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Qualitative and Quantitative Characteristics of G0 Kokok Balenggek Chicken: The Formation Superior Local Meat-Type Chicken

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ABSTRACT

This research aims to know the characteristics of the qualitative and quantitative properties of G0 Kokok Balenggek Chicken (KBC-G0). As many as fifty heads of KBC consisting of 8 adult roosters and 42 adult hens were raised intensively using battery cages at the Faculty of Animal Husbandry, Andalas University, Indonesia. Chickens were numbered using wing bands for roosters G0-J01 to G0-J08 and hens G0-B01 to G0-B42. The observed variables included qualitative and quantitative traits. The results showed that the phenotype frequency of roosters and hens KBC-G0 had various qualitative characteristics, except for the comb (single type 100%). High-frequency phenotypes were colored coat color, striated coat pattern, Columbian coat pattern in roosters and wild coat pattern in hens, Golden feather flickering, white/yellow shank color in roosters and black shank color in hens. The color of the lobes was red and white. The color of the eyes was red and orange. The body weights of roosters and hens were 2024.50±291.23g and 1429.34±228.06g, respectively. The genetic diversity of qualitative traits was polymorphic except for comb type and black coat pattern. The heterozygosity value was low, except for the coat pattern (hens) was classified as high. The coefficient of diversity for quantitative traits was moderate, except for the body weight (hens) was high. KBC-G0 has the potential to be selected for the formation of superior local meat-type chickens.

Key words: Kokok Balenggek Chicken, Qualitative, Quantitative, Heterozygosity, Gene Frequency, Phenotype.

INTRODUCTION

Kokok Balenggek Chicken (KBC) is a local chicken native to West Sumatra originating from Tigo Lurah District, Solok Regency, Indonesia, and has even become an icon for Solok Regency (Masfi and Mafardi 2022). In 2021 the total population of KBC was 1960 chickens in Nagari Batu Bajanjang (Husmaini et al. 2022). KBC is known as a singing cock because of its distinctive crowing sound, which is multilevel. KBC has a high number of crows and frequency of crows which increase the sale value of the chicken. However, not all KBC broodstock can produce offspring that meet these criteria. KBC that does not have a multilevel crow has the potential to be developed as a meat type. This is supported by the opinion of Husmaini et al. (2022), who stated that the purpose of maintaining KBC in the ex-situ area was only as songbirds which KBC lovers could contest. Whereas in in-situ areas, KBC is not only used as songbirds but also as a source of protein by breeders. KBC in the in-situ area is raised traditionally like native chickens in general. The KBC consumed by breeders is the KBC that does not have a crow with slang. KBC can be classified based on body size and coat color. Based on body size, KBC is divided into three types, namely Yungkillok Gadang chicken (body weight >2kg) and Ratiah chicken (body weight <2kg), and Batu chicken (short legs like kate chicken) (Rukmana 2003). Based on the color of the feathers, KBC is divided into Taduang, Pileh, Jalak, Putih, Kuriak, Kanso, Biriang, and Kinantan (Rusfidra 2004).

In designing a breeding program, livestock performance records are one of the keys to successfully implementing the breeding program. The performance record data is used as the basis for selecting this livestock. Selection is choosing livestock that meets the selection criteria, and this livestock is allowed to develop or produce offspring. The performance data collected consists of qualitative and quantitative characteristics Qualitative traits are traits controlled by one or two pairs of genes that cannot be measured but can be grouped. In poultry, the qualitative characteristics consist of shank color, comb type, lobe color, eye color, coat color, and coat pattern (FAO 2012). Qualitative characters are controlled by more genes and little or no environment.

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Several qualitative studies have been performed, such as Burgo chicken and red jungle fowl have low diversity on qualitative character (Rafian et al. 2017), Local chicken in Dekina is of the light ecotype class that can be improved by selection and other breeding strategies (Daikwo et al. 2011) Population of free-range chicken in the Kelurahan Karang Mulia has a variety of characteristics (low qualitative and quantitative up to currently) (Edowai et al. 2019). Female Pelung chickens have similar qualitative characteristics except for plumage color (Asmara et al. 2019), The qualitative and morphometric characteristics of native chicken on Lombok Island are very diverse (Lestari et al., 2020).

Meanwhile, quantitative traits are traits controlled by many genes and can be measured (Noor 2008). Quantitative traits in poultry recommended by FAO (2012) are body weight, body length, chest length, chest circumference, wingspan, leg length, and shank circumference. These qualitative and quantitative characteristics can be used as a selection criterion with the aim to make KBC as superior local meat-type chicken. KBC-G0 is chicken which is used as parents and then mated to produce the first generation KBC (G1). Therefore, it is necessary to observe the qualitative and quantitative characteristics of KBC-G0, which then evaluates the selection of offspring, namely KBC-G1.

MATERIALS AND METHODS

This study used 50 KBC consisting of 8 adult roosters KBC and 42 adult hens KBC. Chickens were raised intensively using battery cages at the Faculty of Animal Husbandry, Andalas University, Indonesia. Chickens were numbered using wing bands for roosters G0-J01 to G0-J08 and hens G0-B01 to G0-B42. KBC-G0 comes from Solok Regency, West Sumatra, Indonesia. KBC was given the ND vaccine. The feed code given was 524TA. Feed was given 2 times a day and drinking water was given *ad libitum*. The equipment used was digital scales, digital caliper, measuring tape, and camera.

Data Analysis

Frequencies of Qualitative traits

Qualitative trait data consisting of coat color, coat pattern, coat pattern, feather flickering, shank color, comb type, ear lobe color, eye color, and KBC type were analyzed descriptively based on phenotype (Noor 2008)

$$\text{Qualitative phenotype frequencies (\%)} = \frac{number\ of\ individual\ chickens\ with\ the\ same\ phenotype}{the\ number\ of\ individuals\ observed} \text{x100}$$

Phenotype gene frequencies of qualitative traits

Subsequent qualitative traits were analyzed using Noor's formula (2008) to see the frequency of autosomal dominant genes (coat color, comb type). Sex-linked (Z) dominant gene frequency for roosters (feather pattern, feather flickering, shank color), and sex-linked (Z) dominant gene frequency for hens (feather flickering, feather pattern, shank color)

The following formula was used for roosters autosomal and sex-linked Z gene frequencies (Noor 2008):

$$p = 1 - q$$

$$q = \frac{\text{Number of chickens with recessive phenotype}}{\text{The number of individuals observed}}$$

Following formula was used for frequency of multiple allele genes (feather pattern E, e+, e,) (Dako et al. 2020):

$$p = 1 - q - r$$

$$q = \sqrt{\frac{\text{recessive allele (e) and } e^{+}}{\text{the number of individuals observed}}} - r$$

$$r = \sqrt{\frac{\text{recessive allele (e)}}{\text{the number of individuals observed}}}$$

Description:
p = frequency of gene E
q = frequency of gene e^{+}
r = frequency of gene e

Heterozygosity Value
Gene frequency results were further tested to determine genetic diversity by looking at the heterozygosity value based on the formula (Nei and Kumar 2000)

$$h_e = 1 - \sum X_i^2 \qquad \overline{H}_e = \frac{h_e}{r}$$

Description:
I = p, q, r
he = individual expected heterozygosity value
$\overline{H}_e$ = average value of hererozygosity
xi = frequency value of the i-th gene
r = number of observed loci

Quantitative Traits Phenotypes

Quantitative trait data such as body weight, body length, chest-length, wing span, chest circumference, upper thigh length, lower thigh length, shank length, third finger length, and shank circumference of roosters and hens KBC-G0 chickens were analyzed descriptively, namely by calculating the average -mean, standard deviation, coefficient of variance using the formula of Steel and Torrie (1993).

$$\overline{x} = \frac{\Sigma x}{n} \qquad s = \sqrt{\frac{(\Sigma x - \overline{x})^2}{n-1}} \qquad KK = \frac{s}{x} x100$$

Description:
$\overline{x}$ = the average value of the variable
x = variable value
n = number of individual chickens in one group
s2 = variance value
s = standard deviation value
KK = coefficient of variance

RESULTS AND DISCUSSION

Qualitative Traits

Phenotype Frequency, Gene Frequency and Heterozygosity Value

The results of the analysis of qualitative traits, namely the frequency of KBC-G0 phenotypes, can be seen in Table 1.

Color Frequency and Coat Pattern

Feathers have a very important role, apart from being a body cover, the color of the feathers is used as the main identifier visually. Based on Table 1, Colored coat color (I_) KBC-G0 is 87.5% in roosters and 59.5% in hens. While colorless (Ii) roosters and hens by 12.5 and 40.48%. The color of chicken feathers is influenced by melanoblast pigment which is formed early in the embryo around 8 hours of incubation (Scanes et al. 2004). The frequency of the KBC-G0 coat pattern phenotype in roosters was Colombian 62.5, black 12.5, wild 12.5 and white 12.5%, while in hens wild coat pattern was 33.5, black 23.5, Columbian 21.43, and white 21.43%. KBC's white coat color is called Kinantan. The Columbian coat pattern is Named Biriang, the black coat color is Named Taduang, and the striated fur pattern is Named Kuriak (Rusfidra 2004).

The frequency of the pattern of feathers on roosters and hens KBC-G0 was dominated by striated feather patterns, namely 87.5 and 52.38%. The striated fur pattern is dominant over the plain pattern (Kuniti et al. 2021). The flickering of golden feathers in roosters is 75% and hens is 61.90% while the flickering of silver feathers is 25% in roosters and 38.10% in hens. The silver fringe is recessive to the golden fringe (Kuniti et al. 2021).

The highest frequency of shank color in roosters KBC-G0 was yellow and white, namely 87.5%, while in hens the highest was green/black shank color, 64.29%. According to Kuniti et al. (2021), yellow/white shank color is the dominant shank color in both roosters and hens, while black is recessive. The dominant nature of yellow color is influenced by the Id gene which is able to regulate melanin in the dermis layer to suppress the formation of colors other than yellow. This is supported by the opinion of Sartika (2008) which states that the color of the yellow or white shank is caused by a lack of melanin content in the skin tissue. The black shank color of Id (an inhibitor of dermal melanin) is incomplete dominant to id.

The highest shank color for super chicken and Bangkok chicken was white 80.49 and 100%, then KUB chicken and Kampung chicken were black 78.05 and 63.41%, while Sentul chicken was yellow 75.6% and Merawang chicken was 100% gray (Depison et al. 2022).

The type of comb in roosters and hens is 100% of the single type. In roosters KBC-G0, the frequency of red ear lobe is 50% and red-white is 50%. While in hens 52% red-white, 14.29% white, and 33.33% red. Rusfidra (2014) states that the KBC kinantan bagombak is dominated by red 74.02%. The eye color of roosters KBC-G0 is dominated by red, namely 87.5%, while the hens have orange eyes, namely 78.57%.

Table 1: Phenotype Frequency and Gene Frequency of KBC-G0

Traits	Phenotype	Allele	Genotype		KBC-G0	
			♂	♀	♂ n = 8	♀ n = 42
Fur Color	Plain White	I	I_	I_	12.5	40.48
	Colored	i	ii	Ii	87.5	59.52
Pattern of fur	Striated	B	B_	B	87.5	52.38
	Plain	b	bb	B	12.5	47.62
Feather pattern	Black	E	E_	E_	12.5	23.81
	Wild	e^+	e^+_	e^+_	12.5	33.33
	Columbian	e	ee	ee	62.5	21.43
	Plain White	I	I_	I_	12.5	21.43
Flickering feathers	Silver	S	S_	S	25	38.10
	Gold	s	ss	Ss	75	61.90
Shank Color	White/Yellow	Id	Id_	Id	87.5	35.71
	Black/Gray	id	idid	id	12.5	64.29
Comb type	Pea	P	P_	P_	0	0
	Single	p	pp	Pp	100	100
Ear lobe color	Red	-	-	-	50	33.33
	White	-	-	-	0	14.29
	Red and White	-	-	-	50	52.38
Eye Color	Brown	-	-	-	12.5	16.67
	Red				87.5	4.76
	Orange	-	-	-	0	78.57

Table 2: KBC-G0 Gene Frequency

Traits	Phenotype	Allele	Genotype		KBC-G0	
			♂	♀	♂ n = 8	♀ n = 42
Fur Color	Plain White	I	I_	I_	0.06	0.23
	Colored	i	ii	Ii	0.94	0.77
Pattern of fur	Striated	B	B_	B	0.65	0.31
	Plain	b	bb	B	0.35	0.69
Feather pattern	Black	E	E_	E_	0.06	0.07
	Wild	e^+	e^+_	e^+_	0.08	0.28
	Columbian	e	ee	ee	0.79	0.46
Flickering feathers	Silver	S	S_	S	0.13	0.38
	Gold	s	ss	Ss	0.87	0.62
Shank Color	White/yellow	Id	Id_	Id	0.65	0.36
	Black/Gray	id	idid	id	0.35	0.64
Type of Comb	Pea	P	P_	P_	0.00	0.00
	Single	p	pp	Pp	1.00	1.00

Table 3: Expected Heterozygosity Value (he) and Average Heterozygosity (He) KBC-G0

Traits	He	
	♂	♀
Fur Color	0.12	0.35
Pattern of fur	0.46	0.50
Feather pattern	0.36	0.67
Flickering feathers	0.23	0.47
Shank Color	0.46	0.46
Type of Comb	0.00	0.00
$\overline{H}_e$	0.27	0.41

Note: He: expected heterozygosity, $\overline{H}_e$: average value of heterozygosity.

Based on Table 2, it can be seen that there is variation in coat color, coat pattern, feather pattern, feather flickering and shank color in roosters and hens KBC-G0. Meanwhile, roosters and hens KBC-G0 comb types have uniform qualitative properties. Nei and Kumar (2000) stated that a population is said to be polymorphic if it has an allele frequency above 0.01. This is supported by the results of the heterozygosity analysis which can be seen in Table 3.

The heterozygosity value for the qualitative characteristics of KBC-G0 roosters is low. Whereas in KBC-G0 hens, the coat pattern and coat pattern have a high heterozygosity value. Allendorf et al. (2013) stated that the genetic diversity of a population is declared high if the heterozygosity value is more than 0.5.

Quantitative Characteristics

The mean value, standard deviation and coefficient of diversity for the quantitative characteristics of KBC-G0 can be seen in Table 4.

The roosters and hens KBC-G0 body weights are 2024.50±291.23 and 1429.34±228.06g. Nafiu et al.(2020) reported that the body weight of Kampung Chicken in North Kolaka district is 1,681.92g and hens 1,305.45g. KUB-2 Balai chicken in ten-week-old age has body weight 1045.91±112.23g (Komarudin et al. 2021). Ten-week body weight is a preferred market for commonly local meat chickens (Iskandar and Sartika 2015).

Based on Table 4, It can be seen that the coefficient of variation in roosters KBC-G0 is moderate in all the quantitative traits analyzed. Whereas in KBC-G0 hens, the body weight trait has a high coefficient of variance, and the other traits are classified as moderate. Kurnianto (2010) states that the diversity category is divided into three, namely low (KK ≤ 5%), medium (5% <KK <15%) and high (KK ≥15%). Arlina et al. (2007) reported that KBC had high variability in the length of the tibia and femur.

The diversity of body size in chickens is influenced by genetic and environmental factors. The average body weight of roosters KBC-G0 is 2024.5g. KBC who were used as parents in G0 were selected based on high body weight >2 kg. KBC that has a body weight >2 kg includes the type of Yangkilok Gadang chicken. Body weight has a high heritability value, which is in the range of 0.50-0.55 in adulthood. Heritability estimates for BW18 and BWL were 0.50 and 0.53 in turkeys (Meleagris Gallopavo) (Begli et al. 2019). Heritability describes how much of the differences in phenotypes among animals treated similarly is due to genetics. A high heritability value indicates that most of the diversity is influenced by genetic factors. The heritability value is said to be low if it is less than 0.10, moderate if the value is between 0.10 – 0.30 and high if it is more than 0.30 (Bennett et al. 2014).

Conclusion

The phenotype frequency of roosters and hens KBC-G0 had various qualitative characteristics, except for the single type 100% comb type. High frequency phenotypes are colored coat color, striated coat pattern, Columbian coat pattern in roosters and wild coat pattern in hens, Golden feather flickering, white/yellow shank color in roosters, and black shank color in hens. The color of the lobes is red and white, and the color of the eyes is red and orange. The average of body weights of roosters and hens are 2024.50±291.23 and 1429.34±228.06g.

The genetic diversity of qualitative traits is polymorphic except for comb type and black coat pattern. The heterozygosity value is low, except for the pattern of fur and feather pattern of hens, which are high. The coefficient of diversity for quantitative traits was moderate, except for the body weight in hens which was high.

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Table 4: Mean Value, Standard Deviation and Coefficient of Variety on Quantitative Characteristics of KBC-G0

Traits	Units	Roosters		Hens	
		Average	KK	Average	KK
Body Weight	g	2024.50±291.23	14.39	1429.34±228.06	15.96
Body length	cm	39.61±3.61	9.12	36.27±2.03	5.54
Chest Length	cm	14.41±1.41	9.81	11.40±1.20	10.56
Chest Circumference	cm	29.7±2.05	6.90	26.5±2.38	9.00
Wingspan	cm	37.78±2.62	6.92	28.14±2.88	10.24
Femur Length	mm	102.5±15.28	14.91	83.39±8.40	10.08
Tibia Length	mm	135±12.19	9.03	101.88±11.50	11.29
Shank Length	mm	84.25±8.33	9.88	67.19±7.25	10.79
Third toe length	mm	71.88±5.94	8.26	58.80±5.45	9.27
Shanks Circumference	mm	12.00±0.76	6.30	9.66±0.84	8.69

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