

Conference Paper

Growth Characteristic and the Study of Polymorphism Growth Hormone Genes of Sentul Chicken

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ORCID<https://orcid.org/0000-0002-7920-3681>**Abstract.**

The research was conducted to study the characteristics of growth, carcass production and growth hormone gene polymorphisms in various male sentul chickens. The research was conducted using experimental methods with a completely randomized design. The research material was 100 male day old chickens of Sentul. The treatment was a fixed factor, namely the variation of the color of the feathers of various Sentul chickens consisting of: "Abu" Sentul, "Emas" Sentul, "Geni" Sentul, "Debu" Sentul, "Batu" Sentul.. Each experimental unit consisted of 5 chickens and 4 replications. The variables measured included: hatching weight, body weight, body weight gain and the percentage of carcass produced at the age of 8 weeks. Identification of growth hormone gene polymorphisms used the primary design Gallus gallus haplotype GH-h22 growth hormone (GH) gene, complete cds, GenBank: JN675393.1 with forward primer / Sequence: AGGTGGTTCGGTTTTCACTG and reverse primer / Sequence: TCCCTTCTCCAGGTCCTTT. Characteristics of growth and carcass production data were analyzed by analysis of variance; while to determine the presence of GH gene, polymorphisms were analyzed using the bioedit program. Analysis of variance showed that there were no significant differences ($P > 0.05$) between hatching weight, body weight, body weight gain and carcass percentage of various Sentul chickens. The results of GH Gallus gallus gene sequencing at base length 80 bp showed a mutation from adinine to cytosine, when comparing sentul chickens and Gallus gallus data in GenBank. The GH gene were present in various sentul chickens with monomorphic characteristics with homozygous genotypes of CC. The results of this study can be concluded that the characteristics of growth and carcass production in various Sentul chickens are relatively the same, as well as the monomorphic GH gene.

Keywords: Sentul chickens, body weight, carcass percentage, growth hormone gene, monomorphic.

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1. Introduction

Indonesia is a country that has a wealth of biodiversity, one of which is a local chicken. The existence of local breed chickens in Indonesia is still very diverse genetically and phenotypically, and most of them are still maintained semi-intensively or even traditionally. There are 31 breeds of local Indonesian chickens that have distinctive characteristics, including: Pelung chicken, Sentul chicken, Nunukan chicken, Sedayu chicken, Sentul chicken, Gaok chicken and others [1]. One type of local poultry with a large enough potential is the Sentul chicken. Sentul chicken is a local chicken that grows in Ciamis Regency, and is one of the original genetic resources and has been designated as a leading commodity in West Java.

The advantages of Sentul Chicken include relatively fast growth and high egg production compared to other local chickens. With these advantages, Sentul Chicken can be used as a community industrial commodity or to be further developed into superior local chickens. Based on the feather color pattern, Sentul Chicken can be divided into five types, namely Sentul Abu, Sentul Emas, Sentul Geni, Sentul Debu and Sentul Batu.

The high genetic diversity in Sentul chickens made it possible to improve the genetic quality through selection. Molecular markers associated with one or more quantitative characteristic can help increase production and health simultaneously [2]. The use of selection with the aid of molecular markers has been shown to be efficient and leads to improved production performance in livestock [3]. Previous studies reported candidate genes could result in higher efficiency for detecting traits of desired economic value, to improve production and reproductive performance in poultry breeding programs. One of the genes that correlate with growth is GH, is considered as the candidate gene that has the most role in growth performance and carcass quality traits in chickens [4]. This study aims to study the characteristics of growth, carcass production and growth hormone gene polymorphisms in various male sentul chickens.

2. Materials and Methods

The research material used 100 male Sentul day old chickens. The research material was taken from the Farmers Group Breeders of the Ciung Wanara, Ciamis District, Ciamis Regency. Materials used include: complete feed broiler starter crumble for chicks aged one day-3 weeks, containing nutrients: 22% crude protein, 12% moisture content, 5% fat, 5% crude fiber, 1% Ca, 0.5% P and ME 3000 kcal / kg. Complete Par S feed for chickens aged 4-8 weeks contain nutrients: 19% crude protein, 12% moisture content,

3% fat, 7% crude fiber, 1% Ca, 0.45% P and 2800 kcal ME / kg. The materials used to assess the polymorphism of the GH gene consist of materials for DNA isolation and PCR. Identification of growth hormone gene polymorphisms using the primary design Gallus gallus haplotype GH-h22 growth hormone (GH) gene, complete cds, GenBank: JN675393.1 with forward primer / Sequence: AGGTGGTTCGGTTTTCACTG and reverse primer / Sequence: TCCCTTCTTCCAGGTCCTTT.

The research was conducted by using experimental methods with a completely randomized design. The treatments consisted of varieties of Sentul Chicken including: "Abu" Sentul, "Emas" Sentul, "Geni" Sentul, "Debu" Sentul, and "Batu" Sentul. Each experimental unit was filled with 4 chickens and 5 replications, so that it involved 100 chickens. Chicken rearing is carried out for 8 weeks. Feeding is done in a measured ad libitum. Weighing the body weight is done once a week.

Blood samples were taken at the age of 7 weeks individually through the axillary veins of each Sentul Chicken as much as 1 ml using a syringe and put into a tube containing EDTA for DNA isolation. DNA isolation using a DNA kit to obtain pure DNA, then electrophoresis using 1% agarose gel.

The PCR amplification was carried out by targeting the Growth Hormone gene in a total reaction volume of 25 µl consisting of 12.5 µl of KAPA2G Fast Ready mix PCR kit (Kapa Biosystems), 9.5 µl of dH₂O, 1 µl of GH Gallus gallus primers, and finally 1 µl of genomic DNA. The amplification stage includes pre-denaturation carried out for 5 minutes at 94°C, then denaturation for 30 seconds at 94°C, and followed by annealing for 45 seconds at 55°C. The next step is elongation at 72°C for 1 minute. The last stage is post-elongation, namely the step to complete DNA elongation and is carried out for 5 minutes at a temperature of 72°C. The PCR reaction was repeated 35 cycles to get maximum results, the PCR results were then electrophoresed on 1% agarose gel and visualized using Ultra Violet light to determine the success of PCR. PCR Products are then sequenced using a sequencer machine.

Data analysis to determine differences in the growth performance of various Sentul chickens used analysis of variance. Analysis of genetic diversity based Gallus gallus GH gene is done by calculating the genotype and gene frequencies. Genotypes and gene frequencies were calculated by the formula Pirchner (1981) [5]:

$$\text{Formula: } FAn = \frac{\sum GH \ A \ gene}{\sum GH \ A \ gene + \sum GH \ n \ gene}$$

Note: FAn = frequency of gene A at the nth locus

Genetic diversity is determined using the heterozygosity formula based on Nei (1978) [6] with the formula: $h = 1 - \sum_{i=1}^m x_i^2$

Note:

m = number of alleles,

X_i = frequency of the *i*th gene

3. Results and Discussion

3.1. Growth performance and carcass production

Sentul chicken is an Indonesian local chicken that has genetic diversity. The genetic diversity of Sentul Chickens can be seen from the different plumage colors. The genetic differences of each individual are thought to occur because of differences in the inherited traits of each parent. Individual traits, both qualitative traits (plumage color, comb shape) and quantitative traits (body weight, egg production) are determined by genes and alleles arranged in DNA pairs found in the cell nucleus.

The results of the analysis of variance, the growth performance and carcass production of various Sentul chickens, showed that the fix factor of various Sentul chickens had no significant effect ($P > 0.05$) on all the characteristics measured. These results indicate that the diversity of plumage color does not affect the growth characteristics and carcass production. Differences in breed in local chickens are only reflected in the appearance of their phenotypes, whereas based on their genetics, selection still needs to be done [7]. Based on the color of the feathers, Sentul chickens are divided into 6 types, namely "Batu" Sentul, "Abu" Sentul, "Debu" Sentul, "Emas" Sentul, "Geni" Sentul and "Jambe" Sentul. The results of this study are different from previous studies, which reported the process of feather formation can be a factor affecting the growth rate of poultry, so that chickens with different plumage colors of the same breed can have different viability and growth performance. Chickens with black plumage have lower growth and higher mortality compared to white plumage birds [8].

The results of the analysis of variance of consumption and feed conversion ratio on various Sentul chickens in the initial and growth period, showed that various Sentul chickens had no significant effect ($P > 0.05$) on the feed consumption and feed conversion ratio of chicken feed in a growth period. These results support measurements of body weight and growth. Various Sentul chickens consume relatively the same feed and the weight gain is relatively the same, so the feed conversion ratio is also the same (Table 1).

The results of the analysis of variance showed that carcass production in various Sentul chickens was not significantly different ($P < 0.05$). Carcass production is closely

TABLE 1: Growth performance and carcass production in various male sentul chickens.

Sentul Chickens	DOC weight (g)	Body weight at 8 weeks of age (g)	Weight gain in 8 weeks (g)	Feed consumption (g)	Feed conversion ratio	Carcass weight (g)	Carcass percentage (%)
“Abu”	29.15 ± 1.01	687.00 ± 37.74	657.85 ± 37.60	1710.14 ± 63.74	2.603 ± 0.107	541.2 ± 78.7	66.47 ± 0.88
“Emas”	29.74 ± 1.54	699.87 ± 52.32	669.97 ± 51.28	1812.83 ± 61.07	2.714 ± 0.143	466.8 ± 51.1	63.54 ± 2.14
“Geni”	28.80 ± 1.06	681.35 ± 28.82	652.62 ± 29.09	1741.80 ± 72.51	2.671 ± 0.108	494.2 ± 79.0	66.09 ± 3.24
“Debu”	30.64 ± 1.88	673.04 ± 57.90	642.41 ± 59.64	1729.60 ± 49.04	2.707 ± 0.205	512.4 ± 32.0	64.43 ± 6.38
“Batu”	29.79 ± 2.61	698.22 ± 55.37	668.44 ± 55.93	1771.67 ± 29.64	2.666 ± 0.235	510.8 ± 69.2	67.53 ± 6.58
Average	29.62 ± 1.70	687.90 ± 44.83	658.26 ± 45.15	1753.21 ± 63.75	2.672 ± 0.158	505.1 ± 64.0	65.61 ± 4.88

related to DOC weight, growth, body weight and feed consumption. The results of this study indicate that DOC weight, growth, body weight, and feed consumption are relatively the same, resulting in insignificant differences in carcass production (Table 1). The carcass percentage of Sentul chicken in this study (65.61 ± 4.88%), is higher than in the study the carcass percentage of native chicken (56.08-58.02%) [9].

3.2. Identification of the GH *Gallus gallus* gene polymorphism

Growth hormone (GH) is responsible for several metabolic pathways, such as growth, reproduction, puberty, immune response and regulating cell organization functions through its receptors. The growth hormone gene in chickens (cGH) is located on chromosome 1 with a length of 4098 bp containing 5 exons and 4 introns [10]. Growth hormone in growing animals plays a role in increasing the efficiency of feed use, organ growth and bone growth. This relationship makes growth hormone a candidate gene that can be used as a genetic marker in selection programs [11]. The results of the GH *Gallus gallus* gene sequencing in Sentul chickens are presented in Figure 1.

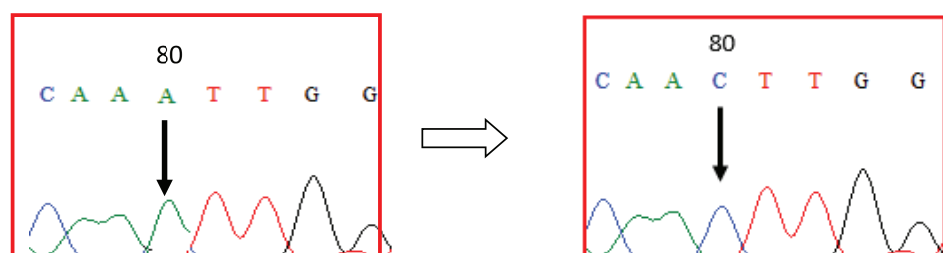


Figure 1: The change in the position of the 80 bp SNP was c.80A> C.

Based on the results of the GH *Gallus gallus* gene sequencing at a base length of 80 bp, it shows a mutation from adenine (A) to cytosine (C) (Figure 1). There is only one genotype of the GH *Gallus gallus* gene in all various of sentul chickens, namely CC. These results indicate that the GH *Gallus gallus* gene is monomorphic. The genotypes of various sentul chickens based on the GH gene are the same, because there is no base variation or polymorphism. Polymorphism in a gene (single nucleotide polymorphism) can occur due to a mutation process in one or more of the bases that are composed of the nucleotides.

The genotype and gene frequency in various sentul chickens, based on the GH *Gallus gallus* gene, is one, because all genotypes are homozygous CC. As a result, there was no genetic diversity based on various sentul chickens based on the identification of the GH *Gallus gallus* gene. The results of this study were different from previous studies, which reported that there were polymorphisms of the GH gene in chickens from crosses between native chickens and broilers, but there was no association with chicken growth, so it could not be used as a candidate gene [12].

This has an impact on body weight, growth and carcass production produced in various Sentul chickens which are relatively the same. Genetic and environmental factors affect the growth rate of Sentul chicken body weight. The results of this study are different from previous studies. Previous studies have shown that the GH gene plays a major role in body weight gain reported in several species such as cattle [13]. The GH gene is very influential on growth and metabolism through interactions with the specific receptor (GHR) on the surface of the target cell, therefore GHR is a candidate gene that influences production [14]. GH and Pit-1 genes affect growth and carcass traits. Pit-1 GG genotypes have a higher percentage of intramuscular fat than AA or AG, and GH and CG genotypes have faster body weight gain than CC and GG genotypes [15]. Genes that control metabolism and energy distribution have a very important economic impact on the livestock world. These genes include growth hormone receptor (GHR), IGF2, and GH. The AG genotype on GHR affects body weight and feed efficiency [16].

4. Conclusions

Based on the results of the study, it can be concluded that there is no genetic diversity in the GH *Gallus gallus* gene, so that the characteristics of growth and carcass production in various Sentul chickens are relatively the same.

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