Effect of Mating and Polymorphism Insulin Like Growth Factor Binding Protein 2 Gene on Body Weight and Heritability of *Kampung* Chicken

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ABSTRACT: Insulin-like growth factor binding protein 2 (IGFBP 2) regulates a broad spectrum of biological activities involved in growth, development, and differentiation. Single nucleotide polymorphisms C1032T of IGFBP2 gene was used to genotyped parents and their progenies of *Kampung* chicken using PCR-RFLP method. Found 3 genotypes that were CC, CT and TT. Four pairs mating that were CC><CC (1), TT><CT (2), CT><CT (3), and CC><CT (4), were raised to produce their progenies. Then the progenies was raised until 12 week of age and weekly weighed individually. Weekly body weight was analized by analysed one way of variance, heritability and breding value was analyzed by formula of Falconer and MacKay (1997). The result showed that eventhough the weekly body weight inconsistency in weight gain but progeny of mating 3 and 4 had better body weight than progeny of mating 1 and 2. Weekly body weight heritability was low to high (0.013 - 0.681), moderate heritability was on age 2 week (0.446) and high heritability was on 12 week of age (0.681). Breeding values were gain wider with the increasing age. Progeny of mating number 1 and 2 showed slower growth rate than number 3, and the best growth rate was progeny of number 4 at periode 8 to 12 week age. It was concluded that IGFBP2 gene was associated with growth and parameter genetic in Kampung chicken.

Keywords: *Kampung* chicken, IGFBP2, body weight gain, heritability

INTRODUCTION

The *Kampung* chicken is not the pure native chicken, and is defined as the locally developed slow growing type of chicken. In Indonesia, *Kampung* chickens dominate meat type chicken market for decades. It raised around 10 – 12 week of age. The *Kampung* chicken have better resistance against heat stress and many diseases, and their eggs and meat possess better eating qualities. Growth performance of Indonesia *Kampung* Chicken is still low. Egg production around 25.32 – 28.85 %, egg weight 36.79-37.24 g, fertility 68.76-69.31 %, hatchability 48.91-26.56%, and weight of hatching egg is only 26.13-26.56 g (Sri-Sudaryati, 2010a).

The genes that are part of the somatotropic axis play a crucial role in the regulation of growth and development of chickens (Nie *et al.*, 2005). The insulin-like-growth factor (IGF) system is well defined, with profound effects on the growth and differentiation of normal and malignant cells. In biological fluids, IGFs are normally bound to IGF-binding proteins (IGFBPs). (Hwa *et al.*, 1999). The chicken IGFBP2 gene spans approximately 38 kb and is located on chromosome 7 (Schoen *et al.*, 1995). It consists of 4 short exons and 3 long introns, encoding a 275-amino acid polypeptide hormone (Schoen *et al.*, 1995), 289 amino acid and is regulated by growth hormones and the target tissue are liver, brain, lung, and kydney (Qin, 2010).

The genotype-phenotype association analysis showed that the difference induced by the haplotypes derived from the 5 SNP was more significant than that by the single SNP (Lei, 2005). Li *et al.* (2006) shown that chicken IGFBP2 gene intron 2 C1032T (accession number AY 326194)

polymorphism was associated with growth and body composition traits in an F2 population. Lei *et al.* (2005), Li *et al.* (2006), and Sri-Sudaryati (2014) used single nucleotide polymorphisms of C1032T of insulin-like growth factor binding protein 2 (IGFBP2) gene to genotype Kampung chickens by PCR-RFLP method.

The study was to know the effect of mating based on genotyped to study on growth and weekly growth heritability.

MATERIALS AND METHODS

Studied previously (Sri-Sudaryati *et al*, 2010b) had done successfully to genotyped the C1032T SNP in intron 2 of Kampung chicken IGFBP2 gene using PCR-RFLP method. The digestion of the PCR product of C1032T gave rise to restricted patterns namely CC (477 bp), CT (477/527 bp) and TT (527 bp).

Four males and 12 females which were genotyped IGFBP2 gene were used in this experiment. Four mating pairs based upon genotyped by polymorphism insulin-like growth factor binding protein 2 (IGFBP2) gene of Kampung chicken were used to produce generation 2. Three females were kept with one female per a litter house for ease of parent identification. The mating pairs were: 1. CC><CC, 2. TT><CT, 3. CT><CT, and 4. CC><CT. During 0-6 week of age, the chicken were fed by commercial broiler feed contain 21% CP and ME 3.200 kcal/kg, and then changed with Kampung feed until the bird reach 12 week of age. Kampung chicken contains 13% CP and 2.150 kcal/kg ME. Body weights of the progeny were taken at day 0 (hatching) and at the end of every week. Birds were individually weighed in order to determine their relative growth (RG) as $RG = 100 \times \frac{G2-G1}{G1}$ (deSmit, 2005). G1 is outset body weight and G2 is the latest body weight. Relative growth were taken 0-4, 4-8, and 8-12 weeks periodically.

Body weight and RG were analyzed by one way analysis of Varian (Kaps and Lamberson, 2004). Genetic parameter such as heritability and breeding value were estimated by Falconer and MacKay (1997). $h^2 = \frac{\sigma^2 s}{\sigma^2 s + \sigma^2 w}$, h^2 is heritability, $\sigma^2 s$ is sire component variance, $\sigma^2 w$ is waste component variance. Coefficient Breeding value of each sire was calculated by equation, $I = \frac{0,25\ XnXh^2}{1+(0,25\ x(n-1)h^2}$ where I is coefficient breeding value, n is total progeny, and h^2 is heritability.

Blood sample of progeny from mating pairs number 2,3, and 4 were taken to identified genotyped by polymorphism IGFBP2 gen in order to evaluate the association between genotyped and body weight, RG and sex.

RESULTS AND DISCUSSION

The PCR-RFLP method was developed successfully for genotyping the C1032T SNP in intron 2 of the chicken IGFBP2 gene. From the mating TT><CT produced 45 progeny, and 16 females and 6 males was chossen randomly to be identified polymorphism IGFBP2. The mating CT><CT produced 59 progeny, 19 females and 5 males of them were identified too. The mating CC><CT produced 50 progeny and 16 females and 8 males of them were successfully screened. Mating beetwen CC><CC was not screened and had 75 progeny. Three genotypes were detected and defined as CC, CT, and TT.

Progeny body weight (Table 1) were differ at 0, 2, 6, 10 and 12 week old. Body weight at one day old chick showed that progeny from mating 1 and 4 were lower than 2 and 3, but at one week old changed become 1 and 3 were lower than 2 and 4, and the highest was number 4. The lowest

weight at three week of age was the progeny of mating number 3. Inconsistensi of body weight was done until the chicken reach 12 week of age. Overall body weight gain of mating number 3 and 4 were better than mating number 1 and 2. All progeny of mating number 1 were all CC genotypes, whereas progeny of mating number 2 were CT and TT genotypes. Progeny of mating number 3 had 3 genotypes and progeny of mating 4 had CC and CT genotypes. The inconsistency of body weight gain of all the mating pairs may be because the effect of allele, genotype, alleles and genotypes frequencies or may be because the diversity of Kampung chicken was very high.

Tabel 1. Weekly body weight (g/bird) and heritability (h^2)

Age. wks	CC><CC (n=75)	TT><CT (n=45)	CT><CT (n=59)	CC><CT (n=50)	h^2
0	22.52^{a}±2.32	23.67^{b}±2.99	23.58^{b}±2.36	22.98^{ab}±2.77	0.270
2	67.86^{B}±13.59	70.29^{B}±9.19	61.69^{A}±13.54	72.72^{B}±11.69	0.446
4	177.50±26.58	178.07±21.97	186.02±35.95	182.98±25.96	0.016
6	325.12^{b}±46.61	293.67^{a}±49.43	314.68^{ab}±74.35	314.58^{ab}±49.15	0.132
8	452.05±68.70	440.76±55.77	471.95±75.26	456.58±56.30	0.073
10	516.67^{a}±74.95	516.62^{a}±54.34	547.71^{b}±69.04	544.58^{b}±62.06	0.183
12	646.00^{A}±89.40	614.53^{A}±71.80	690.10^{B}±81.12	708.86^{B}±92.51	0.681

a,b,c Means within a row with no common superscript are different (P≤0.05)
A,B,C Means within a row with no common superscript are different (P≤0.01)

The range value of body weight heritability from DOC until 12 week was 0.073 until 0.681. Moderate heritability value was at 2 week body weight (0.446) and the highest heritability value was when chicken reach 12 week old (0.681). Upper-low body weight heritability value was when chicken at 0, 2, and 9 week of age (0.202-0.270). The heritability value of native chicken either in Africa and Asia was low. Dana, *et al* (2010) reported that heritability of Ethiopian native chicken body weight at 6 week old was low (0.15±0.08) and medium value when hatch body weight (0.40±0.23). Santosh, *et al* (2012) reported that heritability of Indian native chicken of Aseel breed had heritability 0.3 and Kadaknath breed had heritability value 0.39. Heritability body weight value of Camerron native chicken according Manjeli, *et al* (2003) was 0.31±0.03 at hacth time, 4 week old was 0.35±0.03, and 8 week old was 0.34±0.05 and at 12 week old was 0.35±0.05.

Table 2. Weekly breeding value

Age, wks	CC><CC (n=75)	TT><CT (n=45)	CT><CT (n=59)	CC><CT (n=50)
0	-11.01 to 9.26	-11.29 to 6.90	-8.38 to 6.90	-11.63 to 10.31
2	-73.87 to 67.15	-35.75 to 35.61	-67.04 to 49.25	-46.95 to 51.37
4	-32.20 to 32.33	-20.30 to 16.83	-31.21 to 42.11	-22.50 to 20.47
6	-181.61 to 151.03	-123.33 to 131.40	-201.61 to 296.13	-162.40 to 193.77
8	-191.95 to183.70	-134.31 to 117.48	-191.00 to 175.44	-147.74 to 121.62
10	-212.00 to 293.17	-159.30 to 168.54	-293.49 to 232.32	-178.48 to 216.32
12	-364.33 to 424.43	-249.91 to 341.80	-452.70 to 245.47	-380.54 to 453.93

Breeding values range wider when chicken become older, and breeding value has correlation with heritability. Heritability at 2 week of age is higher than at 3 week of age, the breeding value at 2 week is better than at 3 week old. Individual chicken has own breeding value. The breeding value showed the expectation of progeny for the next future.Since highest heritability value happened at 12 week body weight, it had better chossen chicken with highest breeding value at 12 week old. The highest breeding value were progeny from 4, 1, 2, 3 respectively.

CONCLUSIONS

It conclued that weekly body weight progeny of mating CT><CT and CC><CT better than progeny of mating CC><CC and TT><CT. Heritability weekly body weight value was low at 3, 4, 5, 6, 7, 8,10, and 11 week old (0.013-0.183), upper-low at 0, 1, and 9 week old, moderate at 2 week of age and high at 12 week of age. Breeding value become wider range with the increasing age. Progeny of mating number 4 had the best growth rate, and all showed that native chicken had slow growth rate.

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