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Breeding value and GH gene frequency to four weeks old quails' body weight

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Abstract: Breeding is main factor to evaluate individual superiority in livestock population. Early estimation is very useful in efficient selection process because it can make short interval generation in seed selection. The aim of this study is to measure breeding value and the influence of GH gene generation to quail in 4 weeks old. 100 female quails an 20 female quails in 4 weeks old are divided in high body weight and low body weight, and collecting the blood sample. The DNA is isolated, amplified and continued with PCR-RFLP. Breeding value are counted based on genotype from Mspl enzyme digestion. GH gene frequency are obtained by AA genotype = (∑ genotype AA / ∑ in population) x 100%, AB = (∑ genotype AB / ∑ in population) x 100%, BB = (∑ genotype BB / ∑ in population) x 100%. The result of this study are obtained for low body weigt AA = 21,15, AB = 20,70 and BB = 20,25, AA = 23,02, AB = 22,38 and BB = 21,75. GH gene frequency is low body weight AA = 0,21, AB = 0,49 and BB = 0,30, while high body weight AA = 0,47, AB = 0,43 and BB = 0,10.

1. Introduction

Quail cultivation keeps developed for breeding programs to collect high productive selection which has been studied for more than 200 years. Whereas in Indonesia quails have been known and raised since the end of 1979. Quail besides being bred to produce meat and eggs for consumption [1, 2], is also very well used as experimental animals in the laboratory, due to short life cycles, rapid growth and development, and relatively low maintenance costs [3].

Morphological characteristic are markers that have been widely used in basic genetic and in breeding practical programs. However, morphological characteristic such as weight and egg productivity have some disadvantages on the field application. The quality determination based on morphology only provides less particularity and accuracy to ensure genetic quality of livestock, the selection process runs slow and small response, even though breeding program conducted continuously [4, 5]. Breeding are not enough if conducted based on morphological information only, but with the advance of science and technology nowdays, we can use other alternative characteristic to produce high quality of livestock. It is moleculer marker which is relative easy to do and has fast result.

Morphology characteristic of quail are 19 cm in length, round shape, short tail, four toes, the growth of fur is complete after 2-3 weeks, productive age is 35 days until 42 days, 117 gr for male weight and 143 gr for female weight, egg production 200-300 grains a year with average weigh 10 gr each or 7% - 8% from body weight, 16-17 incubation period [1]. Quail's ability in increasing body weight along certain period are various. It is because quail has high individual diversity. Those diversity can be used to reform the genetic quality of quial, which relevant with body weight on four-weeks-old. Commonly, high growth rate is determined by growth hormone that produces by *GH* gene activity. It polymorpism or mutation will affect quails growth and maturity [6]. *GH* gene polimorfism

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can be detectied in population with PCR-RFLP method [7]. It aims to know whether genetic characteristic can be used or not as a marker in helping acceleration on body weight selection, directly.

Genetical and breeding value are parameter components in individual genetic and very determine the ability to queath characteristics belong to their mother on their generation. Selection are used on breeding program to choose or replace the mother for the next generation. It needs skill in determine the performance as basic skill in reform breeding program practically [8, 9]. One thing that need to do in doing selection is how the system of marital which is used in a cattle. When it is done and success, it will change gene frequency and weak quail will be eliminated. This condition will accelarate final target which can be reached.

2. Methods

A total sampel of 100 of 24-weeks-old-female quails were weighed and grouped into two groups, there were high body weight and low body weight. The quail's blood was collected using syring and microtube 1.5 ml to DNA isolation. The DNA isolation was conducted by following DNeasy Blood and Tissue Isolation Kit (Qiagen; Hilden-Germany) [10]. The high quality of isolated DNA was used as DNA template for amplification process and continued with PCR-RFLP [11, 12].

2.1. Genotype Frequency

Allele frequency and genotype from GH gene on quails in research, counted with this formula :

AA genotype frequency = (∑ AA genotype/∑ AB genotype/∑ individual in population) x 100%
AB genotype frequency = (∑ AB genotype/∑ AB genotype/∑ individual in population) x 100%
BB genotype frequency = (∑ BB genotype/∑ AB genotype/∑ individual in population) x 100%

When the result of the most allele frequency from GH gene found on observed quail no more than 0,99, so the GH gene in polimorphic category.

Breeding Value Calculation

$AA = 2\alpha 1 = 2q\alpha$
$AB = \alpha 1 + \alpha 2 = (q-p)\alpha$
$BB = 2\alpha 2 = -2p\alpha$

3. Result and Discussion

Analysis result which conducting PCR-RFLP were obtained 3 kinds of good genotype of AA, AB, and BB genotype in all groups. Breeding score of body weight can be used to assume that quail with AA genotype in low body weight group has breeding value 21,14 lower than high body weight group.

Table 1. Breeding value and influence of GH gene frequency to body weight of 4 weeks old

Population	Genotype	N	Frequency	BW4 (g)	Median	Breeding value
Low	AA	10,00	0,20	57,90	11,36	21,14
	AB	11,00	0,49	56,45	14,41	20,70
	BB	14,00	0,31	56,29	17,47	20,25
Total	.	35,00	1,00		43,24	
High	AA	20,00	0,47	91,40	43,41	23,02
	AB	11,00	0,43	90,55	25,92	22,38
	BB	6,00	0,10	87,33	8,44	21,75
Total		37,00	1,00		77,77	
Control	AA	38,00	0,36	72,00	26,35	26,04
	AB	45,00	0,48	75,40	18,59	25,53
	BB	17,00	0,16	69,40	10,83	25,01
Total		100,00	1,00		55,77	

Breeding value in AA homozigot is higher than quail with BB homozigot and AB heterozigot. It means aditive gene in AA genotype influence body weight characteristic 21,14% with frequency 20%, for frequency AA genotype is lower than frequency BB genotype, it is 31%.

High body weight group with AA genotype is higher than AB and BB, it means high body weight group with AA genotype is more with frequency 0,49, otherwise on low body weight group of quail with BB genotype is higher with the frequency is 0,31. Control group with AB genotype shows breeding value with 25,53 body weight ang frequency 0,48 is the highest than AA and BB genotype with frequency 0.36 and 0.16.

The concept of additive genes is that genes at different locus produce a joint effect on a trait. Combination genes that influence the quantitative characteristic is additive [13-15]. Breeding values are values that associated with genes carried by individuals and passed to their descent, for each AA, AB and BB genotypes in the high group, low and control. The breeding value of individual can be measured equal with double the average deviation of descent to the average population.

The calculation result of breeding value on quail in high body weight group with AA homozigot genotype is 23,02 and the phenotype frequency is 0,47 higher than AB and BB genotype. That result show that high body weight can be inherited to their children 23,02% and not too different with AB and BB genotype. Genetical factor that influence 13,63 for AA and BB genotype and 9,56 influenced by BB genotype. Low and high body weight can be compared with control body weight based on genetical factor that influence characteristic of body weight that is the highest on control group. Breeding value on AA is higher than AB and BB genotype, show that AA homozigot genotype has higher potential genetic to be inherited.

On control group showed with different frequency BB on low body weight group has lower body weight than AA genotype which genotype and AB which heterozigot. The influence of body weight genotype (AA,, AB, and BB) to 4 weeks old body weight can be seen on table 27 that show the real different ($p<0,05$) between AA with BB and AB with BB, but it not too different ($p>0,05$) between AA with AB. The influence to egg production show that there is no differences between AA with AB and BB.

Research result show that in population of observed quail were found more quail with high body weight than quail with low body weight, but on the quail population as the result of divergen selection with low body weight until the 6th generation were found more quail with low body weight also which known by frequency of allele B = 0.56 higher than frequency of allele A = 0,44 from GH gene. While the influence of allele frequency and genotype from GH gene to egg production is not real ($p>0.05$). Impact of population from divergen selection on body weight and control population to body weight and egg production is real, it means the process of high body weight selection and low body weight selection until the 6th generation can be done to obtain qualified baby quail with quality genetic which related with body weight and egg production. The research result on step 1 obtained correlation value between body weight and egg production is negative. It is rp = -0,63; rg = 0,25. That correlation value can be used as reference in criteria to obtain female quail as meat and egg producer. The results of allele frequency calculations from the GH gene have not been widely studied so the acquisition of the frequency of A and B alleles in the study of GH gene polymorphisms in quail has not been compared with the results of previous studies.

The final results of research on the diversity of quail GH genes show different effects, both on body weight and egg production. One of the genetic approaches to improve genetic quality of quail is through the selection and arranged marital system. The technology of genetic markers in the form of GH gene polymorphisms is expected to be applied in the selection process but GH gene polymorphisms may have different influences on different populations and environments or commonly referred to as phenotypic flexibility. According to Starck [16], what is meant by phenotypic flexibility is the ability of a genotype or individual to produce different phenotypes in response to environmental conditions.

The GH gene is one of genes that regulates the nature of growth. Phenotypic appearance for body weight and egg production in quail is influenced by many factors, but the genetic variation in the GH gene can be used as a reference for selection in order to improve the genetic quality of quail. The success of the Msp I restriction enzyme found this recognized sequence because the DNA sequences of the slaughterers did not mutate, as a result the size of the PCR product before and after digestion with the Msp I restriction enzyme remained the same, namely 776 bp. If two or more alleles are

present in frequencies greater than those expected by the phenomenon of recurrent mutations known as genetic polymorphisms.

The GH gene in quail is a band of genomic DNA, stored in chromosomes found in the cell nucleus. Each eukaryote (quail) in the cell contains two chromosome devices called diploid (2n). In this study, part of the A allele was found on one chromosome device and the other part was found in both chromosome devices in PCR products, while all B alleles were found only in one of the chromosome devices in PCR products. Msp I regression enzyme when finding cutting DNA on both chromosome devices contained in PCR products, then the two chromosome devices will be cut to produce two A alleles, such individuals are classified as AA homozygous individuals. Based on the data in the table that AA genotype significant effect on high body weight and low egg production while BB genotype significantly affected low body weight and high egg production while genotype AB did not affect both body weight and egg production.

GH gene polymorphism that is related to body weight in quail population selection and control from generation to generation means that each quail has different growth and abilities to produce eggs which are inherited from its parent. This difference in growth can be reflected, both in the rate of growth and the potential for egg production from the quail. The difference in ability to grow quails is basically caused by differences in genetic factors (genes). Quail has special genes that can produce certain organs or cells and general genes that give descent to their children. Both special genes and general genes consist of chemicals namely DNA (deoxyribonucleic acid) and RNA (ribonucleic acid). The expression of these genes and cells formed into one package which in turn affects the growth and eggs production [17].

The molecular mechanism of inheritance involves a process known as replication, in which the parent DNA chain serves as a template for the synthesis of copies of DNA. The expression of genes inherited in this case the weight to the young requires a regulation through a complicated mechanism. According to Heinz [18], that for a specific gene regulation can occur simultaneously in various levels and various factors to stimulate and inhibit a gene. From the results of the first phase of the study, data showed that body weight was negatively correlated with egg production and the PCR-RFLP method found GH gene polymorphism, meaning that in the quail body there were various genes including GH which showed wide variations in various cells. Thus, growth hormone and insulin are produced exclusively in the pituitary gland and pancreatic beta cells. This difference is mainly due to the regulation of gene expression, because generally the structure of DNA is the same for all body cells.

4. Conclusion

Individual breeding values based on 4 weeks body weight influenced by GH gene polymorphism for low body weight groups were AA = 21.15, AB = 20.70 and BB = 20.25 and in the high body weight group AA = 23, 02, AB = 22.38 and BB = 21.75. Low body weight population obtained by the dominant degree is not full, namely -0.80, dominant high body weight is not full, it is 0.58 and dominant control over is 3.6. The effect of the GH gene on low body weight was 0.731, height of 1.59 and control of 0.10.

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