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Phenotypic Traits, Egg Productivity and Body Weight Performance of *Gama Ayam* BC_1 *Kamper*

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ABSTRAK

Indonesia kini tengah menempati peringkat 10 besar negara produsen daging dan telur unggas di dunia. Ayam ras pedaging tipe fast-growing Broiler dan ayam ras petelur tipe Layer Lohmann Brown-Classic merupakan dua galur ayam yang mendominasi sektor peternakan unggas di Indonesia. Potensi plasma nutfah ayam lokal asli Indonesia sebanyak 31 galur ayam belum dimanfaatkan secara optimal dalam usaha mewujudkan kemandirian peternakan unggas Indonesia. Hal ini berujung kepada ketergantungan Indonesia terhadap impor bibit ayam (grandparent stock, GPS) dalam kegiatan penyediaan bibit ayam. Gama Ayam Research Team telah memberdayakan potensi plasma nutfah ayam lokal asli Indonesia, salah satunya Pelung melalui program persilangan selektif. Hasilnya beberapa galur ayam potensial untuk dikembangkan diantaranya Kambro dan Kamper. Dalam penelitian ini program persilangan selektif galur ayam Kamper ditingkatkan melalui persilangan balik (backcross) antara ayam pejantan F_1 Kamper (hibrida Pelung dan Layer Lohmann Brown-Classic) dengan ayam betina F_1 Layer Lohmann Brown-Classic. Generasi BC1 (backcross I) diekspektasikan untuk mewarisi performa pertumbuhan ayam Pelung, produktivitas telur ayam Layer Lohmann Brown-Classic dan karakter fenotipe (postur tubuh dan warna bulu) ayam Kamper. Karakter fenotipe yang diamati dalam generasi BC1 Kamper digolongkan ke dalam enam kelas fenotipe. Bobot tubuh BC_1 Kamper (n = 50) mencapai 538.84 g lebih tinggi dibandingkan F_1 Kamper and Layer Lohmann Brown-Classic dalam sistem semi-intensive dengan diet pakan standar ad libitum dalam periode delapan minggu. Produktivitas telur BC_1 Kamper mencapai 39.11 telur (periode 16-minggu) dan hen day production (HDP) sekitar 0.6-0.67. Telur BC_1 Kamper diklasifikasikan sebagai round egg, AB dan spherical dengan nilai heritabilitas telur sekitar 0.2-0.244. Estimasi heritabilitas (h^2 = low-moderate) menunjukkan kesamaan dengan F_1 Kamper mengindikasikan proporsi distribusi alel antara generasi tetua dengan generasi indukan Layer Lohmann Brown-Classic dan F_1 Kamper.

Kata Kunci: Ayam asli Indonesia, plasma nutfah, hen day production, Pelung, Layer Lohmann Brown-Classic

INTRODUCTION

Indonesia is currently in the top 10 of the world's poultry meat and egg producers. The consumption of chicken meat and eggs provide the largest contribution of domestic demand for 60.73% then followed by beef at 21.94%. Based on this percentage, for about 67% is chicken poultry production and only about 23% is provided by local chickens. Pusat Data dan Sistem Informasi Pertanian (2015) stated that chicken meat consumption rate of 2014 reached 4.48 kg/capita/year (total consumption of broiler chicken, post-laying layer chicken and male layer also native chicken). Chicken poultry sector contributed around 60.73% of the demand on animal consumption needs fulfillment (Suprijatna, 2010; Mahardhika and Daryono, 2019). Ditjen PKH (2017) showed that native chicken production nationally reached 8.50% or 284.9 thousand tons with contribution percentage of 12.86% to nation chicken meat production. Ditjen PKH (2018) showed that Indonesia poultry livestock populations in 2018 consisted of 1.8 billion broiler-type/ broiler chickens, 181.752 layer chickens and 310.960 native chickens.

Broiler and layer are types of chicken that dominate the current poultry industry in Indonesia. The domination is caused by the fact that broilers and layers have higher meat and eggs production rate and grow relatively faster than the free range chicken. Broiler-type and laying-type chicken poultry industry went through significant growth per year driven by improvement on income and knowledge on healthy nutritional-balance food product (Iskandar, 2017; Mahardhika and Daryono, 2019). Chicken poultry industry in Indonesia is still depending on imported broiler caused by short production

period and rapid turnover (Nurfadillah et al., 2018).

Native Indonesia chickens are called *Kampung* chickens or native (non-breed chickens) to differentiate commercial breed such as Cobb, Hubbar, Hybro, Isa Hyline and Hisex (Henuk and Bakti, 2018; Mahardhika and Daryono, 2019). Identification of native chicken germplasm resulted in 34 breeds of chicken consist of *Ayunai, Balenggek, Banten, Bangkok, Burgo, Bekisar, Cangehgar, Cemani, Ciparage, Gaok, Jepun, Kampung, Kasintu, Kedu* (*hitam* and *putih*), *Pelung, Lamba, Maleo, Melayu, Merawang, Nagrak, Nunukan, Nusa Penida, Olagan, Rintit atau Walik, Sedayu, Sentul, Siem, Sumatera, Tolaki, Tukung, Wareng, Sabu,* and *Semau* (Nataamijaya, 2010; Henuk and Bakti, 2018; Mahardhika and Daryono, 2019). Approximately 11 native chicken breeds are categorized as candidates of broiler-type and laying-type chicken (Henuk and Bakti, 2018). Ardo et al. (2019) stated that improvement of productivity and competitive quality of local broiler chicken can be achieved through selective breeding of indigenous Indonesia chicken breeds. Selective breeding is aimed to produce superior chicken breed with adjusted phenotype quality based on human needs (Das et al., 2008; Cheng, 2010; Oldenbroek and van der waaij, 2014; Mariandayani et al., 2013; Sudrajat and Isyanto, 2018; Mahardhika and Daryono, 2019).

Pelung Blirik Hitam has several distinguished characters such as higher posture and body weight (BWT) compared with other indigenous breeds (Daryono et al., 2010; Mahardhika and Daryono, 2019; Ardo et al., 2019). Body weight (BWT) of male *Pelung* chicken can reach 3.37 kg, and females can reach 2.52 kg (Daryono et al., 2010). Hidayat and Asmarasari (2015) stated that in the period of 20 weeks body weight (BWT) of Pelung can reach 1663 g/head heavier than other meat producer indigenous chicken such as *Kampung* (1408 g/head), Black *Kedu* (1480 g/head), White *Kedu* (1320 g/head) and *Nunukan* (1203 g/head). Meanwhile, Broiler Cobb 500 has distinguished productivity and a high growth rate in the early phase (7 to 18 weeks). The male and female Broiler Cobb 500 can reach 1,599.17 g and 1,540.46 g (Hassan et al., 2016). Selective breeding between *Pelung Blirik Hitam* and Broiler Cobb 500 produced hybrid chicken F_1 Broiler or *Kambro* (*Kampung*-Broiler) (Mahardhika and Daryono, 2019). Based on body weight (BWT) measurement, *Kambro* population (n = 17) has an average BWT of 1,244.14 ± 453.82 g significant ($p<0.01$) to F_1 *Pelung* (n = 7) with an average BWT of 602.88 ± 79.93 g in 8 weeks period with *ad libitum* diet of standard feed (Mahardhika and Daryono, 2019).

Due to this promising result, we conducted a selective breeding program between *Pelung* and Layer Lohmann Brown-Classic and produced *Kamper*. The purpose of this research is to develop a breed of chicken with both characteristic of meat-type chicken and egg-producer chicken. F_1 *Kamper* was produced as the first generation, further in the selective breeding program we conducted backcross to evaluate the result. BC_1 *Kamper* generation (backcross I) was expected to inherit the growth performance of *Pelung* chickens, the egg productivity of Layer chicken and phenotypic traits (body posture and feather colors) of *Kamper* chickens.

MATERIALS AND METHODS

This research was conducted in Pusat Inovasi Agroteknologi (PIAT), Desa Kali Tirto, Berbah, Sleman Regency, Yogyakarta, Indonesia using 50 females layer Lohmann Brown-Classic and 10 males F_1 *Kamper* in semi-intensive rearing system with the ratio female to male of 5:1. Parental crossbreeding was conducted in brood shed (8 m^2) owned by Gama Ayam Research Team and fed with *ad libitum* AD-II diet. Standard feed produced by PT. Japfa Comfeed Indonesia, AD-II (brood/juvenile, 9-22 week) and BR-1 (starter, 0-22 day). A total of 50 day-old BC_1 *Kamper* chicks were reared intensively in insulated bamboo pens fed with ad libitum BR-1 diet. Four weeks-old BC_1 *Kamper* chickens then transferred into the larger shed under a semi-intensive rearing system (8 m^2) with ad libitum BR-1 diet for the extents of eight weeks. Body weight (BWT) growth of BC_1 *Kamper* was measured over eight weeks period, followed by observation and measurement of phenotypic traits at the week-

7. Body weight (BWT) growth performance was measured with a digital scale KrisChef EK9350H with 0.01 g accuracy per week. Zoometrical measurement was measured with metline based on morphological guidance of chicken sceletal adopted with modification and addition from Daryono et al. (2010) (Table 1).

Table 1. Zoometrical measurements with modification and addition from Daryono et al. (2010) (Mahardhika and Daryono, 2019)

Characteristics (abbreviation)	Detailed procedure
Chicken height (TA)	measured from the digit/hallux to the tip of the comb
Body height (TB)	measured from the digit/hallux to the end of the distal vertebrae
Beak width (LP)	measured from articular to dexter
Beak length (PP)	measured from the base of the angular process to the end of the mandibular symphysis
Head length (PK)	measured from the supraorbital bone to premaxilla
Head width (LK)	measured from quadratojugal sinister to dexter
Comb height (TJ)	measured from the highest tip of the comb to the base of the comb
Comb length (PJ)	measured from the back to the front of the comb
Body length (PB)	measured from the tip of the first thoracic vertebra to the base of the pygostyle
Body width (LB)	measured from the base of the femoral bone to dexter
Chest circumference (LD)	measured from the sternal of the keel in a circle
Dorsal length (PPu)	measured from the thoracic vertebrae to the caudal vertebrae end
Wingspan (PS)	measured from the base of the humerus to the end of the carpus
Neck length (PL)	measured from the base of the atlas to the tip of the thoracic vertebrae
Tibia length (PBe)	measured from the tip of the femur to the base of the tibiotarsus
Femur length (PPa)	measured from the end of the patella to the base of the femur
Shank	measured from the tarsus to the base of the patella

Data is analyzed with descriptive statistics and independent sample t-test using IBM© SPSS© Statistics version 21. Documentation of phenotypic traits conducted with high resolution camera and phenotypic classes was determined based on color of body feather. Egg productivity was measured with daily count and Hen Day Production (HDP) of 20 BC_1 *Kamper* hens in the period of four months.

RESULTS AND DISCUSSION

Phenotypic Traits

In 2013-2014, Gama Ayam F_1 *Kamper* was successfully produced with the average body weight of 911-1100 g at 49-days-old (Lesmana, 2016). F_1 *Kamper* (F_1 *Kampung*-Layer) has the combination of both its parental *Pelung* and Layer Lohmann Brown-Classic. Ardo et al. (2019) stated that the purpose of F_1 *Kamper* was to inherit laying traits of Layer Lohmann Brown-Classic. The use of *Pelung* in this study was to enhance its phenotypic traits on body weight performance and also visual appearance for example body posture and feather color. Semakula et al. (2011) stated that visual judgement has significant influence on sale value with a tendency of increasing demand of native Ugandan chickens. Suprijatna (2010) stated that native Indonesia chickens has a niche market and the prevalencies of customer showed a higher demand on native chickens based of its unique taste and phenotypic appearance. In the previous study, F_1 *Kamper* had been observed to have as many as five phenotypic

classes of feather color variation including pure white, brown-white, *belirik*-brown, *belirik*-black, and black (Lesmana, 2016). High presence of allele heterozygosity drives the selective breeding program of F_1 *Kamper* chickens by selecting individuals who have prominent body weight performance and desired phenotypic traits to obtain more uniform hybrids at subsequent crosses. In order to achieve that a backcross was conducted with female Layer Lohmann Brown-Classic and male F_1 *Kamper* (Figure 1).

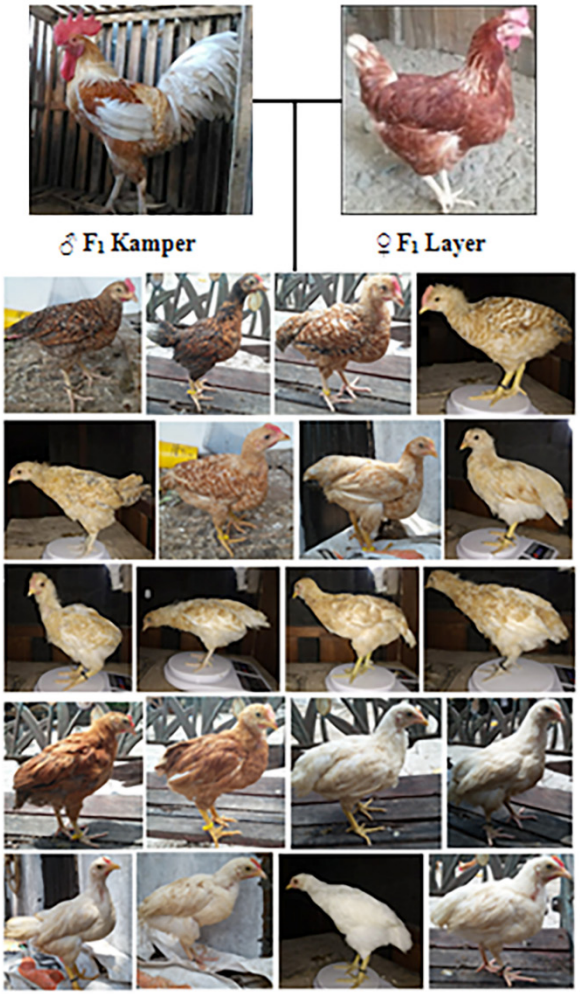

Figure 1. BC_1 *Kamper* chickens phenotypic traits. A crossbreed of female F_1 Layer (n=50) and male ♂ F_1 *Kamper* (n=10) represented with the image above resulted in a total of 687 BC_1 *Kamper* day-old-chicks. Selected BC_1 *Kamper* DOC of 50 chickens were measured and observed.

In this study, we followed the instruction provided under the direction of the Regulation of the Minister of Agriculture No. 19/Permentan/OT.140/2/2008 concerning Determination and Release of Clumps or Animal Strains. The regulation requires breeders to fulfill genetic data, one of which is genetic data on chicken phenotypes. The data consists of some phenotypic characters with population details of 30 males and 200 females from a crossing structure of 10 males and 50 females (Setiadi, 2016).

Based on classification, phenotypic traits of BC_1 *Kamper* (n=50) can be grouped into six classes including plain brown (10%), plain white (30%) and *belirik* colors (60%). *Belirik* class can be divided into specific classes including black and brown (hc), black, brown and white (hcp) and brown and white (cp). Habibah et al. (2019, *unpublished data*) found that crossbreds of F_1 *Kamper* were classified into four phenotypic classes including brown, white, black-brown *belirik*, and brown-golden *belirik* based on observation of feather color

in 30 F_2 Golden *Kamper* (GK) chickens. These findings indicates a wider variety of allele being inherited from Layer Lohmann Brown-Classic in backcross I *Kamper*. Lesmana (2016) found that there were five phenotypic classes including pure white, brown-white, belirik-brown, belirik-black, and black in F_1 *Kamper* population. Qualitative characters are a trait that can not be measured but can be classified into different phenotypic categories (Habibah et al., 2019 *unpublished data*). In the natural population of chickens or poultry, there is a diversity of plumage colors among different species or very uniform plumage colors within the species. Much of this inter-species diversity is due to regulatory changes that affect the expression of involved-genes in pigment synthesis. Pigment biosynthesis itself comes from two types of melanin (eumelanin and pheomelanin) that occur in melanosomes (Kushimoto et al., 2003).

In contrast to the quantitative nature of polygenic, qualitative properties based on classical trait ability are under the genetic control of one or more genes, with little or no environmental factors that can obscure the effects of genes (Elrod et al., 2006).

Table 2. Zoometrical measurements of BC_1 *Kamper* (n=50)

Parameters (cm)	Sex Groups		*t*	*df*
	Male (n=27)	Female (n=23)		
TA	32.0148**a** (3.43777)	28.8000**b** (3.18091)	3.410***	48
TB	21.7185**a** (2.32015)	20.6435**a** (3.76887)	1.234^{ns}	48
LP	1.8407**a** (0.23900)	1.7739**a** (0.33604)	0.819^{ns}	48
PP	2.8407**a** (0.25155)	2.7652**a** (0.24974)	1.062^{ns}	48
LK	2.9333**a** (0.38730)	2.7304**a** (0.39131)	1.838^{ns}	48
PK	3.0963**a** (0.49028)	2.8783**a** (0.36922)	1.751^{ns}	48
PJ	3.0741**a** (0.45454)	2.1087**b** (0.43475)	7.635***	48
TJ	1.2407**a** (0.32612)	0.8739**a** (1.43787)	1.289^{ns}	48
PL	9.0333**a** (1.0164)	8.6957**a** (1.61962)	0.897^{ns}	48
PPu	15.5741**a** (1.76931)	14.7652**a** (1.76161)	1.614^{ns}	48
PB	10.4815**a** (1.05650)	10.0739**a** (1.62403)	1.067^{ns}	48
LB	5.6185**a** (0.74112)	5.3087**a** (0.64801)	1.560^{ns}	48
LD	21.2296**a** (2.26475)	20.8870**a** (2.89566)	0.469^{ns}	48
PS	10.7852**a** (1.17201)	10.2522**a** (1.22544)	1.570^{ns}	48
PPa	7.7556**a** (0.82010)	7.2913**a** (1.01932)	1.785^{ns}	48
PBe	9.9926**a** (1.05500)	9.3391**b** (0.85213)	2.381*	48
Shank	5.9778**a** (0.63690)	5.4652**b** (0.65478)	2.8**	48

* = p <0.05, ** = p<0.1 *** = p < 0.001, ns = non-significant. The standard deviation is listed beside the mean. The averages with different subscripts in the same column differ significantly. (TA: chicken height; TB: body height; LP: beak width; PP: beak length; LK; head width; PK: head length; PJ: comb length; TJ: comb height; PL: neck length; PPu: dorsal length; PB: body length; LB: body width; LD: chest circumference; PS: wingspan; PPa: femur length; PBe: tibia length; shank) .

Zoometrical measurement was conducted at week-7 with total BC_1 *Kamper* of 50 chickens divided into two groups based on sex, group I (male) and group II (female). An independent sample t-test was conducted to determine significance level of each parameters in group I and group II (Table 2). Based on the result several parameters including TA, PJ, PBe and shank were significantly different between two groups. Chicken height between male and female BC_1 *Kamper* were significantly different, male TA (M = 32.0148, SD = 3.43777), t (48) = 3.410, p<0.001) and female TA (M = 28.8000, SD = 3.18091, t (48) = 3.410, p<0.001). Comb length between male and female BC_1 *Kamper* were significantly different, male PJ (M = 3.0741, SD = 0.454, t (48) = 7.635, p<0.001) and female PJ (M = 2.1087, SD = 0.43475, t (48) = 7.635, P<0.001). Tibia length between male

and female BC_1 *Kamper* were significantly different, male PBe (M = 9.9926, SD = 1.05500, t (48) = 2.381, p<0.05) and female PBe (M = 9.3391, SD = 0.85213, t (48) = 2.381, p<0.05). Shank length between male and female BC_1 *Kamper* were significantly different, male shank (M = 5.977, SD = 0.63690, t (48) = 2.8, p<0.01) and female shank (M = 5.4652, SD = 0.65478, t (48) = 2.8, p<0.01). A visual comparison can be seen in Figure 2, these parameters show the physical appearance of BC_1 *Kamper*.

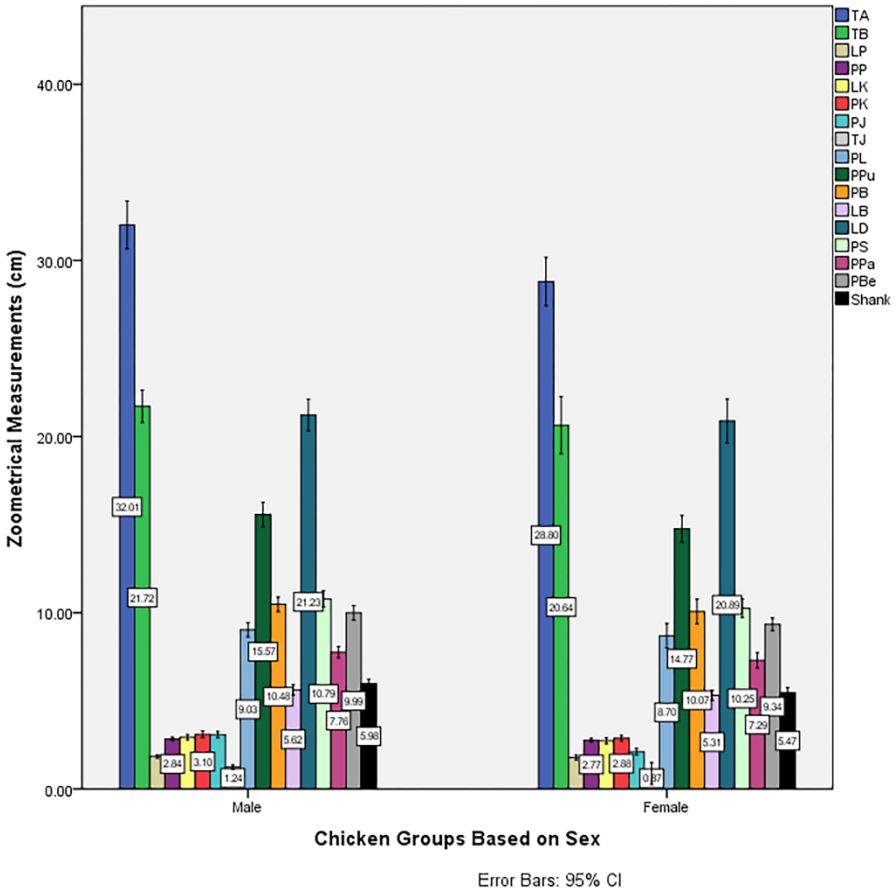

Figure 2. BC_1 *Kamper* chicken groups based on sex. (TA: chicken height; TB: body height; LP: beak width; PP: beak length; LK; head width; PK: head length; PJ: comb length; TJ: comb height; PL: neck length; PPu: dorsal length; PB: body length; LB: body width; LD: chest circumference; PS: wingspan; PPa: femur length; PBe: tibia length; shank).

Egg Productivity and Body Weight Performance

There are two types of layer chicken, light type and medium type. Light layer type chickens or often known as White Layer Chicken come from pure white leghorn strains with specific characteristics including lean body, white feather color, red comb, and have egg prodity of approximately 260 eggs per year. Medium layer type chickens or often known as the Brown Layer Chicken has the characteristic including medium body size (not too thin and fat), brown feathers, and have egg productivity of approximately 200 eggs per year. Medium layer type chickens are often called dual-type chickens, the reason is it can produce eggs and meat at once in large quantities. Egg production is the number of eggs produced by each chicken during the spawning period.

BC_1 *Kamper* egg productivity reached 39.11 eggs and HDP ranged from 0.6-0.67, slightly similar with *Pelung* chicken egg productivity and approaching the F_1 *Kamper* egg productivity. Based on the previous study, it is known that there are very significant differences in egg productivity

(P<0.05) between the three chicken strains. In the first week, the hen day production (HDP) F_1 *Kamper* chicken reached 0.67 while the production of Layer Lohmann Brown-Classic and *Pelung* chicken was 1.29 and 0.6, respectively (Kurnia, 2016). During the four months egg-laying period, F_1 *Kamper* chicken egg productivity reached 55.58 ± 1.04 eggs, Layer Lohmann Brown-Classic chicken egg productivity reached 71.89 ± 1.64 eggs while *Pelung* chicken egg productivity reached 27.2 ± 0.97 eggs (Kurnia, 2016).

Table 3. Heritability value (h^2) of F_1 *Kamper* compare with Layer Lohmann Brown-Classic and *Pelung*

h^2	h^2 of egg F_1 *Kamper*		h^2 of egg F_1 *Kamper*	
	Layer Lohmann Brown-Classic	*Pelung*	Layer Lohmann Brown-Classic	*Pelung*
length	0.047	0.122	low	low
width	0.183	0.064	low	low
weight	0.244	0.470	moderate	high

BC_1 *Kamper* chicken egg heritability was measured according to length, width and egg shape index. The egg shape index is an observation of the shape of an egg through a comparison between the largest width or diameter of an intact egg and its length. Egg can be classified into three categories based on egg shape index (EI) including sharp egg (EI<72), standard egg (EI = 72 - 76) and round egg (EI>76) (Duman et al., 2016). Kurnia (2016) reported that egg shape index of F_1 *Kamper*, Layer Lohmann Brown-Classic and *Pelung* can be classified into 0.77, 0.79 and 0.70 respectively. Romanoff and Romanoff (1963) stated that the ideal chicken egg shape index is 0.74. This shows that morphologically, the shape of F_1 *Kamper* chicken eggs can be classified as ideal. Egg shape variations are influenced by variations in individual, species, age and heredity (Kurnia, 2016). Based on recent study BC_1 *Kamper* egg shape index shows a similarity with F_1 *Kamper* and classified as round egg (EI>76). The division of egg grade is grouped into three classes, AA (perfect/standard egg), A / B (nearly perfect/ sharp egg) and AB (round egg) (Duman et al., 2016; Ikegwu et al., 2016). In Setiawati et al. (2016) egg shape consists of biconical (both pointed ends), elliptical (elliptical), oval (best shape) and spherical (almost round). The shape of the egg is influenced by genetic factors and no correlation is found between the maintenance system and the temperature of the egg shape (Setiawati et al., 2016). BC_1 *Kamper* egg can be classified into round egg, AB and spherical.

BC_1 *Kamper* egg heritability value ranged from 0.2 to 0.244. Kurnia (2016) classified the heritability value into 3 groups, low (0-0.02), low-moderate (0.2-0.4) and high (>0.4). This shows that, heritability value of F_1 *Kamper* chicken eggs are classified as low-moderate (Kurnia, 2016) (Table 3). Heritability value (h^2) closer to 1 indicates that the hybrid or offspring have exactly the same characteristics as the parentals. Meanwhile, if the heritability value approaches 0, it shows that the hybrid yield is more influenced by environmental factors. BC_1 *Kamper* heritability estimation shows a significant similarity with F_1 *Kamper* indicated a proportion of allelic distribution between grandparent generation with parental generation of Layer Lohmann Brown-Classic and F_1 *Kamper.*

Based on the calculation of heritability estimation, it was known that, h^2 value of F_1 *Kamper* chicken egg length character has more similarity with the length of the *Pelung* chicken egg compared with Layer Lohmann Brown-Classic chicken egg. Heritability value on width character, h^2 values of F_1 *Kamper* chicken egg has more similarity with the Layer Lohmann Brown-Classic chicken egg (Kurnia, 2016). Meanwhile, the weight character, h^2 value of F_1 *Kamper* chicken egg has more similarity with the character of Layer Lohmann Brown-Classic chicken egg (Kurnia, 2016). Thus, BC_1 *Kamper* heritability value gives a phenotypic proportion of egg characters inherited from parental generation of F_1 *Kamper.*

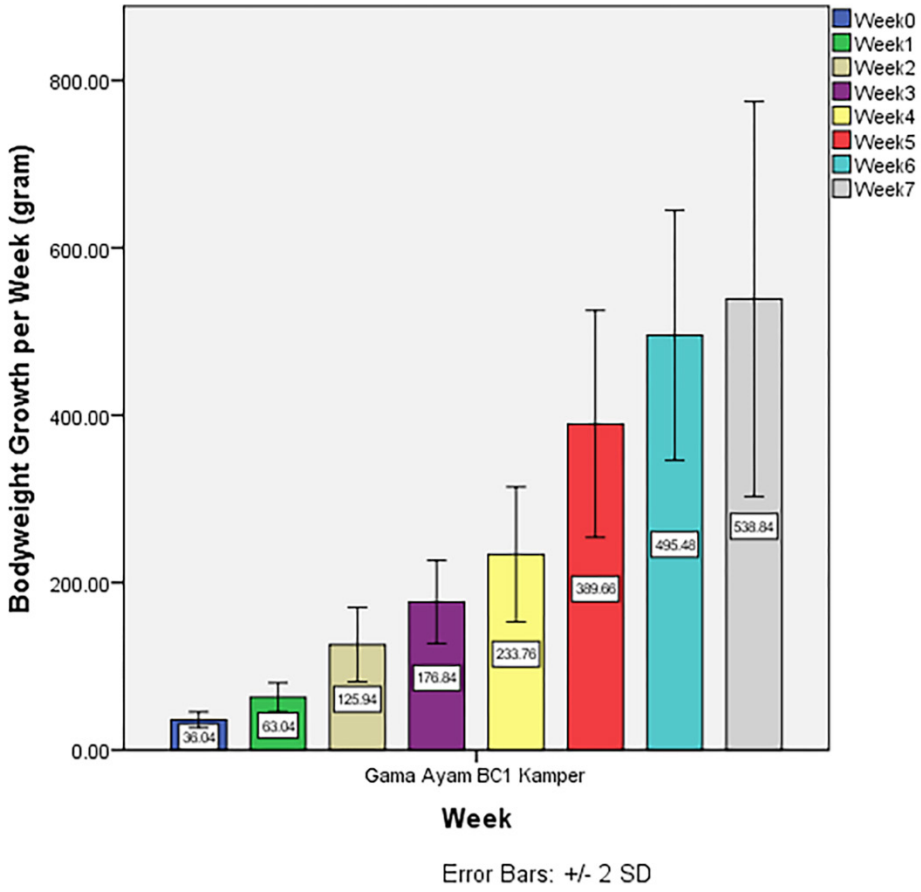

Figure 3. BC_1 *Kamper* body weight growth performance during eight weeks period observation.

In Figure 3 BC_1 *Kamper* under semi-intensive rearing system and *ad libitum* standard feed diet can reach body weight of 538.84 g in eight weeks period. In the previous study, F_1 *Kamper,* Layer Lohmann Brown-Classic and BC_1 *Kamper* each have the body weight of 771.3 g, 530 g and 448.75 g respectively (Lesmana, 2016). BC_1 *Kamper* shows a higher body weight compare with F_1 *Kamper* and Layer Lohmann Brown-Classic. In comparison, crossbreeding of *Sentul* chicken reached average body weight of 896.34 ± 55.46 g (male *Sentul*) and 736.00 ± 46.63 g (female *Sentul*) during 75 days period (Solikin et al., 2016; Sudrajat and Isyanto, 2018). Mariandayani et al. (2013) stated data about several body weight of native chicken at 8-weeks-old which including *Pelung* (male 458.23 g and female 420.11 g), *Sentul* (male 406.36 g and female 355.98 g), *Kampung* (male 411.56 g and female 358.74 g). BC_1 *Kamper* chicken is expected to have a better body weight and during body weight observation has not reached inflection point period. Inflection point is maximum body weight growth, during this period a shift of growth phase occurs with declining growth. Growth can occur during weeks follow because chicken has not reached sexual maturity (Sogindor, 2017). Suprijatna (2010) stated that sexual maturity of Pelung chicken at day-165 with 12-weeks-old weight can reach 669 g. Nurhuda (2017) stated that genetic component combination affects BT of chicken from crossbreeding with hybrids observed to have better performance than parantal generation on several characters or traits.

CONCLUSION

The phenotypic traits observed in the BC_1 *Kamper* generation are classified into six phenotypic classes. Body weight of BC_1 *Kamper* (n = 50) reached 538.84 g higher than both F_1 *Kamper* and Layer Lohmann Brown-

Classic under semi-intensive rearing system with *ad libitum* standard feed diet in eight weeks period. BC_1 *Kamper* egg productivity reached 39.11 eggs (16-weeks period) and hen day production (HDP) ranged from 0.6-0.67. BC_1 *Kamper* egg can be classified into round egg, AB and spherical with egg heritability value ranged from 0.2 to 0.244. Heritability estimation (h^2 = low-moderate) shows a significant similarity with F_1 *Kamper* indicated a proportion of allelic distribution between grandparent generation with parental generation of Layer Lohmann Brown-Classic and F_1 *Kamper.*

CONFLICT OF INTEREST

Authors have no conflict of interest to declare.

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