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Implementation Selection to Increase Body Weight Fancy Mice

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Abstract

Use laboratory animal for research purposes is often used especially in the fields of health research, food, agriculture, and livestock. The laboratory animal that is often used as research objects include rabbits, mice, guinea pigs, monkeys, and rats. Research in the field of livestock in animal breeding requires a long time to research and a large number of animals so mice can be used to apply it. The goal of research is determine effect of the selection program on parameters of mice body weight including weaning weight and adult weight. The research was held with Fancy mice keeping and selection implementation of weaning weight 21 days age (WW21) and 35 days age (AW35) which starts from 0 generation until 2nd generation. The data used in the selection of Fancy mice on 0 generation until 2nd generation each of 327 tails, 330 tails, and 263 tails. The result of the selection of Fancy mice to WW21 increased obtained WW21 G0 to G1 is 3.69 gram and WW21 G1 to G2 is 2.09 gram. Selection of Fancy mice to AW35 that result in AW35 G0 to G1 is 5.14 gram and AW35 G1 to G2 is 4.92 gram, which means selection is impacting increased WW21 and AW35 Fancy mice.

Keywords: selection, weaning weight of mice, adult weight of mice, Fancy mice

1. Introduction

To satisfy the necessary for protein consumption from animal, so be required the availability of the number of animal to satisfy the necessary (Priyono and Priyanti, 2018). Important economic traits can affect long age, animal health, animal productivity as well as animal reproduction which owned is the method to measure animal breeding. (Munywoki *et al.,*2021). Implementation of selection with due observance appearance of animal from outside in the form of feather color or body posture is an implementation of selection based on qualitative characteristics. Quantitative characteristics, such as weighing or body size are used to determine the animal selected through the selection method (Irianto *et al.,*2020). Activities to obtain selected animal based on high genetic quality with the aim of breeding selected males and females can be interpreted as an act of selection (Sutisna *et al.,*2020). An advantage that is obtained from the selection can be predicted with the existence calculation of genetic parameter consisting of heritability estimation as well as genetic advancement estimation (Bartaula *et al.,*2019).The calculation of genetic parameters that are not involved as the basis to implementing the selection will affect the advantages found in the elders because there is no certainty that the superiority elders will inherited on their offspring (Sutisna *et al.,* 2020). Heritability is useful in estimating selection responses and measuring genomic study capability (Berry *et al.,* 2017). Estimation of genetic correlation value has benefit to knowledge a trait which selected to other traits which unselected but has a genetic correlation to trait selected, as is consideration of positive or negative impact (Sulastri *et al.,*2019). Therefore, in this research, be required to calculate the genetic parameter are heritability and genetic correlation for implementation selection to body weight gain of Fancy mice. Based on these, researcher doing research about selection implementation to body weight improvement of Fancy mice.

2. Method

Fancy mice were reared from zero generation to second generation. The data taken include weaning weight data for Fancy mice and adult weight data for Fancy mice. Weaning and adult weight data of Fancy mice will be used for the selection process.

2.1 Weighing WW21 and AW35

Weaning weight of Fancy mice was carried out at the age of 21 days. At the age of 21 days, the mice can be separated from their mother. The weighing of adult Fancy mice was carried out at the age of 35 days. Weaning weight and adult weight data of Fancy mice were recorded and adjusted to the pedigree of Fancy mice, sex, age of the mother, and birth type of Fancy mice.

2.2 Calculation of Factor Correction

The data on WW21 and AW35 that have been collected and recorded in the recording is then calculated according to the conditions and research location of Fancy mice.

2.3 Estimation of Heritability

The data on WW21 and AW35 that had been collected were then the estimation of heritability for each generation. Sulastri *et al* (2019) state that method of statistic that used to estimating heritability value based halfsib correlation is one way lay out. The formula based on is as follows:

$$h^2 = \frac{4\sigma_S^2}{\sigma_S^2 + \sigma_W^2}$$

2.4 Estimation of the Genetic Correlation

The calculation of the genetic correlation value is carried out every generation, while the formula used for estimating the genetic correlation uses data from paternal half correlation according to the following formula by Sulastri et al (2019)

$$r_g = \frac{4(cov_S)}{\sqrt{(4\sigma_{S(x)}^2)\,(4\sigma_{S(y)}^2)}}$$

2.5 Estimation of Breeding Value

Selection of Fancy mice is carried out based on breeding values on weaning and adult weight data. The selection was carried out using fancy mice weaning weight data based on breeding values taken from the best 50%. Selection using adult weight data of Fancy mice was taken 8 males and 32 females. The formula for calculating the breeding value using the formula based on Hardjosubroto (1994) is:

$$BV = h^2 (P-\overline{P})+\overline{P}$$

2.6 Estimation of Response to Selection

To find out the response to the implementation of the selection of WW21 and AW35 of Fancy mice, calculation of direct selection responses and indirect selection responses was carried out.

3. Results

3.1 Weaning weight of Fancy Mice

Based on the research result, WW21 Fancy mice obtained the results in Table 1 and Table 2 show the increase in WW21 from each generation.

Table 1. Data of weaning weight Fancy mice (gram)

WW21	WW21 P0	WW21 G0	WW21 PG1	WW21 PG1	WW21 PG2	WW21 G2
Mean	13.48	14.42	16.62	18.11	19.44	20.20
St. Deviation	2.05	2.00	1.98	1.20	1.69	1.18

WW21 P0 = initial population of Fancy mice on WW21; WW21 G0= Fancy mice selected on WW21 of generation 0; WW21 PG1= population of WW21 on 1st generation, WW21 G1 = Fancy mice selected on WW21 of 1st generation; WW21 PG2= population of WW21 on 2nd generation, WW21 G2 = Fancy mice selected on WW21 of 2nd generation.

Table 2. Data of Increased Weaning Weight of the Fancy Mice

Increased Weaning Weight of the Fancy Mice				
Generation	G0	G1	G1	G2
Weaning weight	14.42 gram	18.11 gram	18.11	20.20
Increased weaning weight (gram)	3.69 gram		2.09 gram	
Increased weaning weight (%)	25.59 %		11.54 %	

Mice in weaning age has body weight 10 gram/tail until 12 gram/tail, 18 gram/tail until 20 gram/tail or 7,69 gram/tail (Nugroho, 2018). Dam candidates can be determined based on the height of weaning weight to find out increased genetic quality (Kurniawan *et al.,*2021). Birth weight high so will be obtained weaning weight higher than compared to those who have a birth weight lower. (Bunok *et al.,*2020). One of environmental factor is feed that takes affects animal performance. That matter because the weight on weaning age will achieve the maximum if the feed given has a higher feed content. Besides dam ability in milk production, offspring ability to obtain milk and growth experience is a parameter of weaning weight (Sudrajat *et al.,*2021). Based on the result of research using weaning weight of Fancy mice through the selection process obtained result was to be found increased weaning weight of Fancy mice that can be observed in Table 1 and 2. Increased WW21 G0 to WW21 G1 is 3.69 gram or 25.59% and increased WW21 G1 to WW21 G2 is 2.09 gram or 11.54%. Tribudi *et al.,* (2021) state that part of a breeding program is the implementation evaluation of the genetic potential that be found in sire candidates and dam candidates are the important thing in the selection of animal. Genetic potential used to be the basis of selection implementation can affect the effectiveness of selection experience increased, then genetic progress also increased. The performance which can be used to find out the genetic potential of the sire candidate and dam candidate is measurable. Being of birth weight and weaning weight can be an important factor to find out be in production potential that has.

3.2 Adult Weight of Mice

Based on the result of research weighing results obtained on AW35 of Fancy mice which can be found in Table 3 and Table 4 show increased AW35 each generation.

Table 3. Data of adult weight of the Fancy mice

AW35	AW35 P0	AW35 G0	AW35 PG1	AW35 G1	AW35 PG2	AW35 G2
Mean	21.83	23.44	26.49	28.58	31.64	33.50
St. Deviation	2.00	1.67	1.99	1.41	1.87	1.39

AW35 P0 = initial population of Fancy mice on AW35; AW35 G0= Fancy mice selected on AW35 of generation 0; AW35 PG1= population of AW35 on 1st generation; AW35 G1 = Fancy mice selected on AW35 of 1st generation; AW35 PG2= population of AW35 on 2nd generation; AW35 G2 = Fancy mice selected on AW35 of 2nd generation.

Table 4. Data of Increased Adult Weight of the Fancy Mice

Increased adult weight of the Fancy mice				
Generation	G0	G1	G1	G2
Adult weight	23.44	28.58	28.58	33.50
Increased adult weight (gram)	5.14 gram		4.92 gram	
Increased adult weight (%)	21.93 %		17.21%	

Adult body weight in female mice is 18 gram/tail until 35 gram/tail, adult body weight in male mice is 20 gram/tail until 40 gram/tail (Nugroho, 2018). Growth rate effect on adult rate (Prayogo *et al.,*2017). Based on the data adult weight of the research result which is found in Table 3 and 4 can be concluded that can be found the increased adult weight of Fancy mice after the implementation of the selection process from zero generation until the second generation. As for increased AW35 G0 to G1 is 5.14 gram or 21.93% and increased AW35 G1 to G2 is 4.92 gram or 17.21%. Based it can be concluded that the selection of adult weight can be increasing the adult weight of Fancy mice from zero generation until the second generation. Adult weight is the trait that uses selection criteria in research to be expected to increase the performance of adult weight Fancy mice. Ashari *et al* (2021) added that hormones are affecting of growth in male and female animals, it is hormone affected hormones will have an impact on the speed of growth in males and females, is because hormones are affected growth. Based on research results about Bali Cattle, the weight gain of bulls has a faster body weight gain than in dam.

3.3 Heritability of weaning and adult weight Fancy mice

Calculation heritability estimation of WW21 and AW35 of the Fancy mice using paternal half sib correlation method in Table 5.

Table 5. Estimation of heritability weaning weight of the Fancy mice and adult weight of the Fancy mice

Generation	h^2 WW21	h^2 AW35
G0	0.68 ± 0.34	0.49 ± 0.33
G1	0.45 ± 0.26	0.45 ± 0.31
G2	0.33 ± 0.22	0.30 ± 0.27

Poulsen *et al* (2020) state that difference existence of heritability value estimation be affected by parameters of a population that have differences, number of sampling variances, as well as be found different methodologies. Tribudi *et al* (2019) add the heritability value to breeding program improvement as is selection required for the estimation of genetic advancement that is connected with response to selection. Genetic parameter be affected by amount of population, location and estimation method. That matter can be found based on research that has been done using Madura cattle that be found in every district throughout Madura Island to increase genetic quality through the estimation of the genetic parameter value. It is based on heritability value is affected by population variety of population but not affected by animal performance. Sulastri *et al* (2019) state that a trait of heritability with classified low heritability in the range 0 until 0,1, classified intermediate heritability of in the range 0,1 until 0,3, and classified high heritability if the value is 0.3 until 1.0. Based the research of Fancy mice and compared with literature can be discovered that the h^2 WW21 of value is included classified as high heritability and the h^2 AW35 of value is included classified as intermediate until high so compatible to the selection process improvement. Krisnamurti *et al* (2019) state that response to selection of high valuable if high heritability. Tribudi *et al* (2019) state that selection is an effective effort genetic quality improvement if the heritability value has high or intermediate classified. However, if obtained heritability value is low classified so the suitable program is accompanying selection improvement.

3.4 Genetic Correlation Weaning Weight – Adult Weight of Fancy Mice

Based on the research obtained on G0 is 0.57 ± 0.38, G1 is 0.51 ± 0.38 and G2 is 0.47 ± 0.52. Tiara *et al* (2019) state that there is a estimation of genetic correlation provide knowledge about genes that affect each other a trait, efectivity on selection as well as advancement will be used to evaluate when more than one trait is selected. Genetic variance on two traits can be affected by there are related genes, that matter is reflection of genetic correlation. Estimation of genetic correlation is very required to known correlation of response to selection. Mahmud and Tribudi (2020) added that high genetic correlation is affected by genes that have pleiotropy trait contained on both traits and have the additive effect which that matter inherited to offspring. Genes that have a close relationship with the additive effect which has impacted two traits or more than two traits are genetic correlation overview. Existence of genetic parameters become instruction to genetic quality improvement of the population. Individual selection can be a suitable method to genetic quality improvement of a trait if the genetic correlation is a positive trait. That matter due to will obtains a bigger response to selection that expected if compared to a trait that has a low genetic correlation.

3.5 Breeding Value

Based on research results using WW21 and AW35 of Fancy mice obtained breeding value as there is in Table 6.

Table 6. The breeding value of Fancy mice

Breeding value (g)			
NP WW21	G0	G1	G2
♂ maximum	17.74	23.088	25.19
♂ minimum	14.18	16.04	20.60
♀ maximum	18.28	24.9505	22.29
♀ minimum	14.18	16.05	21.20
NP AW35	G0	G1	G2
♂ maximum	32.22	31.30	40.95
♂ minimum	28.65	30.63	39.90
♀ maximum	30.45	35.702	41.83
♀ minimum	27.00	30.9365	39.51

Implementation of selection based on WW21 and AW35 of the Fancy mice implemented based on breeding value WW21 and AW35 already ranked stars highest ranked until lowest. Implementation of selection based on breeding value using data WW21 and AW35 of Fancy mice is suitable with the opinion from Tribudi *et al.,*(2021) state that estimation of individual breeding values can be used as a reference for improvement selection on breeding to know the evaluation of animal genetic quality. Genetic potential from the average animal livestock population in a location can be known the superiority through the quantity of the estimated breeding value getting bigger. Breeding values which be created as animal selection as elders better be based on the animal which has a higher breeding value than the population that is lower. This is because an animal individual can inherit genetic potential and have production ability that can be repeated.

3.6 Response to Selection

Based on research result obtained direct response to selection based on WW21 every generation as follows 1.09 gram/generation; 0.43 gram/generation and 0.31 gram/generation. Direct response to selection value based on data AW35 is 1.12 gram/generation; 0.88 gram/generation and 0.53 gram/generation. Indirect response to selection based on research result on Fancy mice obtained result 0.76 gram/generation; 0.45 gram/generation. Implementation of the selection will obtain more effective and more efficient results to improve a animal genetic quality if the heritability of a high value trait or intermediate value, it is because can give of great response. As is expected selection can result in offspring which have superior genetic performance be compared with the elder, because selection implementation is a method of animal selection which have superior performance based genetics (Tribudi *et al.,*2019). Steps to improve the population of genetic quality can be used genetic parameter genetic as a reference. The high value of heritability for a trait can be a suitable method to improve genetic quality through individual selection. This is because the expected selection response expectation has a greater value compared to heritability with low heritability values. (Masili *et al.,*2018). There is a genetic correlation able to obtain knowledge about gen which can be the impact of one trait on another, therefore when selection implementation to more than one trait so can measure selection effectivity and genetic advancement (Dakhlan *et al.,*2022).

4. Conclusion

Selection can improve the weaning weight of Fancy mice and adult weight of Fancy mice. Selection on weaning weight of Fancy mice obtained increase result from G0 to G1 is 3.69 g and increase from G1 to G2 is 2.09 g. The increase of adult weight based selection result of Fancy mice on G0 to G1 is 5.14 g and adult weight from G1 to G2 increased is 4.92 g. This research can provide opportunities for researcher who will apply a selection program to livestock on an industrial scale.

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