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Hatching Performance of Kokok Balenggek Chicken (G1): Formation of Superior Local Chicken in West Sumatra

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ABSTRACT

This study aims to determine the hatching performance of Kokok Balenggek chicken (KBC) using different males as the formation of superior local meat-type chickens. The study used an experimental method, randomized block design (RBD), with eight treatments and three groups. The treatment was male KBC (G0) and the group was the hatching period. Chickens are mated using Artificial Insemination (AI) with a sex ratio of 1:5. A total of 594 KBC egg were selected. The variables of this study consisted of fertility rate (FR%), embryonic mortality (EM%), hatchability of fertile egg (HRF%), and day-old chick (DOC) viability. Data were analyzed using Minitab version 19. The results of the study showed that individual differences in males had non-significant (P>0.05) effect on FR, EM, HRF and DOC viability. The average FR was (73.38%), EM (30.96%), HRF (69.04%) and DOC viability (90.73%). The macroscopic examination of KBC-G0 semen indicated volume as 0.31±0.11mL, consistency to be thick creamy with a milky white color and pH as 7.35±0.17. The microscopic examination of KBC-G0 semen indicated average ++ mass movement and sperm motility, viability and abnormality of spermatozoa to be 71.25±8.35, 78.34±6.22 and 11.67±2.90%, respectively whereas concentration of spermatozoa was 210.46±43.68 x 10^7 sperm/mL spermatozoa. In conclusion, the eight males KBC have the same and good hatching performance so can be used as males to produce KBC (G1) in the formation of superior local meat type chickens.

Key words: DOC Viability, Fertility, Hatchability, Mortality, Semen Quality.

INTRODUCTION

Kokok Balenggek chicken (KBC) is one of native chicken from West Sumatra, which originates from Tigo Lurah District, Solok Regency, Indonesia (Masfi and Mafardi 2022). KBC has a multilevel crowing sound and is classified as a singing chicken. The price of KBC is in line with the number and frequency of crowing. However, not all KBC broodstock can produce progeny that have multilevel cocks. Husmaini et al. (2022) stated that 59.69% of breeders in in-situ areas had slaughtered KBC and 52.94% of the KBC has been discarded because these did not have a multilevel crowing. KBC can be classified based on body size and coat color. Based on body size, KBC is divided into three types, namely Yungkilok Gadang chickens (body weight (BW) >2kg), *Ratiah* chickens (BW <2kg) and Randah Batu chickens (short legs like *Kate* chickens (Rukmana 2003). Yungkilok Gadang type KBC, which does not have multilevel crowing, can be used as a meat-type chicken. The average BW of roosters and hens reported to be 2024.50±291.23 and 1429.34±228.06g, respectively (Husmaini et al. 2023).

The development of KBC into superior local meat-type chickens can be done by selection. This development program has been successfully carried out on several local chickens, including the Kampung Unggul Balitbangtan chicken (KUB-1). KUB-1 chickens are the result from developing free-range chickens (*Gallus-gallus domesticus*) from Depok, Cianjur and Majalengka (Masito 2021). The development of free-range chickens (*Gallus-gallus domesticus*) produces superior characteristics, including, at the age of 20 weeks, male KUB-1 chickens have a body weight of between 1.60-1.80kg (SNI 2017).

KBC selection can be done based on the quality of male and female. The ability to produce healthy offspring is a characteristic, one of which involves the mating behavior of males and females as well as genetic components (Wolc et al. 2019). The quality of the male can be determined through the hatching performance of eggs produced. The male's quality can determine the egg fertility level (Ridwan and Rusdin, 2008). According to Bandu et al. (2015), egg hatchability can also be influenced by the male's ability to fertilize eggs. Fertilization can occur if the

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rooster has good sperm quality and even mortality is closely related to fertility and hatchability (Astomo et al. 2016). A fertile egg has two possibilities: successfully hatching and being mortal. If the egg hatchability is high, the chick mortality rate will be low. Sperm quality has been shown to predict male fertility. By adding external factors like semen collection, processing, and storage, exposure to environmental factors and semen application to a receptive hen, AI further complicates the reproductive process through human intervention (Wolc et al. 2019). So, it is necessary to know the quality of KBC-G0 males through the hatching performance. This difference in male quality can be a reference in developing KBC into superior meat-type chicken to increase reproductive and reproductive performance of this chicken.

MATERIALS AND METHODS

Ethical Approval

Animal experiments were conducted following the Republic of Indonesia Law No. 18 of 2009 (section 66), which addressed animal keeping, raising, killing and proper treatment and care.

Material and Experimental Design

This study used 48 Kokok Balenggek chicken (8 male and 40 female) with male and female with an age of 48 and 36 weeks and body weight 2 and 1.5kg, respectively. Female Kokok Balenggek chicken were in egg production. Chicken were raised intensively using battery cages at the Faculty of Animal Husbandry, Andalas University. Chickens were numbered using wing-bands for males J01 to J08 and for females B01 to B40. KBC-G0 was procured from Solok Regency, West Sumatra. KBC was given the ND vaccine. Chickens were artificially inseminated twice a week with sex ratio of 1:5. A total of 594 KBC egg were selected (storage <7 d). Eggs were selected based on criteria that the eggshell was not cracked, broken, has a normal shape and egg weight ranged from 39-45g. Day-old chicks were maintained for a week to determine its suitability.

The equipment used were three egg hatching machines with a capacity of 200 eggs, 5 watt lamps, thermometers (Gea Medical), hygrometers (HTC-1) with a humidity range, thermostat (STC-1000), mini LED flashlight (Surya SYT L017), 1mL injection syringes (Onemed), 1.5mL microtubes and digital scale (Camry).

Measurement and Methods

This research was conducted using randomized block design (RBD). The treatment was eight male KBC (G0) and the groups were three hatching periods with three egg hatching machines. After the complete end of incubation, the total number of fertility rate, embryonic mortality, hatchability of fertile eggs and DOC viability were recorded according to the groups. Temperature (°C) and humidity (%) were recorded for 21 days.

Hatching results were calculated according to the formula (Alasahan and Copur 2016):

Fertility Rate (FR %) = (number of fertile eggs/numbers of set egg) x 100

Embryonic mortality (%) = (number of embryonic mortality/numbers of fertile egg) x 100

Hatchability of Fertile Egg (HRF %) = (number of hatched chick/number of fertile egg) x 100

DOC Viability (%) = (number of initial DOC observation/ total DOC at the end of the observation) x 100.

DOC viability was observed for a week after hatching (Suprijatna et al. 2005). The characteristics of a quality DOC include having fur that looks smooth and full, the DOC's body is not deformed, agile, aggressive, has a high appetite, avoids dry feet and does not have omphalitis (SNI 2017).

Semen collection was by massage method in a microtube twice weekly from each cock. Fresh semen was evaluated macroscopically (volume, color, consistency, pH) and microscopically (mass movement, concentration, motility, abnormalities). The evaluation procedure refers to Arifiantini (2012) which was adapted for poultry semen.

Statistical Analyses

Data were expressed as mean±SD from three hatching machines and analyzed statistically using Minitab version 19. One-way ANOVA was used to analyze the effects of male on hatching performance such as fertility rate, embryonic mortality, hatchability of fertile egg and DOC viability. The percentage was arcsine transformed before analysis. $P<0.05$ was regarded as statistically significant. Sperm quality was analyzed descriptively. Recording temperature and humidity are displayed in graphs.

RESULTS AND DISCUSSION

Sperm Quality of KBC-G0

The macroscopic examination of KBC-G0 semen indicated volume as 0.31±0.11mL, consistency to be thick creamy with a milky white color and pH as 7.35±0.17 (Table 1). Ananda et al. (2023) stated that fresh semen of KBC produced a volume ranging from 0.2-0.3mL/ejaculate. Andaruisworo and Yuniati (2021) reported that the semen of the Green Jungle chicken was white to cloudy white. Color and consistency illustrate the concentration of spermatozoa.

The microscopic examination of KBC-G0 semen indicated average ++ mass movement and sperm motility, viability and abnormality of spermatozoa to be 71.25±8.35, 78.34±6.22 and 11.67±2.90%, respectively whereas concentration of spermatozoa was 210.46±43.68 x 10^7 sperm/mL spermatozoa (Table 2).

Hatchability Performance

The effect of males on hatching performance and DOC viability are showed in Table 3. The male of KBC had no significant (P>0.05) effect on the fertility rate, embryonic mortality, hatching rate of fertile egg and viability of KBC-G1 DOC. Average eight male of KBC percentage of fertility, embryonic mortality, hatching of fertile egg and day-old chicks viability was 73.38, 30.96, 69.04 and 90.73%, respectively (Table 3).

In this study, the KBC-G0 males were selected based on age, body weight, and perfect or flawless appearance. Hatching performance between males does not differ in the present study. This could be due to the same ration fed, namely 524 TA mixed with bran, which can cause the quality of the semen produced and the ability to fertilize to be relatively the same. The level of protein given can affect

Table 1: Macroscopic quality of male KBC-G0 semen

Male	Volume (mL)	Consistency	Color	pH
J01	0.12	Thick creamy	Milky white	7.33
J02	0.38	Thick creamy	Milky white	7.33
J03	0.45	Thick creamy	Milky white	7.17
J04	0.40	Thick creamy	Milky white	7.33
J05	0.32	Thick creamy	Milky white	7.33
J06	0.25	Thick creamy	Milky white	7.67
J07	0.38	Thick creamy	Milky white	7.17
J08	0.20	Thick creamy	Milky white	7.50
Average	0.31±0.11	Thick creamy	Milky white	7.35±0.17

Table 2: The microscopic quality of male KBC-G0 semen

Male	Mass movement	Motility of spermatozoa (%)	Concentration of spermatozoa (10^7 sperm/mL)	Viability (%)	Abnormality of spermatozoa (%)
J01	++	60	162.50	73.17	13.66
J02	+++	80	228.75	79.71	7.25
J03	+++	80	251.25	88.84	10.70
J04	+++	80	278.75	86.12	9.09
J05	++	70	223.75	73.30	9.50
J06	++	70	208.75	75.36	14.98
J07	++	70	171.25	77.97	13.66
J08	++	60	158.70	72.25	14.54
Average	++	71.25±8.35	210.46±43.68	78.34±6.22	11.67±2.90

Table 3: Effect of males on hatching performance and viability of KBC-G1 Day Old Chicks

Treatment	Fertility Rate (%)	Embryonic Mortality (%)	Hatchability of Fertile Egg (%)	Day Old Chicks Viability (%)
J01	67.68±3.00	40.55±6.38	59.45±6.38	91.67±14.43
J02	74.60±9.91	38.33±12.58	61.67±12.58	88.89±19.24
J03	77.18±15.21	33.13±4.47	66.87±4.46	85.00±13.22
J04	84.87±4.50	31.94±6.36	68.06±6.36	78.06±10.55
J05	63.06±3.37	21.67±10.20	78.33±10.20	100.00±0.00
J06	76.35±14.21	18.89±10.09	81.11±10.09	100.00±0.00
J07	68.45±15.19	32.78±7.52	67.22±7.52	88.89±19.25
J08	74.81±7.14	30.36±6.44	69.64±6.44	93.33±11.55
Average	73.38±5.29	30.96±2.69	69.04±2.69	90.73±7.51

the quality of semen in male chickens and in turn, affect fertility and hatchability (Tadondjou et al. 2013). In addition, the eggs collected were selected based on egg weight. Hatching egg quality and hatchability can be affected by egg weight (Ipek and Sozcu 2017).

The average fertility (73.38%) KBC in the present study was lower compared to results 87.70 and 85% reported by Ritonga (2016) and Asri and Surtina (2020), respectively. In this study, mating was carried out using the AI method, whereas in the research conducted by Ritonga (2016) and Asri and Surtina (2020), the natural mating method was used. Sutiyono (2001) stated that AI can reduce fertility and hatchability. Implementing AI requires persistence, thoroughness, and caution. If there are errors in the implementation of AI, it can cause damage to the mucosa of the reproductive organs, which can affect the quality of semen and chicken eggs. According to Sadid et al. (2016), percentage of fertility of local chicken eggs using natural mating methods was higher compared to AI. The fertility rate of chicken eggs using the AI method using fresh semen ranges from 62-77% (Long and Kulkarni 2004).

The factors that most influence embryo mortality include egg age, temperature, and humidity in the hatching machine (Ningtyas et al. 2013) and egg handling during hatching (Wicaksono et al. 2013). Napirah and Has (2017) stated that differences in the storage time of hatching eggs can affect embryo mortality. Kostaman et al. (2020) stated that the longer the egg is stored, the quality of the egg decreases, causing the egg's nutrients used for embryo development to decrease and resulting in failure to hatch. Ningtyas et al. (2013) stated that the temperature of the hatching machine can affect embryo mortality. Eggs that fail to hatch can be caused by the humidity of the hatching machine being too low and the temperature of the hatching machine being too high (Ningtyas et al. 2013). Air humidity functions to maintain fluid in the egg. Inconstant increases and decreases in temperature during hatching can cause embryo death (Ningtyas et al. 2013).

The mortality rate in the present study (30.96%) was lower than that reported (47.2%) by Ritonga (2016). Embryo mortality can be influenced by several factors, including the age of the egg, temperature and humidity of the hatching machine (Ningtyas et al. 2013; Iraqi et al. 2024) egg weight, egg shape index, storage period (Dey et al. 2019) breeder flock age, setter, hatcher type and genotype (Grochowska et al. 2019) and handling of the eggs during hatching (Wicaksono et al. 2013; Ozl et al. 2021). Higher mortality rate (65.83%) has also been reported by Agustira and Yayuk (2017) which could be due to more storage time of hatching eggs as Agustira and Yayuk (2017) stored eggs for nine days while in the present it was only five days. This statement was in accordance with the opinion of Kostaman et al. (2020) that the longer storage of eggs can decrease the quality of the eggs resulting in decreased egg's nutrients necessary for embryo development thus resulting in failure to hatch.

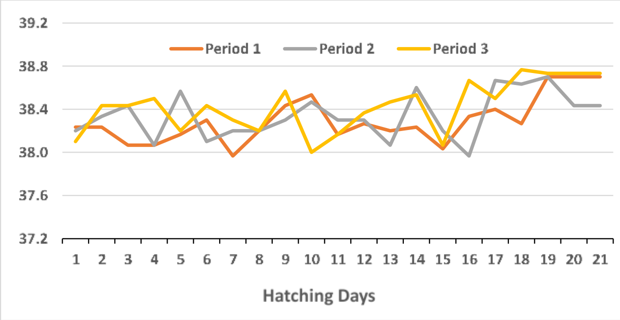

Fig. 1: KBC-G0 hatching temperature (°C). Three groups were three hatching periods.

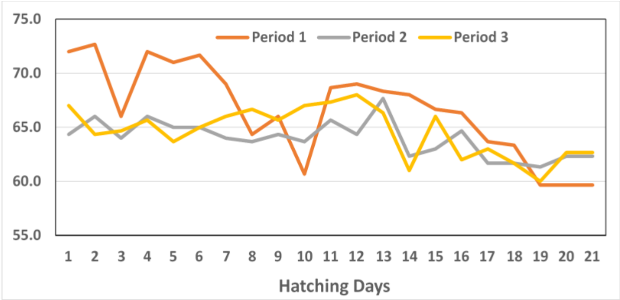

Fig. 2: Hatch humidity (%) recording. Three groups were three hatching periods.

The average hatchability in the present study ranged from 59.45±6.38 to 81.11±10.09%. Hatchability is also influenced by the length of time the eggs are stored before entering the hatching machine (Ayeni et al. 2020; Melo et al. 2021; Kolokolnikova 2021; Adriaensen et al. 2022; Shirley and Ardener 2023). In this study, the eggs were kept for five days and then started hatching. Short storage can improve hatchability of eggs from young breeders, but not from older breeders (Nasri et al. 2019). The hatchability rate for KBC eggs in this study was 69.04%. The average hatchability in this study was lower than reported (75.9%) by Syamsudin et al. (2016) in three days storage of Sentul Chicken eggs at Warso Unggul Farm. This can happen because hatching eggs stored for three days are fresh than eggs stored for five days. Fresh eggs have small pores to prevent bacteria from entering the egg so that egg quality can be maintained properly (Susanti et al. 2015). Eggs that are contaminated with bacteria cause the nutrients contained in the egg to be damaged so that the nutritional needs for embryo development are not met and this will have an impact on the egg's hatchability (Mahmoud et al. 2022). Bacterial contamination, such as *Enterococcus faecalis* and *Escherichia coli*, can colonize the internal organs of chicken embryos, potentially affecting their viability (Chiang et al. 2022).

In the present study, treatment has no effect on DOC viability (Table 3). The average Day Old Chicks Viability in this study ranged from 78.06 to 100%. DOC survival can be influenced by genetic factors, feeding, breeding management, and disease (Pratiwi et al. 2013). DOC survivability in the study was not 100% due to DOC mortality during one week of rearing. DOC deaths occurred due to physical defects that prevented the DOC from surviving. These physical defects included omphalitis, abnormal leg, and beak shape. Santosa (2016) stated that omphalitis is the leading cause of increased DOC mortality. Omphalitis in chicks, also known as yolk sac infection, is a common hatchery-born disease that leads to high rates of early chick mortalities (El-Sawah et al. 2016). It is characterized by the infection of the yolk sac, which can result in the deterioration and decomposition of the yolk, leading to nutrient deficiency and a decrease in the transfer of maternal antibodies (Jalob et al. 2016).

Hatching Temperature and Humidity

The range of KBC-G0 hatching temperature data for 21 days was 38 to 38.8ºC (Fig. 1) while KBC-G0 hatching humidity for 21 days ranged from 59.7 to 70.72% (Fig. 2).

Temperature is one of the most important factors during incubation and drives embryonic growth and development. Incubation conditions have a substantial impact on embryonic development, hatchability, chick quality and post hatch performance (Hans et al. 2022; Rocha et al. 2022; Fares et al. 2023; Al-Zghoul et al. 2023). Incubation condition need to be adjusted to meet embryonic requirement to obtain optimal chick quality and hatchability (Meijerhof 2009). Egg Shell Temperature lower than 37.8°C from E15 onward appears to be beneficial for optimal embryo development (Maatjens et al. 2016).

Conclusion

In conclusion, the eight males KBC have the same and good hatching performance so can be used as males to produce KBC (G1) in the formation of superior local meat type chickens.

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Author's contribution

All authors contributed equally to the manuscript

Conflict of interest

The authors have declared no conflict of interest

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