76.6
72	42.6	76.8	42.6	74.4
Average	46.1	75.5	46.2	75.4

EW: Egg weight; ES: Egg shape index, n: surveyed egg number

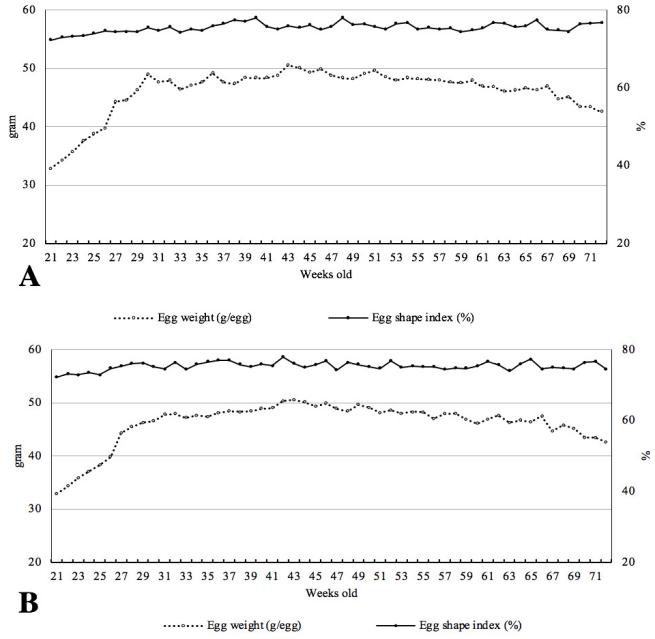

Figure 4: The egg weight and egg shape index of Noi chickens (A) G0 generation and (B) G1 generation.

Besides, the egg shape index of two groups increased gradually at 21-72 weeks old. In experimental period, the average egg shape index of the G0 generation were 75.5% that was higher than G1 generation (75.4%). Hasan et al. (2020) indicated that egg shape index of Hyline Brown, ISA Brown, Saver-579, Novogen brown and Naked neck (native chickens in Bangladesh) were 78.9%, 78.9%, 78.5%, 81.4% and 76.9%, respectively. The study of Moula *et al.* (2012) showed that egg shape index in Ri chickens and Mia chickens were 77.5% and 76.9%, respectively. The egg shape index in the present study was lower than on Lien Minh egg shape (78.1%) (Nguyen *et al.*, 2018). According to Duman et al. (2016), the egg shape index was sharp (< 72%), normal (standard) (72-76%) and round (>76%). This showed that Ac chicken eggs was standard, whereas Ri, Mia and Lien Minh chicken eggs was round. Some previous studies showed that egg shape index has no impact on some egg quality indicators. Egg shape index did not affect breaking strength (Duman et al., 2016), yolk colour (Sarica et al., 2012; Duman et al., 2016), shell thickness and shell weight (Alkan et al., 2013; Duman et al., 2016). Besides, the study did not research the association between the egg shape and egg quality indicators. Therefore, the study cannot be confirmed that Ac egg shape were better than other local chicken breeds in Vietnam if based on the egg shape index.

Besides, H'mong chickens needed 0.66 kg feed to produce 10 eggs with an average weight of 38.1 g/egg (Phuong *et al.*,2017). The results of Linh *et al.*(2022) indicated that Ac hens intake 1.12 kg feed for 10 eggs at 28-39 weeks old. This proved that the feed intake/10 eggs of Noi chicken in this study was more than some published native chicken breeds. According to results of Thuy and Ha (2022), the FCR of Ac chickens was 2.94 (fed with *Moringa oleifera* powder supplementation) and 2.98 (feed with *Curcuma longa* powder supplementation) at 23-29 weeks old. However, the present study indicated the FCR of Ac chickens was lower than results of Duy *et al.* (2020) on Ho chickens (FCR 4.36) and Dong Tao chickens (FCR 4.06). The FCR lower has beneficial economics in the egg production process. The different research results may be due to chicken breeds and care conditions.

The egg production of Noi hens in the present study was lower compared to some other indigenous chicken breeds such as Bang Troi chickens at 37-40 weeks old (34.1%) (Thinh *et al.*,2020), Ac chickens (54.6%) at 28-39 weeks old (Linh *et al.*,2022), Ac hens (52.3-58.1%) at 23-37 weeks old (Thuy and Ha, 2022). According to Hoa *et al.* (2021), the egg yields of the Noi black hens was 74.3 eggs/hen and Noi dark brown hens was 77.9 eggs/hen at 25-50 weeks old. The total number of eggs in Ho chickens and Dong Tao chickens were 88.5 eggs/hen and 94.9 eggs/hen, respectively (Duy *et al.*,2020). Besides, the Noi chickens with II genotype (NPY/*Dra*I) had 38.9 eggs/hen/20 laying weeks (Ngu *et al.*,2015).

In general, G1 generation outperformed G0 generation in some indicators such as laying rate, egg number. This can be explained as the selected G0 generation and G1 generation chicken flock had the appearance characteristics for breeding purposes. Besides, the study did not research on genetic improvements in Noi chickens. However, the G1 generation outperformed G0 generation in some indicators might be due to changes in management practices. The present results showed the selection significantly improved

the reproductive performance of the experimental flocks. Similarly, the research of Oleforuh-Okoleh (2011) on indigenous chicken breeds in Nigeria indicated the selected generations had higher reproductive performance than the derived generation. Specifically, the total number of eggs had been significantly improved over two generations as shown in the following G0 generation (33.4 eggs/hen), G1 generation (43.2 eggs/hen) and G2 generation (47.2 eggs/hen). Furthermore, the study of Nwagu (2004) showed that egg production increased by 3.1 eggs compared to the original generation after 5 selected generations.

The low growth and laying rate are the major challenges to for raising indigenous chicken breeds. Using an intensive indoor farming system with adequate feed, appropriate lighting and veterinary care in this experiment can be an effective solution to improve the efficiency of local chicken farming. The research on native chickens in Bangladesh indicated that change in traditional management practices could improve the performance of native chicken farming and thus contribute to household incomes per year (Sarkar and Golam, 2009). Therefore, the low productivity of indigenous chicken breeds can be improved through research into improved husbandry methods, health care and nutrition.

Overall, besides the results achieved, the study also has some limitations as follows: the number of generations surveyed is small (2 generations), the samples number is small (150 hens/generation), the sample origin is only collected from one location (one province in the Southern of Vietnam). Besides, the study investigated some indicators of reproductive performance based only on appearance characteristics without combining with genetic selection factors. Therefore, the next research direction can be expanded is to evaluate the selection effect on egg productivity of Noi chickens using molecular markers over more than three generations of surveys. This research direction helps to quickly and accurately select genotypes with high egg productivity, thereby contributing to the application of animal husbandry practices towards egg production. However, this research direction requires proficiency in molecular biology techniques (PCR-RFLP, SNPs, microsatellite etc.), a lot of time and funding.

CONCLUSION AND RECOMMENDATIONS

In summary, the G1 generation of Noi chickens has improved some indicators of reproductive performance compared to G0 generations. The G1 generation had the highest average egg production rate (34.6%) and the lowest average FCR (4.60 g feed/g egg). The G1 generation had average feed intake for 10 eggs (3.29 kg) lower than G0 (3.53 kg). Egg production increased in G1 (125.8 eggs/hen) compared to G0 (117.5 eggs/hen), and also FCR improved in G1 (4.60 g feed/g egg) to compare with that of G0 (4.96 g feed/g egg). These findings can be applied in the practice of selecting Noi chicken breeds towards egg production. However, the selection of Noi chickens was only carried out one generation. Therefore, if conditions permit, the study can research on the 2nd and 3rd generations, thereby evaluating the effectiveness of selection to improve reproductive productivity over 3 generations. Moreover, the study also suggest phenotypic selection combined with genotypic selection (based on molecular markers) on Noi chickens to improve accuracy and shorten time.

AUTHOR'S CONTRIBUTION

Le Thanh Phuong: Investigation, methodology, formal analysis, manuscript preparation, editing and finalization. Pham Tan Nha: Conceptualization and design of the experiment, investigation, supervision, editing and finalization.

Conflict of interest

The authors have declared no conflict of interest.

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