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Production performance of laying hens crossed between Choi and Luong Phuong chickens

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Abstract

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The purpose of the experiment was to evaluate the production performance of laying hens crossed between Choi and Luong Phuong (LP) chickens. The experiment consisted of four treatments (T), including treatment 1 (T1): pure LP hens, T2: pure Choi hens, T3: crossbred hens F1 (♂ Choi x ♀ LP), abbreviated as F1 (CxLP) and T4: crossbred hens F1 (♂LP x ♀Choi), abbreviated as F1 (LPxC). Each treatment had 14 hens with 5 replicates. Treatments 1 and 2 were arranged to compare the results of the crosses (T3 and T4) with their parents (T1 and T2). The experiment was carried out in 40 weeks from the first egg laying week of each treatment. The hens of the treatments were fed *libitum*, according to the standards of colored egg laying hens with the same commercial complete compound feed, which had 2750 kcal/ kg and 17% protein. The care regimen was the same for all 4 treatments. Research results show that the F1 (CxLP) and F1 (LPxC) hens had first egg laying age of 174 and 181 days, the laying rates of 45.35 and 42.15%, the egg yield/ hen/ 40 weeks of 127 and 118 eggs, egg mass/hen/40 weeks of 6.60 and 5.89 kg, feed conversion ratio for 1 kg of eggs reaching 5.30 and 5.94 kg, respectively. The above parameters of F1 (CxLP) and F1 (LPxC) hens were inferior to those of LP hens but much better than those of Choi hens and these parameters of the F1 (CxLP) hens were better than F1 (LPxC) hens.

Keywords: Choi hens; Luong Phuong hens; crossbred hens; production performance

Introduction

Crossbreeding between livestock breeds to create hybrids that inherit good characteristics and overcome the weaknesses of parents is always concerned. Several breeding studies on laying hens for this purpose have been carried out in recent years, for example: Kadigi et al. (2001), Saadey et al. (2008), Youssao et al. (2011), Tabinda et al. (2013) Rjkumar et al. (2018), Kedija et al. (2020). Research on crossbreeding between Choi and Luong Phuong chickens was also carried out for the above purpose.

Choi is a chicken breed with colored feathers, slow growing, consuming a lot of feed for 1 kg of weight gain, however, thanks to the good meat quality, its selling price is much higher than that of common chicken breeds. Therefore, this breed of chicken is still maintained and developed by farmers. Luong Phuong is also a colored chicken breed, but it has been selected and improved, so it grows faster, and the feed consumption per 1 kg of weight gain is lower than that of Choi chickens, but the selling price is much lower than that of Choi chickens.

Crossbreeding between Choi and Luong Phuong chickens is expected to promote the advantages and overcome disadvantages of these two chicken breeds. The study was carried out in several steps, evaluating the production performance of laying hens crossed between Choi and Luong Phuong chickens to serve as a basis for next research steps.

Materials and Methods

Pure Choi (C) hens, pure Luong Phuong (LP) hens, crossbred hens F1 (♂ Choi x ♀ LP), abbreviated as F1 (CxLP) and crossbred hens F1 (♂LP x ♀Choi), abbreviated as F1 (LPxC), were used in this experiment.

The experiment was conducted at Thai Nguyen University of Agriculture and Forestry, Vietnam in 2022.

The experiment consisted of 4 treatments (T), namely, treatment 1 (T1): pure LP hens, T2: pure Choi hens, T3: F1 (CxLP) hens and T4: F1 (LPxC) hens. Each treatment had 14 hens with 5 replicates. Treatments 1 and 2 were arranged to compare the results of the crosses (T3 and T4) with their parents (T1 and T2). The experiment was carried out in 40 weeks from the first egg laying week of each treatment. Hens of treatments were fed *libitum* according to the standards of colored egg laying hens with the same commercial complete compound feed, which had 2,750 kcal/ kg and 17% protein. The care regimen was the same for all 4 treatments according to Van et al. (2015).

Monitoring parameters included age at laying the first egg, weight of laying hens, survival rate, laying rate, egg yield, some egg parameters, feed intake and feed conversion ratio for egg production.

The above criteria were monitored after Doan et al. (2011) and statistically analyzed after Dzung et al. (2018).

Results and Discussion

Laying hen's parameters.

Some parameters of laying hens such as laying age, hen weight, and survival rate were presented in Table 1.

Table 1 showed that the age of laying the first egg of the crossbred hens F1 (CxLP) and F1 (LPxC) was 17 and 10 days earlier than that of the Choi hens, but 18 and 25 days later than that of LP hens. The F1 (CxLP) hens had an earlier age to lay its first egg than F1 (LPxC). The hens of the treatments had different ages of laying the first egg, so the start and end of the experiment were also at different ages of hens. The beginning of the experiment of LP, Choi, F1 (CxLP) and F1 (LPxC) hens was 23, 28, 25 and 26 and the end was 62, 67, 64 and 65 weeks of age, respectively. The weight of hens at the beginning and the end of the experiment of the F1 (CxLP) and F1 (LPxC) hens were both larger than Choi hens with significant difference ($P< 0.01$ or 0.001). The weight of the hen is one of the important factors affecting the egg weight. Hens of all 4 treatments did not gain much weight, which proved that the amount of feed and nutritional value of the feed were suitable. Hens of all 4 treatment had a high survival rate, reaching from 94.3 to 97.1% and there was no significant difference among treatments ($P> 0.05$).

Mostafa et al. (2020) cross – breaded chicken Alexandria (A) with late sexual maturity (182.78 days) and chicken Lohmann White (L) with early sexual maturity (151.40 days); the sexual maturity for crossbred hens F1 (LxA) was 172.83 days and F1 (AxL) was 180.01 days. Kedija et al. (2020) informed that at the age of laying the first egg, the weight of Horro hens (H) was 900 g, that of Dominant Red Barred (DRB) hens was 1350 g, that of the crossbred hens F1 (H x DRB) was 1220 g and that of the crossbred hens F1 (DRB **x** H) was 1310 g. Some other studies also showed that the age of sexual maturity and weight of crossbreed hens were significantly improved (Kadigi et all. 2001, Tabinda et al. 2013, Ahmed et al. 2017, Amao, 2017). However, the improvement was different among hybrid combinations because different breeds of chickens are capable of inheriting different traits.

Hens' egg production.

Some parameters such as laying rate, egg productivity and yield of hens are presented in Table 2.

Table 1. Some parameters of laying hens

Categories	Unit	LP	Choi	F1(CxLP)	F1 (LPxC)	SEM	P
Age at first egg	days	156	191	174	181		
Age at beginning (1)	weeks	23	28	25	26		
Age at the end (2)	weeks	62	67	64	65		
WH at 1st egg	g	2154^{a}	2084^{b}	2148^{a}	2137^{a}	23.700	0.001
WH at the end	g	2652^{a}	2515^{c}	2624^{ab}	2595^{b}	25.147	0.000
Weight gain	g	498^{a}	431^{d}	476^{b}	458^{c}	5.544	0.000
Survival rate	%	94.3	97.1	95.7	94.3	2.262	0.196

Note: (1) and (2): Age at the beginning and at the end of the experiment. WH is the weight of the hen. Numbers with different subscription letter in the same row are significantly different ($p < 0.01$ or 0.001)

Table 2. Laying rate and egg yield of hens

Categories	Unit	LP	Choi	F1 (CxLP)	F1 (LPxC)	SEM	P
Days of hens alive	ds/T	18962	19076	18993	18974	270.646	0.908
Average Hens	Hs/ T	67.72	68.13	67.83	67.76	0.967	0.908
Egg yield	Es/T	9955[a]	7154[d]	8614[b]	7997[c]	26.195	0.000
Laying rate	%	52.50[a]	37.50[d]	45.35[b]	42.15[c]	0.635	0.000
Egg productivity	Es/H	147.0[a]	105.0[d]	127.0[b]	118.0[c]	1.134	0.000
Compare	%	140.0	100	120.9	112.4	–	–
Egg mass	kg/ H	8.10[a]	4.91[d]	6.60[b]	5.89[c]	0.179	0.000

Note: ds: days, Hs: hens, Es: eggs, T: treatment. The number of days of the hens died from NT1 to NT4 were 638; 524; 607 and 626 days; Average hens of T1 = 18962: 280 = 67.72. Numbers with different subscription letters in the same row are significantly different ($p < 0.001$)

Table 2 showed that the average number of hens of treatment were almost equal. However, the egg yield of the treatments was completely different. This indicator of F1 (CxLP) and F1 (LPxC) hens was larger than that of Choi hens and smaller than that of LP hens with a significant difference ($P<0.001$). The F1 (CxLP) and F1 (LPxC) hens had the laying rate of 7.85 and 4.65% higher than that of Choi hens, 7.15 and 10.35% smaller than that of LP hens; the average egg productivity per hen was 22 and 13 eggs higher than that of Choi hens, 20 and 29 eggs smaller than that of LP hens, respectively. The laying rate and egg yield of the F1 (CxLP) and F1 (LPxC) hens improved markedly compared to Choi hens ($P<0.001$); the improvement level of the F1 (CxLP) hens was greater than that of F1 (LPxC) hens ($P<0.001$).

The results of laying rate of the treatments in this experiment were consistent with the results of some previous studies. Amao (2017) crossed Naket Neck (NN) with Rhode Island Red (RIR) chickens. As a result, the F1 (♂RIRx-♀NN) hens had a 11.42% higher laying rate than NN hens and 13.13% smaller than that of RIR hens; the F1 (♂NNx-♀RIR) hens had a higher laying rate than both NN and RIR hens. Kadigi et al. (2001) crossed Malawi local chicken (LC) with Black Australorp chickens (BA) and showed that the F1 (BAxLC) hens had a 7% higher laying rate than LC hens, and 9% smaller than that of BA hens. Mostafa et al. (2020) crossed Alecxandria and Lohmann White chickens; the results were similar to the results of the above studies. The improved laying rate of crossbred hens leaded to an increase in their egg production. Normally, chicken breed with better laying rate is used as the hen line in crossbreeding.

Egg parameters.

Some parameters of eggs such as the weight of egg, yolk, albumen and shell were presented in Table 3.

Table 3 showed that the egg weight of the F1 (CxLP) and F1 (LPxC) hens was 5.19 and 3.11 g lager than that of Choi hens, but 3.15 and 5.23 g smaller than that of LP hens, respectively, with a significant difference ($P< 0.001$). In addition to genetic factor, hen weight also affects egg weight. The F1 (CxLP) and F1 (LPxC) hens had a larger weight than Choi hens, smaller than LP hens, which may be one of the reasons for the above results. The egg weight of the treatments was different, so the weight of yolk, albumen and shell of the treatments was not the same. This difference was similar to the difference in egg weight among treatments. Low albumen ratio and high shell ratio have a negative effect on embryo development and egg hatching rate. Eggs of Choi hens had these disadvantages. Eggs of the F1 (CxLP) and F1 (LPxC) hens had overcome these limitations of Choi hen's eggs.

The above results were consistent with the results of previous studies. Soro et al. (2014) crossed Ivorian Local (Lo-

Table 3. Some parameters of eggs

Categories	Unit	LP	Choi	F1(CxLP)	F1(LPxC)	SEM	P
Egg weight	g	55.12[a]	46.78[c]	51.97[b]	49.89[b]	1.330	0.000
Compare	%	117.8	100	111.1	106.6	–	–
Yolk weight	g	17.32[a]	14.92[b]	16.36[ab]	15.76[ab]	0.943	0.007
Albumen weight	g	31.39[a]	26.20[d]	29.51[b]	28.22[c]	0.598	0.000
Shell weight	g	6.41	5.66	6.10	5.91	0.509	0.165
Yolk ratio	%	31.42	31.89	31.48	31.59	0.500	0.475
Albumen ratio	%	56.95	56.01	56.78	56.56	0.702	0.215
Shell ratio	%	11.63	12.10	11.74	11.85	1.041	0.906
Yolk/ Albumen	%	55.18	56.62	55.44	55.85	2.774	0.761

Note: The number of eggs used for determining egg weight was 400/ treatment, for determining other parameters of eggs was 200/ treatment. Numbers with different subscription letters in the same row are significantly different ($p < 0.01$ or 0.001)

Table 4. The feed for egg production

Indicators	Unit	LP	Choi	F1 (CxLP)	F1 (LPxC)	SEM	P
Feed intake	kg/ T	2370.3	2384.5	2374.1	2371.8	126.913	0.998
Eggs / T	eggs/ T	9955[a]	7154[d]	8614[b]	7997[c]	439.154	0.000
Egg Mass/ T	kg/ T	548.7[a]	334.7[d]	447.6[b]	399.0[c]	25.554	0.000
Feed/ 10 eggs	kg	2.38[d]	3.33[a]	2.76[c]	2.96[b]	0.153	0.000
Compare	%	71.5	100	82.9	88.9	–	–
Feed/ 1 kg eggs	kg	4.32[d]	7.12[a]	5.30[c]	5.94[b]	0.330	0.000
Compare	%	60.7	100	74.4	83.4	–	–

Note: T: Treatment; Numbers with different subscription letters in the same row are significantly different ($p < 0.001$).

cal) with French Red Label (Label) chickens and showed that the egg weight of the crossbred hens were 13.1% larger than that of Local hen but 11.6% smaller than that of Label hen. Some other studies (Yousao et al., 2011, Hoan et al., 2017, Ahmed, 2017 and Kedija et al., 2020) crossed different laying hen breeds and the results was similar to that of Sorro. Research by Yousao et al., (2011), Sorro et al., (2014) showed that eggs of native hens had lower albumen and higher shell ratios than t those of egg-laying breeds.

Feed for egg production.

Some criteria on feed for egg production such as feed intake, feed consumption for 10 eggs and 1kg eggs were presented in Table 4.

Table 4 showed that the feed intake of the treatments were almost the same, but due to the difference in egg production of the treatments, the feed consumption for 10 eggs and 1 kg of eggs differed significantly among treatments ($P<0.001$). Feed consumption for 10 eggs of the F1 (CxLP) and F1 (LPxC) hens was 0.57 and 0.37 kg lower than that of Choi hens, but 0.38 and 0.58 kg higher than that of LP hens. The egg weight of Choi hens was smaller than that of the other treatments, so the feed consumption for 1 kg eggs was much higher than that of other treatments. If the feed consumption for egg production of Choi hens was 100%, then the feed consumption of the F1 (CxLP) and F1 (LPxC) hens for producing 10 eggs was 82.9 and 88.9%, for producing 1 kg eggs was 74.4 and 83.4%. Thus, feed consumption for egg production of the F1 (CxLP) and F1 (LPxC) hens has been significantly improved.

Heterosis of crosses.

Heterosis (H %) for the studied traits are shown in Table 5.

Table 5 shows that the F1 (CxLP) and F1 (LPxC) hens both had a later age at first egg laying than the average of their parents (H%>0 as Note). Heterosis for hen weight, laying rate, egg mass, weight of egg, yolk, albumen traits of the F1 (CxLP) hens was positive (i. e., the value of crosses were higher than the average of the parental strains), but except for hen weight, the above traits of the F1 (LPxC) was negative (i. e., the value of crosses were lower than the average of the parental strains). For the trait of feed consumption for egg production, the F1 (CxLP) hens had H%<0, which means that the feed consumption for egg production of the crosses was lower than the average of the parents and the F1 (LPxC) hens had H%>0, which means that the feed consumption for egg production of the crosses was higher than the average of

Table 5. Heterosis for the studied traits (H %)

Categories	H % of CxLP	H % of LPxC	H % of (CxLP) +(LPxC)
Age at first egg (days)	0.29	4.32	2.30
WH at laying first egg	1.37	0.85	1.10
WH at the end of exp.	1.57	0.44	1.01
Laying rate (%)	0.78	- 6.30	-2.78
Egg mass (kg/hen)	1.46	-1.00	-3.99
Egg weight (g/egg)	2.00	-2.08	-0.04
Yolk weight (g/egg)	1.49	-2.33	-0.37
Albumen weight (g/egg)	2.48	-1.99	0.24
Shell weight (g/egg)	1.08	-2.07	-0.50
Feed/ kg eggs (kg/kg)	-7.34	3.85	-1.75

Note: For the trait of age at laying first egg, if H%>0, it means that the laying age of the hybrid is later than the average age of the parents (negative) and vice versa (positive). For the trait of feed consumption for egg production, if H%>0, it means that the feed consumption for egg production of the hybrid is higher than the average of the parents (negative) and vice versa (positive)

the parents (see Note). Thus, in terms of heterosis, the traits of the F1 (CxLP) were improved more than that of the F1 (LPxC) hens. When calculating heterosis of both F1 (CxLP) and F1(LPxC) hens, the values of most traits of the cross were inferior to the average of the parents, except for the traits of hen weight, egg albumen weight and feed consumption for egg production, which were better than the average of the parents.

Conclusion

The F1 (CxLP) and F1 (LPxC) hens had age of laying first eggs of 174 and 181 days. The laying rate was 45.35 and 42.15%, egg yield of a hen in 40 weeks of laying was 127 and 118 eggs, and egg mass of a hen was 6.60 and 5.89 kg. The feed consumption for producing 10 eggs was 2.76 and 2.96 kg, for producing 1kg eggs was 5.30 and 5.94 kg. The above parameters of the F1 (CxLP) and F1 (LPxC) hens were inferior to those of LP hens but significantly better than that of Choi hens. The improvement level of F1 (CxLP) hens was greater than that of F1 (LPxC) hens.

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