Research Article

Egg Weight, Sex and Variety Effects on Body Weights and Growth Ability of Kedu Chickens

Sutopo Sutopo, Dela Ayu Lestari, Edy Kurnianto, Asep Setiaji*

Department of Animal Science, Faculty of Animal and Agricultural Sciences, Universitas Diponegoro, Semarang, 50275 Central Java, Indonesia.

Abstract | The objective of this study was to analyze the effects of egg weight, sex, and varieties on body weights and growth ability of Kedu Chickens. The number of chicken used in each variety of the male Red comb Kedu and Black Comb Kedu Chickens were 5 and 4 heads, respectively. Meanwhile, the number of female was 24 and 20 heads, respectively. A total of 901 eggs were collected during the period of 11 weeks. Egg weight (EWG) and body weight (BW) were weighed individually. BW recorded were BW_0, BW_{15}, BW_{30}, BW_{45}, and BW_{60}. The average daily gain was counted as the amount of weight has gained during the growing period (ADG_{0-15}, ADG_{15-30}, ADG_{30-45}, ADG_{45-60}, and ADG_{0-60}). A linear mixed model was used to analyze the effect of EWG, sex, and variety on BW and ADG. EWG had a significant effect on BW_0, BW_{15}, and BW_{30}. Variety was significant on BW_0, BW_{45}, BW_{60}, ADG_{30-45}, and ADG_{0-60}. Sex was significant on most of the traits. Male Kedu chickens showed more superior than the female ones. EWG showed positive phenotypic correlations to most of BW measured.

Keywords | Average daily gain, Kedu chickens, Mixed model, Phenotypic correlations

Received | February 02, 2022; **Accepted** | March 01, 2022; **Published** | April 01, 2022
***Correspondence** | Asep Setiaji, Department of Animal Science, Faculty of Animal and Agricultural Sciences, Universitas Diponegoro, Semarang, 50275 Central Java, Indonesia; **Email:** asepsetiaji93@gmail.com
Citation | Sutopo S, Lestari DA, Kurnianto E, Setiaji A (2022). Egg weight, sex and variety effects on body weights and growth ability of kedu chickens. Adv. Anim. Vet. Sci. 10(5): 1017-1022.
DOI | http://dx.doi.org/10.17582/journal.aavs/2022/10.5.1017.1022
ISSN (Online) | 2307-8316

INTRODUCTION

Kedu chicken is one of Indonesia's local livestock genetic resources which is quite popular among rural breeders but its existence has not been explored optimally. Knowing as dual-purpose livestock, Kedu chicken was originated from Kedu district of Temanggung, Central Java. According to phylogenetic studies using microsatellite markers, Kedu chicken is closely related to Kampung chicken (Sartika et al., 2004). Kedu chicken was the result of selection by traditional breeders from native Indonesian chickens having specific characteristics and productivity which has been carried out since 1926 (Hidayat and Asmarasari, 2015). Apart from Java island, Kedu chickens are also spread in Kalimantan and Sulawesi islands.

Based on Decree 2487/Kpts/LB.430/8/2012 by Ministry of Agriculture, Kedu chicken has black, white and striated feathers; a big compact body with a wide back; black and white greyish color skin; black or yellow color of beak, base of throat and tongue; and black and white color of leg. The rooster has a large, thick, and erect comb, in black or red

color forming a single comb, and it also has a large wattle, in black or red color. While the hen has a single shape comb, serrated blade, thick, oddly serrated, in black and red color, and has no wattle (Directorate General of Livestock Services, 2012). Based on feathers color, Kedu chickens were divided into 3, namely black Kedu chicken, white Kedu chicken, and a mixture of black and white which were then called striated Kedu chicken (Johari, 2009).

As dual-purpose livestock, Kedu chicken was reported to have rapid growth and lays more eggs. Mustofa et al. (2021) stated the average mature body weights of Kedu hen and rooster were 1.61 kg and 1.95 kg, respectively. The hen also was able to produce more than 200 eggs/year by rearing intensively, but it could only produce 60 eggs/year by rearing extensively (Nataamijaya, 2010). By those superior of its productive traits, Kedu chicken had great potential to be developed as one of superior Indonesia's local livestock. But unfortunately, information about the directed breeding selection program for Kedu chicken that has been carried out is still very limited. In addition, as dual-purpose livestock, egg weight and growth performance can be used as basic parameters in determining the direction of selection to create a superior selective stock of Kedu chicken. The study of correlations between those traits for Kedu chicken is of great importance in the development of breeding selection programs. Therefore, objective of this study was to analyze the effects of egg weight, sex, and varieties and their interactions on body weights and growth ability of Kedu Chickens.

MATERIALS AND METHODS

Data Collections

Two varieties of chicken used in the study were Red comb Kedu (Red) and Black Comb Kedu (Black) chickens. The number of chicken used in each variety of the male Red and Black were 5 and 4 heads, respectively. Meanwhile, the number of females for Red and Black varieties were 24 and 20 heads, respectively. The matting was arranged with 1:4-5 of male: female ratio. A total of 901 eggs were collected during the period of 11 weeks. Eggs were incubated using a machine and divided by 11 hatching times. Fertility and hatchability of eggs were 79.69 % and 93.31 %, respectively and mortality of chickens to 60 days was 25.5 %. Chickens were fed a complete diet containing 17 % of crude protein, 8 % of fiber, 3 % of fat, and 2700 Kcal/kg of metabolic energy.

Egg weight (EWG) and Bodyweight (BW) of Kedu chickens were weighed individually. BW was recorded at 0, 15, 30, 45, and 60 days of old were BW_0, BW_{15}, BW_{30}, BW_{45}, and BW_{60}, respectively. The average daily gain was counted as the amount of weight has gained during the growing period (ADG_{0-15}, ADG_{15-30}, ADG_{30-45}, ADG_{45-60}, and ADG_{0-60}). The detailed description of the data presented in Table 1.

The number of day-old chickens (DOC) for Red and Black variety was 395 (182 male, and 213 female), and 275 (104 male, and 171 female), respectively. EWG was assigned four groups: group 1 (EWG 40 gram; n=71), group 2 (EWG 41-45 gram; n=336), group 3 (EWG 46-50 gram; n=182), and group 4 (EWG > 50 gram; n=81).

Statistical Analysis

A linear mixed model was used to analyze the effect of egg traits, sex, and variety on body weight and average daily gain. Data were analyzed by MIXED procedure of Statistical Analysis System (SAS) University Edition V.6p.2. software (SAS, 2014) Sire was treated as a random effect. The linear mixed model was as follows:

where; $\boldsymbol{y}_{ijklmn}$ is the observation of BW_0, BW_{15}, BW_{30}, BW_{45}, BW_{60}, ADG_{0-15}, ADG_{15-30}, ADG_{30-45}, ADG_{45-60}, and ADG_{0-60}, $\boldsymbol{E}_i$ the ith fixed effect of EWG, $\boldsymbol{V}_j$ the jth fixed effect of variety (Red or Black), $\boldsymbol{X}_k$ the kth fixed effect of sex (male or female), $\boldsymbol{VX}_{jkl}$ are interactions between the jth effect of variety with the kth effect of sex, $\boldsymbol{s}_m$ is the random effect of sire, and $\boldsymbol{e}_{ijklm}$ the random residual of $\boldsymbol{y}_{ijklmn}$. The Tukey–Kramer multiple comparison was used with a significant level of 5%. Pearson correlation was used to analyze the phenotypic correlation between EWG and body weight of chickens.

RESULT AND DISCUSSION

The average EWG of Kedu chickens in this study (45.00 gram) were higher than the EWG of Kedu chicken by Wahyuni et al. (2018) ranging from 40.81 to 42.38 gram (Table 1). Compared with other breeds the EWG was lower than 50.8-58.4 by Dahloum et al. (2018) in naked-neck chickens and was higher than 29.99 by Iskandar and Sartika (2014) in Kub chicken.Analysis of variance showed that EWG had a significant effect on BW_0, BW_{15}, and BW_{30} of Kedu Chickens. Ng'ambi et al. (2013) reported a favorable effect of EWG on BW_0, BW_{49}, and ADG_{0-49} of Venda Chicken in South Africa. Chicks hatched out from the large eggs have heavier BW_0, this condition is due to heavier eggs containing more nutrients than small eggs and vice versa (Ulmer-Franco et al., 2010).

Variety was significant on BW_0, BW_{45}, BW_{60}, ADG_{30-45}, and ADG_{0-60}. Sex was significant on most of the body weight and average daily gain, whereas the interaction of both factors was significant (0.05) only on ADG_{45-60} (Table 2). The effects of variety and sex on body weight and average daily gain were agreed with (Newkirk and Classen,

Table 1: Descriptive statistic of egg weight and growth ability of Kedu chicken.

Traits	N	Minimum	Maximum	Mean	SD
EWG (gram)	670	28.01	69.99	45.00	2.83
BW0 (gram)	670	22.00	41.00	30.52	3.36
BW_{15} (gram)	651	42.00	235.00	96.73	32.27
BW_{30} (gram)	584	89.00	530.00	212.99	83.87
BW_{45} (gram)	529	175.00	715.00	357.66	119.71
BW_{60} (gram)	499	267.00	777.00	481.86	114.85
ADG_{0-15} (gram/day)	651	0.47	14.07	4.41	2.14
ADG_{15-30} (gram/day)	584	0.47	25.87	7.69	3.83
ADG_{30-45} (gram/day)	529	2.73	19.06	9.34	3.02
ADG_{45-60} (gram/day)	499	1.53	20.07	7.99	2.60
ADG_{0-60} (gram/day)	499	3.80	12.48	7.52	1.91

Table 2: Significant of factor effecting body weight and growth ability of Kedu Chicken.

Traits	Source			
	EWG	Variety	Sex	Variety*sex
BW_0	***	**	ns	ns
BW_{15}	**	ns	***	ns
BW_{30}	*	ns	***	ns
BW_{45}	ns	**	***	ns
BW_{60}	ns	*	***	ns
ADG_{0-15}	ns	ns	***	ns
ADG_{15-30}	ns	ns	***	ns
ADG_{30-45}	ns	**	***	ns
ADG_{45-60}	ns	ns	ns	*
ADG_{0-60}	ns	*	***	ns

ns= non-significant; *= significant P<0.05; **=significant P<0.01; ***=P<0.001.

Table 3: Body weight and average daily gain of different variety of Kedu Chickens.

Traits	Black	Red
BW_0	29.80 ± 0.21^b	31.04 ± 0.16^a
BW_{15}	96.95 ± 1.93	96.57 ± 1.67
BW_{30}	213.02 ± 5.39	212.98 ± 4.54
BW_{45}	360.95 ± 8.18^a	355.16 ± 6.73^b
BW_{60}	480.63 ± 7.83	482.81 ± 6.83
ADG_{0-15}	4.48 ± 0.13	4.37 ± 0.11
ADG_{15-30}	7.71 ± 0.25	7.69 ± 0.20
ADG_{30-45}	9.53 ± 0.21^a	9.20 ± 0.67^b
ADG_{45-60}	7.72 ± 0.17	8.21 ± 0.15
ADG_{0-60}	7.51 ± 0.13	7.53 ± 0.11

Means within the same row having different upper case letters differ significantly (P<0.05) between variety.

Table 4: Body weight and average daily gain of different sex of Kedu Chickens.

Traits	Male	Female
BW_0	30.55 ± 0.19	30.52 ± 0.17
BW_{15}	108.32 ± 2.47^a	87.98 ± 0.99^b

BW_{30}	252.62 ± 6 .77[a]	183.54 ± 2.30[b]
BW_{45}	422.54 ± 9.67[a]	309.27 ± 3.54[b]
BW_{60}	552.84 ± 9.03[a]	428.56 ± 3.45[b]
ADG_{0-15}	5.18 ± 0.16[a]	3.83 ± 0.06[b]
ADG_{15-30}	9.45 ± 0.30[a]	6.39 ± 0.12[b]
ADG_{30-45}	10.76 ± 0.23[a]	8.28 ± 0.12[b]
ADG_{45-60}	8.69 ± 0.21	7.84 ± 0.14
ADG_{0-60}	8.70 ± 0.15[a]	6.63 ± 0.06[b]

Means within the same row having different upper case letters differ significantly (P<0.05) between sex.

Table 5: Phenotypic correlation between egg weight and body weight of Kedu Chicken male (above diagonal) female (below diagonal).

Traits	EWG	BW_0	BW_{15}	BW_{30}	BW_{45}	BW_{60}
EWG		0.550	0.054	0.051	-0.019	0.023
BW_0	0.535		0.048	0.018	-0.066	0.084
BW_{15}	0.193	0.141		0.887	0.815	0.752
BW_{30}	0.149	0.063	0.671		0.961	0.908
BW_{45}	0.113	0.045	0.560	0.871		0.954
BW_{60}	0.076	0.017	0.419	0.693	0.837	

2002; Semakula et al., 2011; Ogbu et al., 2012; Sarker et al., 2014; Benyi et al., 2015; Mebratie et al., 2017). The detail of differences among variety and sex are presented in Table 3 and Table 4, respectively.

Black comb chickens showed lower BW_0 than Red comb chickens, whereas, for BW_{45}, and ADG_{30-45} were higher than Red comb chickens. The results indicated that the weight of DOC has unfavorable relation with growth ability of Kedu chickens. In contrast, Mehmood et al. (2013) reported that DOC's weight of Broiler chickens showed favorable effects on body weight and growth ability.

There was no difference between sex on BW_0 of Kedu Chicken, the result is similar with Osei-Amposah et al. (2012) reported that there were no sex differences for BW_0 of Forest and SASSO T44 chickens in Ghana. Male of Kedu chickens showed superior body weight and growth performance than the female ones. The result was in line with previous studies reported that male chickens showed greater performance than female Tasoniero et al. (2018) in Italian Padovara and Polverara chickens. Previous studies reported that under the same genetic background and nutritional condition male chickens have better growth ability than female ones. (Aggrey, 2002; Rizzi et al., 2013; Nguyen Hoang et al., 2021). This condition could be due to different sex hormones that generally influenced metabolic processes (Varlamov et al., 2014).

Phenotypic correlations between egg weight and body weight ranged from –0.029 to 0.550 and from 0.076 to 0.535 for male and female Kedu chickens, respectively. Daikwo et al. (2011) reported phenotypic correlations between egg weight and body weight of Dekina chicken were 0.172. The highest phenotypic correlations in this study were shown between BW_{30} and BW_{45} (0.961 and 0.871), for male and female chickens, respectively. High and positive correlations between BW_{30} and BW_{45} were similar to that reported by Manjula et al. (2018) on body weight gain at 2-4 weeks and body weight gain at 4-6 weeks of Korean native chicken (Table 5). EWG showed positive phenotypic correlations to most of BW measured, this result indicated than EWG have fovorable relationship to BW of Kedu Chicken. Cahyadi et al. (2015) detected both positive and negative values. The findings of this study could provide useful information for further optimization of breeding plans for Kedu Chicken.

CONCULSION

Body weights and growth ability of Kedu Chickens were affected by egg weight, sex, and variety. Black comb chickens showed lower body weight at hatch than Red comb chickens, then higher at the later stage of growth. Male Kedu chicken showed more superior than the female ones.

ACKNOWLEDGEMENTS

The authors would like to thank Taman Ternak Ayam Lokal maron owned by Balai Budidaya dan Pembibitan Ternak Terpadu, Central Java for permission granted to carry this research.

CONFLICT OF INTEREST

The authors have declared no conflict of interest.

NOVELTY STATEMENT

This study is the first report about the effects of egg weight, sex, and varieties and their interactions on body weights and growth ability in Kedu Chickens by using linear mixed model analysis procedure

AUTHOR'S CONTRIBUTION

EK: Idea and research design. SS: Data collection. AS: Data analysis and DAL: Write the manuscript.

REFERENCES

Aggrey SE (2002). Comparison of Three Nonlinear and Spline Regression Models for Describing Chicken Growth Curves. Poult. Sci., 81(12):1782-1788. https://doi.org/10.1093/ps/81.12.1782

Benyi K, Tshilate TS, Netshipale AJ, Mahlako KT (2015). Effects of genotype and sex on the growth performance and carcass characteristics of broiler chickens. Trop. Anim. Health Prod., 47(7):1225-1231. https://doi.org/10.1007/s11250-015-0850-3

Cahyadi M, Park HB, Seo DW, Jin S, Choi N, Heo KN, Kang BS, Jo C, Lee JH (2015). Genetic parameters for growth-related traits in Korean native chicken. Korean J. Poult. Sci., 42(4):285-289. https://doi.org/10.5536/KJPS.2015.42.4.285

Dahloum L, Yakubu A, Halbouche (2018). Effects of housing system and plumage colour on egg quality characteristics of indigenous naked-neck chickens. Livest. Res. Rural Dev., 30(12): 206.

Daikwo IS, Okpe AA, Ocheja JO (2011). Phenotypic characterization of local chickens in Dekina. Int. J. Poult. Sci., 10(6):444-447.

Directorate General of Livestock Services (2012). Penetapan Rumpun Ayam Kedu, Keputusan Menteri Pertanian Republik Indonesia Nomor 2487/Kpts/LB.430/8/2012. (in Indonesian).

Hidayat C, SA Asmarasari (2015). Native chicken production in Indonesia: a Review. J. Peternakan Indonesia, 17(1): 1-11. https://doi.org/10.25077/jpi.17.1.1-11.2015

Iskandar S, Sartika T (2014). KUB chicken: The First Indonesian Kampung Chicken Selected for Egg Production. Proc. 16th AAAP Anim. Sci. Congress, Yogyakarta, Indonesia., pp. 157-160.

Johari S, Sutopo S, Santi A (2009). Fenotype frequency of the qualitative traits at adult Kedu chicken. Proc. *Seminar Nasional Kebangkitan Peternakan,* Semarang, Indonesia pp 606-616.

Manjula P, Park HB, Seo D, Choi N, Jin S, Ahn SJ, Heo KN, Kang BS, Lee JH (2018). Estimation of heritability and genetic correlation of body weight gain and growth curve parameters in Korean native chicken. Asian-Australas. J. Anim. Sci., 31(1):26-31. https://doi.org/10.5713/ajas.17.0179

Mebratie W, Shirali M, Madsen P, Sapp RL, Hawken R, Jensen J (2017). The effect of selection and sex on genetic parameters of body weight at different ages in a commercial broiler chicken population. Livest. Sci., 204:78-87. http://dx.doi.org/10.1016/j.livsci.2017.08.013

Mehmood S, Sahota AW, Akram M, Javed K, Hussain J, Sharif H, Haroon S, Jatoi AS (2013). Influence of feed restriction regimes on growth performance of broilers with different initial weight categories. J. Anim. Plant. Sci., 23(6):1522-1526.

Mustofa F, Fathoni A, Sari APZNL, Sasongko H, Maharani D (2021). Body weight and body size measurement of five Indonesian local chicken. Proc. 3rd Inter. Conf. Anim. Sci. Tech. IOP Conference Series: Earth Environ. Sci. 788(1): 012016. https://doi.org/10.1088/1755-1315/788/1/012016

Nataamijaya AG (2010). Pengembangan potensi ayam lokal untuk menunjang peningkatan kesejahteraan petani. Jurnal Penelitian dan Pengembangan Pertanian, 29(4): 131-138. (in Indonesian)

Newkirk RW, Classen HL (2002). The effects of toasting canola meal on body weight, feed conversion efficiency, and mortality in Broiler chickens. Poult. Sci. 81:815–825. https://doi.org/10.1093/ps/81.6.815

Nguyen Hoang T, Do HTT, Bui DH, Pham DK, Hoang TA, Do DN (2021). Evaluation of non-linear growth curve models in the Vietnamese indigenous Mia chicken. Anim. Sci. J., 92(1):13483. https://doi.org/10.1111/asj.13483

Ng'ambi JW, Thamaga MW, Norris D, Mabelebele M, Alabi OJ (2013). Effects of egg weight on hatchability, chick hatch-weight and subsequent productivity of indigenous Venda chickens in Polokwane, South Africa. S. Afr. J. Anim. Sci. 43(suppl.1):69-74. http://dx.doi.org/10.4314/sajas.v43i5.13

Ogbu CC, Udeh I, Nwakpu PC (2012). Comparative performance of two commercial egg strains, the indigenous chickens and their random bred progenies. Livest. Res. Rural Dev., 24(3):47.

Osei-Amponsah R, Kayang BB, Naazie A (2012). Age, genotype and sex effects on growth performance of local chickens kept under improved management in Ghana. Trop. Anim. Health Prod., 44:29-34. https://doi.org/10.1007/s11250-011-0010-3

Rizzi C, Contiero B, Cassandro M (2013). Growth patterns of Italian local chicken populations. Poult. Sci., 92:2226-2235. http://dx.doi.org/10.3382/ps.2012-02825

Sarker NR, Hoque A, Faruque S, Islam N, Bhuiyan FH (2014). An ex situ study on body characteristics and effect of plumage color on body weight of indigenous chicken (Gallus domesticus) in Bangladesh. Acta Sci.-Anim. Sci., 36(1):79-84. https://doi.org/10.4025/actascianimsci.v36i1.20118

Sartika TS, Iskandar LH, Prasetyo H, Takahashi, Mitsuru M (2004). Genetic relationships of Kampung, Pelung, Sentul and Black Kedu Chickens using microsatellite DNA markers: I. Lingkage group of macro chromosome. JITV., 9(2):81-86. https://dx.doi.org/10.14334/jitv.v9i2.413

SAS, SAS/STAT (2014). User's guide. Version 13.2. Cary: SAS Institute Inc. https://support.sas.com/documentation/onlinedoc/ets/132/etshpug.pdf.

Semakula J, Lusembo P, Kugonza, Mutetikka D, Ssennyonj, Mwesigwa M (2011). Estimation of live body weight using zoometrical measurements for improved marketing of indigenous chicken in the Lake Victoria basin of Uganda. Livest. Res. Rural Dev., 23(8):170.

Subandriyo (2003). Konservasi sumberdaya genetik ternak, pertimbangan, kriteria, metoda dan strategi. Lokakarya Nasional Pengelolaan dan Perlindungan Sumber Daya Genetik di Indonesia: Manfaat Ekonomi untuk Mewujudkan Ketahanan Nasional, Hal. 124-137.

Tasoniero G, Cullere M, Baldan G, Zotte AD (2018). Productive performances and carcase quality of male and female Italian Padovana and Polverara slow-growing chicken breeds. Ital. J. Anim. Sci., 17(2):530-539. https://doi.org/10.1080/1828051X.2017.1364611

Ulmer-Franco AM, Fasenko GM, O'Dea Christopher EE (2010). Hatching egg characteristics, chick quality, and broiler performance at 2 breeder flock ages and from 3 egg weights. Poult. Sci., 89:2735–2742. https://doi.org/10.3382/ps.2009-00403

Varlamov O, Bethea C L and Roberts Jr C T (2015). Sex-specific differences in lipid and glucose metabolism. Front. Endocrinol., 5: 241. https://doi.org/10.3389/fendo.2014.00241

Wahyuni H I, Suthama N, Mangisah I and Krismiyanto L (2018). Egg's vitamin E deposition of Kedu breeder chicken fed improved diets. J. Indonesian Trop. Anim. Agric., 43(4):421-428. https://doi.org/10.14710/jitaa.43.4.421-428