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# Correlation Analysis of Several Growth Characters in Three Genetic Groups of Native Chickens Under Intensive Rearing System

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**ABSTRACT**
There are various types of native chickens in Nusa Tenggara Timur Indonesia that have the opportunity to be developed such as Sabu chicken, Semau chicken, and also KUB chicken. So that the selection of seeds from these chickens can be done earlier, it is necessary to know the magnitude of the correlation value between various ages of growth, so that the selection can be done earlier. The purpose of this study was to analyze the correlation of several growth traits of three genetic groups of native chickens, namely Sabu chickens, Semau chickens, and KUB chickens that were reared intensively from 0-8 weeks of age. This study used a completely randomized design. All correlation data were analyzed using Pearson Correlation, using SPSS Release 21. The results showed that there was a high positive correlation value between DOC weight and body weight at 8 weeks of age, so that DOC weight could be used as a selection basis for body weight 8 weeks old.

***Keywords:*** correlation analysis; growth characters; genetic groups; native chickens

## INTRODUCTION

Native chicken is one of the poultry that plays a very important role in improving national food security, that is as a source of community nutrition, especially as a source of animal protein both from eggs and meat. Native chicken has a big potential to be developed. The large number of population and almost the entire population means that native chicken is easy to cultivate with the existing climatic conditions. Native chicken is an important possible source of functional food because it contains considerable amounts of bioactive compounds when compared with commercial broiler chicken and other meat (Chareonsin, et al., 2021)

Some local chickens that are spread in East Nusa Tenggara (NTT) Province Indonesia such as Sabu chicken and Semau chicken which have specific advantages and can be used to increase production and productivity of native chickens as well as to fulfill food needs (Telupere, et al. 2017) because Sabu chicken has been known good growth rate so that it can produce a higher adult body weight than other native chickens in NTT. Likewise, in case with Semau chickens which are alleged to have better disease resistance and maternal abilities (Telupere and Nalley, 2019). If the two types of chicken are crossed, chicken can be obtained which is fast growth and disease resistant.

There are several types of local chicken that can be chosen in NTT such as Sabu chicken, Semau chicken, and KUB chicken. Sabu local chicken is a type of native chicken from East Nusa Tenggara originating from Sabu Island, which has grown outside its original territory. The development of methamphetamine only occurs between each other or between local and there has not been a mating with purebred chickens. Development by breeding or genetic improvement has not been done much. Sabu chicken is triple purpose, namely as laying hens and broilers/cuts and is often used as fighting chickens (Kusumaningtyas, 2013).

Sabu and Semau chickens have good production characteristics, as well as KUB chickens. The average weight of Sabu and Semau chicken eggs were 39.83g and 39.27g respectively and the DOC weight was 28.44g and 28.39g, while the KUB egg weight was 37.90-38.50g and the DOC weight was between 28.85-29.25g (Telupere, 2020). This shows that the three genetic groups have relatively no different initial production performance. The adult weight of both Sabu and Semau chickens did not differ from that of other native chickens, where the adult male weight of Sabu chicken was 1971 grams, while the female was 1424 grams. The adult weight of the male Semau chicken is 2039 grams while the female is 1159 grams. Adult weight KUB chickens are quite high. Udjianto (2016) reported that KUB chickens have the advantage of being able to lay more eggs reaching 160-180 eggs/head/year, having a body weight of 20 weeks (5 months) ranging from 1,200-1,600 grams, early laying eggs around 20-22 weeks with egg weight 35-45 grams with a reduced incubation period of up to 10%. The ability of KUB chickens to produce more eggs in one year than local native chickens makes KUB chickens also synonymous with layer native chickens (Hayanti, 2014).

Basically, the genetics of livestock is unknown and cannot be measured or observed directly, but can be estimated. This can be seen in the estimated value of genetic parameters, including heritability ($h^2$) and genetic correlation (rG). The definition of a phenotypic trait is an outward appearance or other trait of an individual that can be observed or measured. Correlation analysis is a method used to determine the extent of the relationship between two properties compared through a number commonly called the correlation coefficient (Walpole, 1995). Estimation of the correlation value has an important meaning for the selection can be done earlier.

Under certain conditions, the parameter of a trait has a high heritability value and a positive genetic correlation, so individual selection is the right method in improving the genetic quality of the trait because the expected selection response will be greater than the trait with low heritability and genetic correlation. The purpose of this study was to estimate the correlation value of several growth traits such as hatching weight, body weight at 2, 4, and 8 weeks of age from three genetic groups of intensively reared free-range chickens. The purpose of this study was to estimate the correlation value of several growth traits such as hatching weight, body weight at 2, 4, and 8 weeks of age from three genetic groups of intensively reared free-range chickens.

## MATERIALS AND METHODS

This study used 48 adult chickens as parents consisting of 9 males and 45 females. Each genetic group consisted of 3 males and 5 females which were used as parents. The mating of these animals produced 135 chicks which were used as research material to calculate the correlation value of their growth characters. Feed for parents is BR2. Drinking water is provided ad libitum. Feed for chicks is 391 feed given from 0-8 weeks of age. Drinking water is provided ad libitum. There were 3 types of cages used in this study, i.e male cages (9 boxes), female cages (45 boxes), and group cages for F1 offspring based on the number of males, as many as 9 cages and each cage containing 15 chicks. The male and female cages are individual cages, while the cages for F1 offspring are group cages, i.e. chicks are housed according to genetic groups and male parents, so that 9 group cages are obtained. This study used a completely randomized design (CRD) with 3 treatments and each treatment was repeated 3 times for the parents, each treatment consisted of 3 males and 15 females, and each replication consisted of 1 male and 5 females.

For offspring, each treatment was repeated 3 times based on males and each replication consisted of 15 chicks.

The treatment given is the marriage group:

KP1 = Sabu chicken >< Sabu chicken
KP2 = Semau chicken >< Semau chicken
KP3 = KUB chicken >< KUB chicken

Mating was carried out by artificial insemination (AI) and from each mating group produced of 45 chicks which were used as research material, so that 135 chicks were obtained as research material. The parameters studied were DOC weight, and F1 growth characteristics, such as body weight at 4 and 8 weeks of age, and body weight gain from 0-8 weeks of age. The data obtained were analyzed using analysis of variance (ANOVA). If the results of the analysis of variance show a significant effect, further analysis will be carried out by using Duncan's Multiple Range Test. Spearman correlation analysis was used to estimate the correlation value of various growth parameters. All data analysis was performed using the SPSS 21 software package.

## RESULTS AND DISCUSSION

### Body weight of Sabu, Semau and KUB chickens

During the study, both in the adjustment period and in the data collection period, no chickens showed symptoms of illness. All chickens look lively, eyes shine, good appetite, and shiny clean feathers. Although at the beginning of the study the difference in air temperature during the day (29OC) and night (21OC) (temperature in the cage) was quite large, this did not affect the activity of the research animals, both in consuming feed and growing. Mean and standard deviation of body weight and body weight gain of research chicken was presented at Table 1.

**TABEL 1:** Mean and standard deviation of body weight (BW) and body weight gain (BWG) of research chickens (g/week)

| Parameters | Genetic groups | | | Overall |
|---|---|---|---|---|
| | Sabu | Semau | KUB | |
| $BW_0$ | 29,70±2,58 | 28.80±2.24 | 29.15±1.79 | 29.22±2.24 |
| $BW_4$*) | 300,28±37,53$^b$ | 263.25±34.84$^c$ | 344.20±22.99$^a$ | 302.58±46.22 |
| $BW_8$ | 626,93±68,54 | 625.00±84.53 | 635.93±39.61 | 629.28±66.47 |
| $WG_{0-4}$*) | 270,58±36,28$^b$ | 234.45±33.84$^c$ | 315.05±22.50$^a$ | 273.36±45.48 |
| $WG_{4-8}$*) | 326,65±60,94$^b$ | 361.75±78.49$^a$ | 291.73±30.80$^c$ | 326.71±66.11 |
| $WG_{0-8}$ | 597,23±67,07 | 596.20±83.80 | 606.78±39.39 | 600,07±65.63 |

*) Different superscripts in the same column showed significant differences (P<0,05)

DOC weight is the result of weighing the chicks immediately after hatching (less than 24 hours). The data in Table 1 showed that the genetic group of Sabu chicken had the highest DOC weight (29.70 ± 2.58g) followed by KUB, and Semau the lowest, which was 28.80 ± 2.24g. The difference in DOC weight seems to have a relationship with egg weight where large eggs tend to produce high DOC weights as well. Genetically, Sabu chicken eggs are quite large, but not much different from KUB chicken eggs. The results of the variance analysis showed that the genetic group had no significant effect (P>0.05) on the DOC. weight. The findings of the DOC weight in this study were higher than the DOC weight of Tolaki chickens (Herlina, et al., 2016) both hatched using an electric heat source incubator (26.47g) and a combined heat source incubator (26.96g). Genetically, Sabu, Semau, and KUB native chickens have the ability to produce better DOC weights than Tolaki native chickens. However, local chickens raised by Jimmny's Farm (Sadid, 2016) had a higher DOC weight than this study, possibly because the chickens at Jimmny's Farm had undergone a good selection, while the chickens used in this study did not go through a good selection process. Similarly, what was found by Sinurat, el al. (2022) where the doc weight ranges from 29.9-31.7g. The chickens used in this study were selected based on individual appearance without any prior genetic record.

Body weight at 4 weeks of age ranged from 263.25 ± 38.84 g (Semau chicken) to 344.20 ± 22.99 g (KUB chicken). This finding indicates that the DOC weight is not linear with the weight at 4 weeks of age. The influence of genetic groups dominates body weight at 4 weeks of age where KUB chickens have a better body weight than Sabu and Semau chickens. The body weight of the chickens in this study was lower than that found by Suryana (2017) where the average body weight of 1 month old was 455g/head.

The results of statistical analysis showed that the treatment group had a significant effect (P<0.05) on body weight at 4 weeks of age. Duncan's further test results showed that there were significant differences between all treatment pairs. The existence of this finding points to the genetic ability of each genetic group, namely the rapid growth, especially of KUB chickens because they have

undergone selection for 6 generations. According to Eriko, et al. (2016), native chickens fed commercial feeds can produce body weight at the age of 4 weeks of 331.33g, while those fed a mixture of commercial feed and rice bran produce lower body weights. Telupere (2021) reported that the body weight of 4-week-old KUB chickens fed fermented cow feces was 284.70±48.86g, lower than that found in this study. Genetically, the average body weight of KUB chickens exceeds Sabu and Semau chickens indicating that chickens that have undergone selection have the ability to grow better than those that have not undergone the selection process, and another thing that can explain this situation is growth at the beginning of the growth period (starter period) had not been influenced by the genetics of each animal.

The body weights at 8 weeks of age of the chickens in this study ranged from 625.00 ± 84.53g (Semau chickens) to 629.28 ± 66.47g (KUB chickens). The body weights of the three genetic groups at the age of 8 weeks showed a small difference, which means that the three genetic groups had been established under the given rearing conditions. The results of the analysis of variance showed that the genetic group had no significant effect (P>0.05) on body weight at 8 weeks of age. There was no effect of treatment on body weight at the age of 8 weeks because the response of the chickens to the treatment given was not different. The results obtained were higher than those found by Susanti and Sopiyana (2014) where the body weight of native chickens aged 8 weeks was 433±85g. Several previous studies found that the body weight of 8-week-old native chickens varied greatly, ranging from 482.50 g to 647 g (Bidura and Suasta, 2006). The variation in body weight of native chickens is caused by different types of native chickens, the maintenance system and the feed provided are also different.

One indicator of animal growth is body weight gain. Chickens in the growth phase have rapid body weight gain and will decrease towards maturity and stop at maturity. Data on body weight gain of research chickens in Table 1 showed that each genetic group was able to express its genetic potential both in the 0-4 week growth period and in the 4-8 week period.

In the 0-4 week age period KUB chickens showed the best body weight gain (315.05±22.50g), followed by Sabu chickens (270.58±36.28g) and the lowest was Semau chickens (234.45 ±33.84g). This situation is reversed at the age period of 4-8 weeks, namely Semau chickens provide the best body weight gain, followed by Sabu chickens, and KUB chickens the lowest. The findings in this study indicate that the genetic abilities of the chickens in each growth phase are different.

The results of statistical analysis showed that the genetic group had a significant effect (P<0.05) on body weight gain both in the 0-4 week period and in the 4-8 week age period. In the 0-4 week age period, Duncan's further test results showed that KUB chickens had significantly higher body weight gain than Sabu and Semau chickens. This finding points to the ability of KUB chickens to grow better than Sabu and Semau chickens. In addition, KUB chickens can also utilize the given ration more efficiently to produce better body weight.

In the 4-8 week age period, Duncan's test results showed that Semau chickens had a significantly higher body weight gain (P<0.05) compared to Sabu and KUB chickens. KUB chickens produced the smallest increase in body boot compared to the other two genetic groups.

The accumulation of body weight gain of research chickens from 0-8 weeks of age showed that KUB chickens produced the best body weight gain (606.78±39.39g), followed by Sabu chickens (597.23±67.07g), and the lowest was Semau chicken (596.20±83.40g). The results of this study are not much different from several previous studies which found that the body weight of native chickens aged 8 weeks varied greatly, ranging from 482.50g to 647g (Bidura and Suasta, 2006). The variation in body weight of native chickens is caused by different types of native chickens, the maintenance system and the feed provided are also different.

The results of the analysis of variance showed that the genetic group had no significant effect (P>0.05) on body weight gain for the 0-8 week age period. There was no significant effect of the genetic group on overall body weight gain, indicating that although the Sabu and Semau chickens did not go through a strict selection process, they were still able to keep pace with the growth of the KUB, which means that the genetic potential of the two genetic groups could be raised. only by improving the maintenance system (intensive system). The results of this study were higher than those reported by Urfa, et al. (2017) where the body weight of native chickens at the age of 8 weeks ranged from 451.3-512.0g.

**Correlation Analysis of Growth Traits**

Estimation of the correlation value of DOC weight with body weight at 4 weeks of age, DOC weight with body weight of 8 weeks, and body weight of 4 weeks and 8 weeks of age is intended to determine the strength of the relationship between each variable, whether positive, negative, or not related. The value of the estimation results is presented in Table 2.

**TABLE 2:** Estimation of correlation value and coefficient of determination of body weight characteristics in three genetic groups of native chickens

| Correlation Between | Genetic Groups of Chicken | | | | | |
|---|---|---|---|---|---|---|
| | Sabu | | Semau | | KUB | |
| | r | $R^2$ | r | $R^2$ | r | $R^2$ |
| BW0 dan BW4 | 0,51±0,11 | 0,26 | 0,47±0,13 | 0,22 | 0,52±0,13 | 0,27 |
| BW4 dan BW8 | 0,47±0,15 | 0,22 | 0,37±0,13 | 0,14 | 0,63±0,16 | 0,40 |
| BW0 dan BW8 | 0,58±0,10 | 0,43 | 0,34±0,16 | 0,14 | 0,77±0,08 | 0,59 |

r= Correlation value; $R^2$= coefficient of determination
BW0= weight of DOC; BW4 = body weight 4 weeks old
BW8 = body weight 8 weeks old

Estimation of the correlation value between DOC weight and body weight at 4 weeks of age showed a positive value in all genetic groups. Sabu chicken and KUB chicken showed a high positive value (0.51 and 0.52), while Semau chicken showed a moderate positive value (0.47). The results obtained indicate that body weight at 4 weeks of age is influenced by DOC weight. The high correlation value in Sabu and KUB chickens indicates that there is a very close relationship between DOC weight and body weight at 4 weeks of age or it can be said that DOC weight greatly determines body weight at 4 weeks of age.

The correlation coefficient of Semau chickens shows a moderate value, meaning that there was a close relationship between DOC weight and body weight at 4 weeks old in these chickens. A high correlation coefficient indicated a very close relationship between the two variables, while a moderate correlation coefficient indicated a close relationship, and a low correlation coefficient indicated a weak relationship. The results obtained are slightly lower than those found by Telupere, *et al*. (2017), where the correlation value between DOC weight and body weight at 4 weeks of age in $F_1$ from a cross between native chickens and laying hens Isa Brown is 0.60. This difference may be caused by the type of chicken used and also other factors such as the environment that is imposed on it.

The coefficient of determination (R square) or symbolized by $R^2$ which is meaningful as the contribution of the influence given by the independent variable or independent variable (X) to the dependent variable (Y). The value of the coefficient of determination or $R^2$ is useful for predicting and seeing how big the contribution of the influence given by the X variable simultaneously (together) to the Y variable.

The coefficient of determination of Sabu chicken for DOC weight and 4 weeks old weight is 0.26 meaning that 26% of 4 week old weight is influenced by DOC weight, and the rest is influenced by other factors such as genetics and environment. For Semau chickens, 22% of body weight at 4 weeks of age was affected by DOC weight and for KUB chickens, the coefficient of determination was 0.43 which means 43% of body weight at 4 weeks of age was influenced by DOC weight.

**Correlation of body weight at 4 weeks of age with body weight at 8 weeks of age**

The data in Table 2 showed that there is a moderate positive correlation for body weights aged 4 and 8 weeks in Sabu chickens (0.47) and 0.37 in Semau chickens, while high positive KUB chickens are 0.63. This finding indicated that there was a close relationship between body weight at 4 weeks of age and body weight at 8 weeks of age in both Sabu and Semau chickens and a very close relationship in KUB chickens. Thus it could be said that body weight at 8 weeks of age is determined by body weight at 4 weeks of age, especially for KUB chickens, so that if a selection is made for body weight at 8 weeks of age, it can be done at 4 weeks of age.

There is a very close relationship between body weight at 4 weeks of age and body weight at 8 weeks of age in KUB chickens indicating that 60% of chickens that have a high body weight at 4 weeks of age will also produce high body weight at 8 weeks of age. Meanwhile, for Sabu chickens around 47% and Semau chickens 37% body weight at 8 weeks of age is determined by body weight at 4 weeks of age.

The coefficient of determination in the two genetic groups (Sabu and Semau chickens) were relatively low (0.22 and 0.14) indicating that body weight in both Sabu and Semau chickens was not fully influenced by body weight at 4 weeks of age but was more influenced by elements others such as genetics and the environment imposed on it. It is different with KUB chickens, which have a higher coefficient of determination, which is 0.40, which means that 40% of body weight at 8 weeks of age is affected by body weight at 4 weeks of age. There is a tendency in these three genetic groups that the nature of growth as it ages, is more influenced by the environment it is subjected to.

**Correlation of DOC weight with body weight at 8 weeks old**

The estimation of the phenotypic correlation value between DOC weight and body weight at 8 weeks of age in the three genetic groups of native chickens obtained a high positive value in KUB chickens (0.77), followed by Sabu chickens (0.58), while for Semau chickens a positive value was found. moderate correlation (0.34). All genetic groups showed a positive correlation value, meaning that if the DOC weight was high, the weight at 8 weeks of age was also high and vice versa. There is a very close relationship until the close relationship between DOC weight and body weight at 8 weeks of age indicates that body weight at 8 weeks of age is more determined by DOC weight, thus the selection needs for these three genetic groups can be carried out on the first weighing or DOC weight.

The size of the proportion for each genetic group is determined by the coefficient of determination. Sabu chicken has a coefficient of determination of 0.43, meaning that 43% of body weight at 8 weeks of age is determined by DOC weight, while for KUB chickens the coefficient of determination is 0.59, meaning that 59% of body weight at 8 weeks of age is influenced by DOC weight. Semau chicken only had a coefficient of determination of 0.14 meaning that only 14% of body weight at 8 weeks of age was affected by DOC weight. The presence of a low value for the coefficient of determination in Semau chickens indicates that body weight at the age of 8 weeks is more influenced by the environment it is subjected to, namely an intensive rearing system and not too dependent on DOC weight.

In general, the correlation value at all ages is positive indicating that an increase in the independent variable will increase the dependent variable. In this study, body weight at 8 weeks of age was more dependent on weight at 1 day of age or DOC weight. Manjula et al. (2017) found a high positive phenotypic correlation between body weight traits from 0 to 8 weeks of age of Korean native chicken. So, if you want to make a selection, it can be done immediately after weighing the DOC weight because chickens that have a high DOC weight will produce a high 8 week old body weight as well.

Correlation between body weight at various stages of growth is still lacking in the literature for native chickens. Lwelamira et al. (2009) reported high correlations for additive genetic effects (0.60-0.93) and for phenotypic effects (0.54-0.74) for body weight at 8, 12, 16, and 20-week-old of local chickens in Tanzania. Niknafs et al. (2012) reported a moderate to high, genetic correlation between DOC weight and body weight at 8 weeks (0.57) and body weight at 12 weeks (0.36) for local chickens in Iran. The high genetic correlation between DOC weight and first egg laying weight showed that selection for body weight of adult hens would indirectly increase the body weight of day old chicks. Moreover, if there is a high genetic correlation between body weight in early growth and body weight at first laying age, it is advisable to choose juvenile chickens which are heavier and will increase adult weight in Lueng Hang Kao Kabinburi chickens (Tongsiri, el al., 2017)

## CONCLUSION

Based on the results and discussion, it can be concluded that the genetic groups had no effect on DOC weight and body weight at 8 weeks of age, only at 4 weeks of age, KUB chickens could produce better body weights than Sabu and Semau chickens. At the age period 0-4 weeks and 0-8 weeks genetic group had a significant effect on body weight gain, while in period 0-8 weeks, the three genetic groups did not show any difference. There is a moderate to high positive value for the phenotypic correlation of DOC weight with body weight at 4 weeks of age and weight at 4 weeks of age and 8 weeks of age, while the DOC weight and age of 8 weeks are all high positive. Based on the correlation value obtained, the selection for body weight at the age of 8 weeks can be done at the age of 0 weeks.

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