Egg production and quality of *kedu* chicken based on plumage color reared intensively[1]

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ABSTRACT: The purpose of this research was to evaluate egg production and quality of *Kedu* chicken based on plumage color that reared intensively. The materials of research were 30 *Kedu* hens on eight month of age maintained for egg production. *Kedu* chickens were consisted of : 6 *Cemani Kedu* chickens, 6 black *Kedu* chickens, 6 red *Kedu* chickens, 6 white *Kedu* chickens, and 6 striped *Kedu* chickens. Experimental method used was Completely Random Design with five treatments, i.e. *cemani Kedu* chicken, black *Kedu* chicken, red *Kedu* chicken, white *Kedu* chicken, and striped *Kedu* chicken. Each treatment had six replications. Observed variable were egg production performance (egg number, clutch size and egg weight) and egg quality (density of eggshell, eggshell color, and specific gravity.). Data analyzed with analysis of variance and continued with Honest Significant Difference Test (HSD). Analysis of variance showed that plumage color of *Kedu* hen had no significant effect on egg production, egg weight and *clutch* size. The average of egg production was 25.39±5.44 during one period, clutch size was 3.43±0.69 and egg weight was 46.30±9.26 g. Egg quality consisted of density of eggshell, eggshell color, and specific gravity, on various *Kedu* chicken types showed significant differences ($P<0.05$). Black *Kedu* chicken had thicker eggshell (0.383 mm) than the others that had density between 0.36-0.37 mm. Red *Kedu* chicken had eggshell color more brownish (2.47) than the others. Highest specific gravity was on striped *Kedu* chicken, it was 1.09. In conclusion, egg production performance of *Kedu* chickens was similar regardless of plumage color, but egg quality was different.

Key words: plumage color, *kedu* chicken, egg production, egg quality

INTRODUCTION

One of the local Indonesian chickens is *Kedu* chicken which is a germplasm of Indonesia and have a better genetic potential compared to local chickens in general. Population of *Kedu* chicken decreases every year and it is expected that until 1997, approximately 3000 live chickens were widely distributed in Temanggung Regency (Mugiyono, 1997). *Kedu* chickens reared intensively with a better diet would be capable on producing approximately 130 to 170 eggs per year (Poespodihardjo, 1986).

Results from the study showed that the age of the egg-laying *Kedu* chickens is 189 days, the first 12 months of egg production was 123.9 eggs with average egg weight is 42.9 g. Some are laying more than 180 eggs with the average egg weight 50 g. Generally chickens start laying eggs at the age of 6 to 7 months, with intensive system; hens can begin to lay eggs at the age of 4 to 4.5 months. The average egg production for one year (age 6 to 18 months) is 124 eggs (Sunarto et al., 2004).

Some *Kedu* chicken which currently being developed is the black and white chickens. Total population of *Kedu* chicken in the District of *Kedu*, namely: Black *Kedu* chicken: 90.6%, the remaining are 3.4% white *Kedu*, 0.25% brown *Kedu*, 0.1% grey *Kedu*, and 5.7% striped *Kedu* (Iskandar and Saepudin, 2004).

Kedu Chicken has various specific characteristics. Black *Kedu* chickens have specific characteristics: plumage, beak and shank are glossy black, comb is blackish-red and tongue, throat and palate is reddish. *Cemani* chickens have specific characteristics namely color of fur, skin, shank,

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comb, wattle, beak, tongue, throat, palate, anal hole, meat and bone are black. White *Kedu* have specific characteristics that is plain white feathers, comb, wattle and ear are bright red; beak and shank, are yellow or sometimes there is a blackish color. Red *Kedu* chicken feather color has a specific feature of black, yellow shank, comb, wattle and ear are bright red. Stripped *Kedu* chickens have specific characteristics that the color of feather is striated red-gold, yellow shank and beak, and red comb (Sulandari et al., 2006). Intensive maintenance intended to improve production performance and egg quality of *Kedu* chicken to maximize genetic ability, so that various kinds of *Kedu* chicken will result in the production and egg quality in accordance with their genetics. System maintenance which affects the quality of eggs produced and quality of eggs from various *Kedu* chicken are not much informed yet, it needs to be studied through research. Problems that would be investigated in this study is whether there are differences in egg quality and production at various *Kedu* chickens reared intensively.

MATERIALS AND METHODS

In total, 30 hens of eight months old *Kedu* chicken (*Cemani Kedu*, black *Kedu*, red *Kedu*, white *Kedu* and striped *Kedu*), purchased from Temanggung were selected and randomly divided into five groups of 6 hens each. The hens were kept to produce eggs. Materials and tools used were feed with the composition of corn, bran, concentrates with a ratio 1:1:1 containing 17 percent protein and 2600 kcal energy, cages and equipment, egg tray, 1000 ml measuring cup, bowl, scales, micrometer calipers , and digital scales.

The research method was experimental with a Completely Randomized Design (CRD) according to Steel and Torrie (1991), the treatment is *Kedu* feather color differences were: K1 = *Cemani Kedu*; K2 = Black *Kedu*; K3 = Red *Kedu*; K4 = White *Kedu*; and K5 = Striped *Kedu* chicken. Each experimental unit consisted of one hen of 8 months old *Kedu* chickens, it was observed for production and quality of eggs. Variables measured were egg production, includes: (1) the number of eggs in one period of production (eggs / fish / production period), (2) egg weight (g / egg), and (3) clutch is of the order with the number of egg laying one or more, clutch ends when the next day the chicken did not lay eggs again (Jull, 1951), and egg quality were (1) thick eggshell is thick outer shell of the most measured using Calipers Micrometer, (2) eggshell color is a color external display on eggshells, it was measured using the score, and (3) specific gravity is the ratio between the specific gravity of a substance with a specific gravity at standard temperature (Ahmad et al.,1976, in Yuwanta, 1997).

The data obtained were tabulated in the tables, and then analyzed using analysis of variance. If there was any significant treatment, then the test continued with Honestly Significant Difference Test (HSD) (Steel and Torrie, 1991).

RESULTS AND DISCUSSION

The observation of eggs during the study period showed that the average number of eggs production of black, red, white, striped and *cemani Kedu* were 23.33±3.20; 27.86±3.18; 29±2,97; 24±8.06 and 21.4±9.74 eggs/head/period, respectively. *Kedu* chickens reared intensively are able to produce about 130-170 eggs per year (Merkens and Mohede, 1941). Egg productivity of *Kedu* chicken at farmer level is 13-17 eggs per nesting period (within one year a hen could incubate 3-4 times) (Directorate General of Animal Husbandry, 1992).

Observation data on a variety of chicken egg production *Kedu* based on coat color differences is presented in Table 1. Results from analysis of variance showed that differences in the color of chicken feathers at five types of *Kedu* were no significant effect on egg production. The number of eggs produced by various chickens *Kedu* based on coat color is biologically significant difference due to different genetic potential owned by a variety of *Kedu* chicken. White *Kedu* chicken has the highest number of eggs and *cemani* Kedu has the lowest. The highest number of eggs in white *Kedu* chicken caused by high intensity of nesting and nesting periods compared with others *Kedu* chicken. North and Bell (1990) argued that differences in egg production is influenced by genetic differences, caused by inheritance from their parents that early sexual maturity, the high intensity of nesting, the percentage of nesting, clutch, and early breeding. Tuiskula-Haavisto et al. (2002) reported that egg

production characteristics are influenced by genetic QTL (Quantitative trait Loci) that influence the age when the first egg-laying, egg weight, and number of eggs found on the Z chromosome.

Table 1. Performance of *Kedu* chicken egg production based on plumage differences

Kedu chicken	Number of eggs	Egg weight	Clutch period
Black	23.33±3.27	46.43±5.60	2.93±1.90
Red	27.86±3.19	46.46±3.58	3.87±1.45
White	29.00±2.97	47.00±5.40	4.06±1.60
Striped	24.00±8.06	45.04±5.03	3.84± 2.23
Cemani	21.40±9.74	46.32±3.34	2.23±1.22

Resnawati and Ida (2006) stated that there is a negative correlation between body weight and number of eggs produced. Big hen will produce large eggs, but produce a relatively low numbers of eggs. Body weight at various chicken *Kedu* based on coat color were 1.8; 1.75; 1.72; 1.83 and kg 1.93 kg, respectively for black, red, white, striped and cemani *Kedu* chicken. White *Kedu* chicken has the highest number of eggs because they have the lowest body weight, while the *cemani* has the lowest number of eggs because they have the highest body weight. Suryana and Hasbianto (2008) stated that the productivity of local chicken is varied, depending on the rearing system and diversity of individuals. Diversity owned by the local chicken is the achievement of an adult's body, age, body weight, plumage color, and the level of adaptation. Topography on the location of local chickens is also has an effect on the performances of local chicken.

In laying hens, that white plumage of laying hens has a higher production than brown plumage of laying hens. Romjali (2006) stated that the pattern and color of plumage on Mallard ducks include: dark brown (wild), black (Dusky), bright white, and grayish, the brown and black plumage color in Mallard ducks have the most dominant of production, fertility, and hatchability. In addition, plumage color in Mallard ducks also affect body weight and egg weight.

Results of measurement on egg weight during the study showed that the average egg weight of black, red, white, striped and *cemani Kedu* were 46.43 ±5.60; 46.46 ±3.60; 47 ±5.40; 45.04 ±5.03 and 46.32 ±3.34 g, respectively. Weight of eggs produced were relatively similar to research conducted by Merkens and Mohede (1941) who reported that egg weight of *Kedu* chicken at the age of 6 months was 40.1 g, 44.1 g of the age of 12 months, and increased again 45.6 g at age 18 months.

Results of research at sub-Center-Research-Livestock in Klepu showed that the average egg weight was 42.18 g. Haryanto (1990) stated that egg weight of black *Kedu* chicken was 45.62 g, whereas the other *Kedu* was 45.45 g. Plumage color differences in the five breeds of *Kedu* chicken is no significant differences on egg weight produced but are biologically different. Egg weight in white *Kedu* chicken is the highest, while the chicken of *cemani Kedu* has the lowest egg weight, which is caused by genetic factors. Egg weight is influenced by genes located at the end of chromosome 4 and 2 (Tuiskula-Haavisto et al, 2002). Genetic factors will influence the period of ova growth and ova ability to ovulate egg yolk, so that, it will affect the yolk produced, the higher the large yolk produced, then the weight of eggs produced will be higher and vice versa (North and Bell, 1990).

Yolk weight will affect the egg weight. Scott et al. (1968) suggested that genetic factors influence the length of the period of ovum growth, consequently, if the yolk produced is large, then the eggs produced are also getting bigger. Large white yolk in *Kedu* chicken is smaller than the other *Kedu* chicken, so it has a high number of eggs. Jull (1951) stated that a period of nesting or clutch is the order of nesting with one or more of the number of eggs, clutches terminate if the chickens are not laying again in the next period. Plumage color differences in the five types of *Kedu* chicken have not significant effect on large clutches produced, but are biologically different. The highest clutching was in white *Kedu* chicken, this was due to wide egg-laying period, although the striped *Kedu* chicken had a widest time-period of laying. Clutch size on a white *Kedu* chicken is the highest, because the rest of the egg produced was small. Clutch was lowest in *cemani Kedu* chicken, this was due to lower egg-laying period, but the rest of the egg production was high. North and Bell (1990) argued that differences in egg production is influenced by genetic differences are due to inheritance from their parents, namely early sexual maturity. Egg-laying period of *Kedu* chicken in this study were 23.33±3.20; 3.33±3.20; 27.86±3.18; 29±2.97; and 24.00+8.06 for black, red, white, striped and

cemani, *Kedu* chicken, respectively, while the break-laying period were 10.50±5.05; 8.29±3.50; 8.50±3.15; 7.80±3.96; and 10.00±2.00 for black, red, white, striped and *cemani Kedu* chicken, respectively. Jull (1951) stated that the average time required to produce egg is 25.5 hours. The positive correlation between the numbers of clutches of eggs with white *Kedu* causes chicken has the highest clutch. The statement was in accordance with the opinion of Romanoff and Romanoff (1963), who stated that there was a positive correlation between clutch with a large number of eggs, the higher the number of eggs produced by the clutch is also higher. The observation and measurement on various kinds of egg qualities including eggshell thickness, eggshell color, and specific gravity, the results is presented in Table 2. Eggshell thickness from a different chickens reared intensively was varied, but the range of values is not so large (Table 2). This is caused by the differences in the synthesis and secretion of egg eggshell membrane. Leach and Gross (1983) cited by Whittow (2000) stated that eggs eggshell layer calcification consisting of the mammillary layer, palisade layer and the surface layer of crystals. These layers represent a majority layer of eggshell, determine the strength of eggshell, and contains 97% inorganic material. Calcium is the most dominant cation, eggshell is also formed from the magnesium in the form of magnesium carbonate, manganese is required for the formation of mammillary network because it can synthesize muco-polysacharide.

Table 2. *Kedu* chicken egg quality based on plumage differences

Kedu chicken	Eggshell thickness (mm)	Eggshell color	Gravity specific
Cemani	0.376 ^{ab} ± 0.014	1.972 ^{b} ± 0.125	1.089 ^{ab} ± 0.004
Black	0.383 ^{b} ± 0.006	2.387 ^{c} ± 0.228	1.092 ^{abc} ± 0.002
Red	0.371 ^{a} ± 0.004	2.472 ^{c} ±0.287	1.093 ^{bc} ± 0.002
White	0.370 ^{a} ± 0.001	1.278 ^{a} ±0.202	1.088 ^{a} ± 0.002
Striped	0.364 ^{a} ± 0.002	1.567 ^{a} ±0.234	1.094 ^{c} ± 0.003

^{abc}Different superscript in the same column indicate different (P <0.05).

Eggshell thickness of eggs from a various types of *Kedu* chickens kept intensively showed significant differences. Black *Kedu* chicken eggs have a thicker eggshell (0.383 mm) compared to other *Kedu* chickens, the thickness was ranging from 0.36 to 0.37 mm. Differences in eggshell thickness were influenced by genetics, diet, age and environmental temperature. It is in accordance with Sofwah (2007) who stated that the hen (adult female chicken) can only store a certain amount of calcium into the eggshell and egg number is also influenced by genetic and age of chickens. This means that the increased levels of calcium in the diet also will not necessarily improve the quality of eggshell. In accordance with the age of chicken, egg size increases if a constant number of calcium distributed to whole surface of the egg.

Changes in egg weight and age of the hen can affect the quality of the eggshell. The results showed that the eggshell of *Kedu* Chicken tend to have brighter colors than the eggshell of laying hens, so there is a tendency that laying hens have a more eggshell thickness (0.51 mm) compared to *Kedu* Chicken (0.37 mm). Eggshell color was measured by scoring the intensity of eggshell color. The eggshell colors of black and red *Kedu* chicken tend to more chocolate with the average score was 2.387 and 2.472 respectively, compared with other *Kedu* chickens, eggshell colors was ranging from 1.28 to 1.97.

The differences on eggshell color caused by different types of *Kedu* chicken, further, each individual is influenced by cell porphyrin. Solomon (1996) stated that eggshell pigment was influenced by the porphyrin consisting of uroporphyrin, coproporphyrin, and protoporphyrin. Uroporphyrin concentration is lower than coproporphyrin, whereas coproporphyrin concentration is lower than protoporphyrin. The greater concentration of porphyrin cells, the more brown eggshell color resulted. Mugiyono and Wasito (2005) reported that the average color-eggshell of *Arab*-native chicken cross is 1.50 + 0.50 with the range was 1.0 to 2.0. Eggshell color is white to cream. Native chicken eggshell is more white (Rosidi et al., 1988). The results also showed that eggs of black and

red *Kedu* chickens were browner compared to *Arab* and native chicken hybrids. One effort that can be done on selecting of egg quality is through the determination of specific gravity of eggs, this is because the expected value of specific gravity has a close relationship with egg hatchability (Roberson and Mc Daniel, 1987).

Specific gravity of various types of *Kedu* chickens reared intensively was varied widely and the standard value of specific gravity was not less than 1.075. Yuwanta (1997) stated that good eggs could have a minimum value of 1.075 of specific gravity. Specific gravity of various types of *Kedu* chicken was significantly differences.

Based on the results, the average value of the highest specific gravity was found on striped *Kedu* chicken, it was equal to 1.094, while the average value of the lowest specific gravity was found on the white *Kedu* chicken, namely 1.088. Yuwanta (1997) stated that the value of the specific gravity is the ratio between the density of a substance and the density of water at standard temperature. Specific gravity values have a close relationship with egg weight and egg parts. Jones and Masgrove (2005) stated that the higher the value of specific gravity also increases the value of white eggs. Specific gravity is influenced by genetic factors, it can be seen from positive correlation between egg weight and eggshell thickness, the higher the egg weight and thicker the eggshell, the higher the value of the specific gravity of eggs.

CONCLUSIONS

Kedu chickens with a variety of plumage colors have relatively the same egg production but the quality of eggs was different. Eggs of black *Kedu* chickens has the highest and thickest eggshell, red *Kedu* chicken eggshell color is more brown or dark, and striped chicken has the highest specific gravity.

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