



**UNIVERSITI PUTRA MALAYSIA**

**HERITABILITY ESTIMATES OF WEANING WEIGHT OF RABBITS IN  
COMMERCIAL RABBIT FARM IN SELANGOR MALAYSIA**

**NUR AMIRA HANI BINTI FARIS RAFIDI**

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FPV 2020 4**

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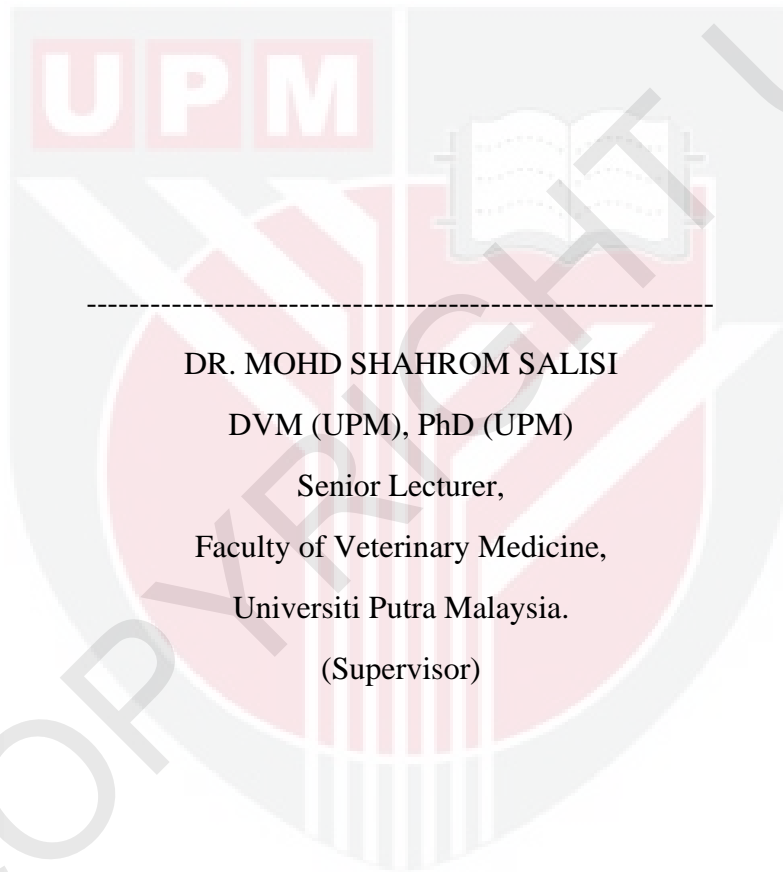
**A project paper submitted to the  
Faculty of Veterinary Medicine, Universiti Putra Malaysia  
In partial fulfilment of the requirement for the  
DEGREE OF DOCTOR OF VETERINARY MEDICINE**

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## CERTIFICATION

It is hereby certified that we have read this project paper entitled “Heritability Estimates of Weaning Weight of Rabbits in Commercial Rabbit Farm in Selangor, Malaysia” by Nur Amira Hani Faris Rafidi and in our opinion, it is satisfactory in terms of scope, quality and presentation as partial fulfilment of the requirement for the course VPD 4999 – Final Year Project.



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Not to forget the manager of the Goodtree Garden in assisting and providing me a great opportunity to conduct my thesis there.

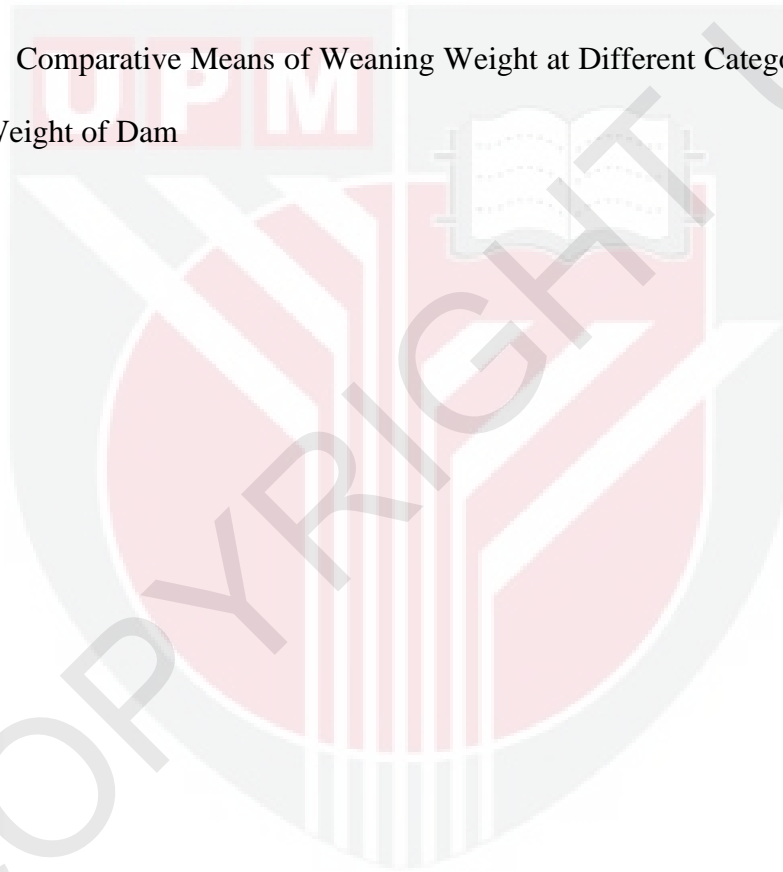
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**ABSTRAK**

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada keperluan kursus VPD 4901 -Projek.

**ANGGARAN HERITABILITI BERAT CERAI SUSU ARNAB DI LADANG  
ARNAB KOMERSIAL DI SELANGOR, MALAYSIA**

Oleh

**Nur Amira Hani Faris Rafidi**

**2020**

**Penyelia: Dr Mohd Shahrom Salisi**

**Penyelia bersama: Dr Hani Syahida Zulkaffli**

Kajian retrospektif pada tahun 2020 dilakukan di ladang arnab komersial di Selangor, Malaysia mengenai berat badan cerai susu bagi arnab kacukan baka arnab putih New Zealand dan Hycole. Kajian ini bertujuan untuk menganggar nilai heritabiliti berat cerai susu dan untuk menilai pengaruh faktor persekitaran terhadap berat badan cerai susu arnab. Kaedah regresi ibu bapa-anak digunakan untuk mengira nilai heritabiliti sementara faktor persekitaran diukur dengan menggunakan analisis regresi linear. Purata bagi berat cerai susu untuk arnab bagi kacukan baka arnab putih New Zealand dan Hycole ialah  $572.824 \pm 51.46$ . Umur dan berat badan ibu arnab tidak ketara ( $p > 0.05$ ) mempengaruhi berat badan cerai susu anak arnab. Kadar keturunan berat badan cerai susu dan ukuran bagi saiz satu kawanan anak arnab diperkirakan  $-0.65$  dan  $-33$ , yang berkorelasi secara negatif. Secara keseluruhan, faktor genetik dan persekitaran tidak mempengaruhi berat badan arnab. Hasil yang diperoleh melalui kajian ini dipengaruhi oleh saiz data yang kecil dan kekurangan data faktor persekitaran. Oleh itu, kajian pada masa

hadapan hendaklah mempunyai saiz data yang lebih besar dan lebih banyak faktor persekitaran diperlukan dan perlu dimasukkan untuk mendapatkan hasil yang lebih baik.

Kata kunci: Nilai heritabiliti, berat cerai susu, New Zealand White dan Hycote, faktor persekitaran



**ABSTRACT****HERITABILITY ESTIMATES OF WEANING WEIGHT OF RABBITS IN  
COMMERCIAL RABBIT FARM IN SELANGOR, MALAYSIA**

by

**Nur Amira Hani Faris Rafidi****2020****Supervisor: Dr Mohd Shahrom Salisi****Co-supervisor: Dr Hani Syahida Zulkafli**

A retrospective study in 2020 was conducted on a commercial rabbit farm in Selangor, Malaysia on the weaning weight of New Zealand cross Hycote rabbit. This study aimed to estimate heritability and to evaluate the influence of environmental factors on the weaning weight of rabbits. A total of 27 data was being recorded and analysed. The analysis was done using Windows-based statistical package viz. Microsoft Excel and IBM SPSS statistics version 25. Parent-offspring regression method was used to estimate heritability while the environmental factors were measured using linear regression analysis. The average weaning weight for New Zealand cross Hycote kit was  $572.824 \pm 51.46g$ . The age of dam and body weight of dam did not significantly ( $p < 0.05$ ) influence the weaning weight of rabbits. The heritability of weaning weight and litter size was estimated to be -0.65 and -33 which is negatively correlated. In overall, genetics and environmental factors do not affect the weaning weight of a rabbit. The result obtained from this study was largely influenced by the small sample of data and lack of parameters of the environmental factors. Hence, a larger sample of data is

needed for future study. Furthermore, the field of study could be expanded by using other traits and compare with different types of breed and more environmental factors are required and need to be included in order to obtain a better result.

**Keywords:** Heritability estimates, weaning weight, New Zealand white cross Hycole, environmental factors



## 1.0 INTRODUCTION

Rabbits (*Oryctolagus cuniculus*) are small mammals that belong to the family of *Leporidae* of the order Lagomorpha. Rather than wild or exotic meat, rabbits has always been associated as a pet animal. However, nowadays rabbits are marketed as meat, pelts or fur and pets after being raised commercially in farms (Alimon et. al., 2013). Alimon et. al. (2013) also added that rabbits could variegate the country's exports and provide an additional choice of halal meat to be consumed by consumers with its inherent characteristics such as breed easily, nutritious with lean and low-fat high-protein meat. With the encouragement from the Ministry of Agriculture, many Malaysian smallholder farmers and entrepreneurs go into rabbit farming for both export and local consumption (Raharjo et. al., 2016). Thus, genetics improvement of rabbit is necessary in order to increase meat production.

Heritability is a concept that describes the relative effect of genetic variation on phenotypes versus that of environmental sources of variation. It is important to use human selection to lead to maximum genetic improvement by estimation of genetic parameters when suitable breeding programs are used (Elamin et. al., 2012). According to Chineke and Raheem (2009) as cited in Okoro et. al., (2012), rapid improvement in rabbits performance would be possible by selection, use of breed diversity and estimating genetic parameters (Chineke and Raheem, 2009). Hence, precise knowledge of both environmental and genetic parameters is required to establish a sound breeding program (Elamin et. al., 2012).

According to Adeolu (2019), improvement of any strain or development of new lines in rabbits includes litter size and litter weight at birth and weaning are a major selection criterion of litter traits evaluated in artificial selection. According to Poigner

et. at., (2000) as cited in Ajayi et. at., (2018), body weight is also believed to be potentially heritable and thus selection of heavier individuals in a population will correspond to genetic improvement of the trait. However, heritability of weaning weight of rabbits in Malaysia is not known since there is a lack of data. Therefore, the purpose of this study is to estimate the heritability of knowing the magnitude of different environmental factors on the growth trait of these animals.

Heritability plays a significant role in formulating breeding plans for enhancing animal performance in which the significant aspect of these plans is selection. Selection is the process of selecting parents to create the next generation with improvement on a certain trait. Heritability is used to help organize breeding programs, establish management strategies, estimate breeding values of individual animals and forecast selection responses (Mebrate et. al., 2019) and this will automatically upgrade the population. Therefore, it is important to determine their prospective value in the selection of breeding animals at an early age. Wean weight selection is proven effective and it favours the improvement of maternal ability for young rabbits (Loussouarn et. al., 2012). With good breeding lines and offspring, this will lead to the farmer with good financial returns.

## 2.0 LITERATURE REVIEW

In scientific literature around the world, estimates of genetic correlations between rabbit body weights and morphometric traits are scarce (Akanno and Ibe, 2005). In addition, according to Okoro et. al., (2010), the relationship between body weight and linear traits of rabbits will explain something about feed efficiency and production performance which is concerned by the farmer and breeder. Besides that, wean weight selection is proven effective and it favors the improvement of maternal ability for young rabbits (Loussourarn et. al., 2012). Moreover, according to Adeolu et. al., (2019), improvement of any strain or development of new lines in rabbits includes litter size and litter weight at birth and weaning are a major selection criterion of litter traits evaluated in artificial selection. Moura et. al., (2001), mentioned that the estimated annual genetic trend was positive and significant for litter size at weaning (0.13) and litter weight at weaning (0.09). In contrast to a study done by Salaun et. al., (2001), heritability of total litter weight at weaning per doe and per year for Rex line was low (0.06) and the genetic correlation with the litter size at weaning (0.87) and the total litter weight at weaning (0.98) were high. However, it could be different for other breeds of rabbits and in this study, New Zealand White crossbred with Hycote was used. Numerous factors could be the reason of wide variation of heritability estimates as reported by other different authors such as management and breeding systems, mothering ability of individual dam (number of kits reared to weaning age), genetic constitution of the population of study, number of parity and environmental factors prevailing at a particular period of investigation (Adeolu et. al., 2019). Heritability will increase if genetic variation increases and the environmental variation also decreases and it is feasible through selection for highly heritable traits while for lowly heritable trait, performance can be enhanced by management and selection is less effective (Getabalew et. al., 2019).

According to McReynolds, 1974; Bhasin et al., 1996 as cited in Rojan et. al., (2013), it is evident that weaned rabbits body weight and growth rate rely on different factors such as age and weight of dam at birth, litter size at birth, litter season, and sex. Studies at Andhra Pradesh Agricultural University (APAU, 1989) also recorded that the dam weight at kindling had a major impact on kits body weight. Females at all ages have been recorded to have higher means with the weaning weight of its litter (Rojan et. al., 2013). Increase in the parity order of the dam showed that it significantly influenced the weight at birth, 3 and 4 weeks of age most probably due to boost in milk production and mothering competency (Uday et. al., 2016). Significantly higher litter weight at weaning was proven to be favourable during winter and other papers also agreed with the findings (Uday et. al., 2016). This parameter is however not applicable in this study since our country did not have four seasons. Environmental factors were shown to have significant effects on the production traits of rabbit (Uday et. al., 2016) and are in agreement with the reports of Rojan et. al., (2013) and Never (2018).

### **3.0 MATERIALS AND METHODS**

#### **3.1 Farm**

The work was carried out at Goodtree Garden Farm located at Kajang, Selangor, Malaysia (2°53'54.8"N 101°43'11.7"E) with an area of 1.2 acres. The average temperature and annual rainfall in the farm are typically between 28 °C to 32 °C and 2361 mm per year. The farm recorded to have a total of 380 rabbits which include 4 different breeds, the New Zealand White crossbred with Hycole, Mini Rex, New Zealand White, and mix breed, 30 were breeder males, 250 were breeder females and 100 offspring. This farm practices intensive farming and daily ration consisted of 100 to 120 grams of pellets per day, and 30 to 50 gram of Alfalfa hay and change alternately with Timothy hay with ad-libitum access of water.

#### **3.2 Source of Data**

All pedigree data and the weaning weight of New Zealand White crossbred with Hycole rabbits that was born in 2020 along with the weaning weight of respective dams were collected and retrospectively analysed for estimation of heritability of weaning weight. Body weight and age of dam were also evaluated as part of the environmental factor. The body weight of dams was grouped into three categories ( $\leq 3.0$  kg, 3.1-3.4 kg,  $\geq 3.5$  kg) and the age of dams also being grouped into two categories of age ( $< 15$  months and  $> 16$  months). Animal records with missing observations have been discarded from analyses. We managed to collect 27 complete data for analysis after the incomplete data was eliminated.

### **3.3 Statistical Analyses**

#### **3.3.1 Heritability Estimation**

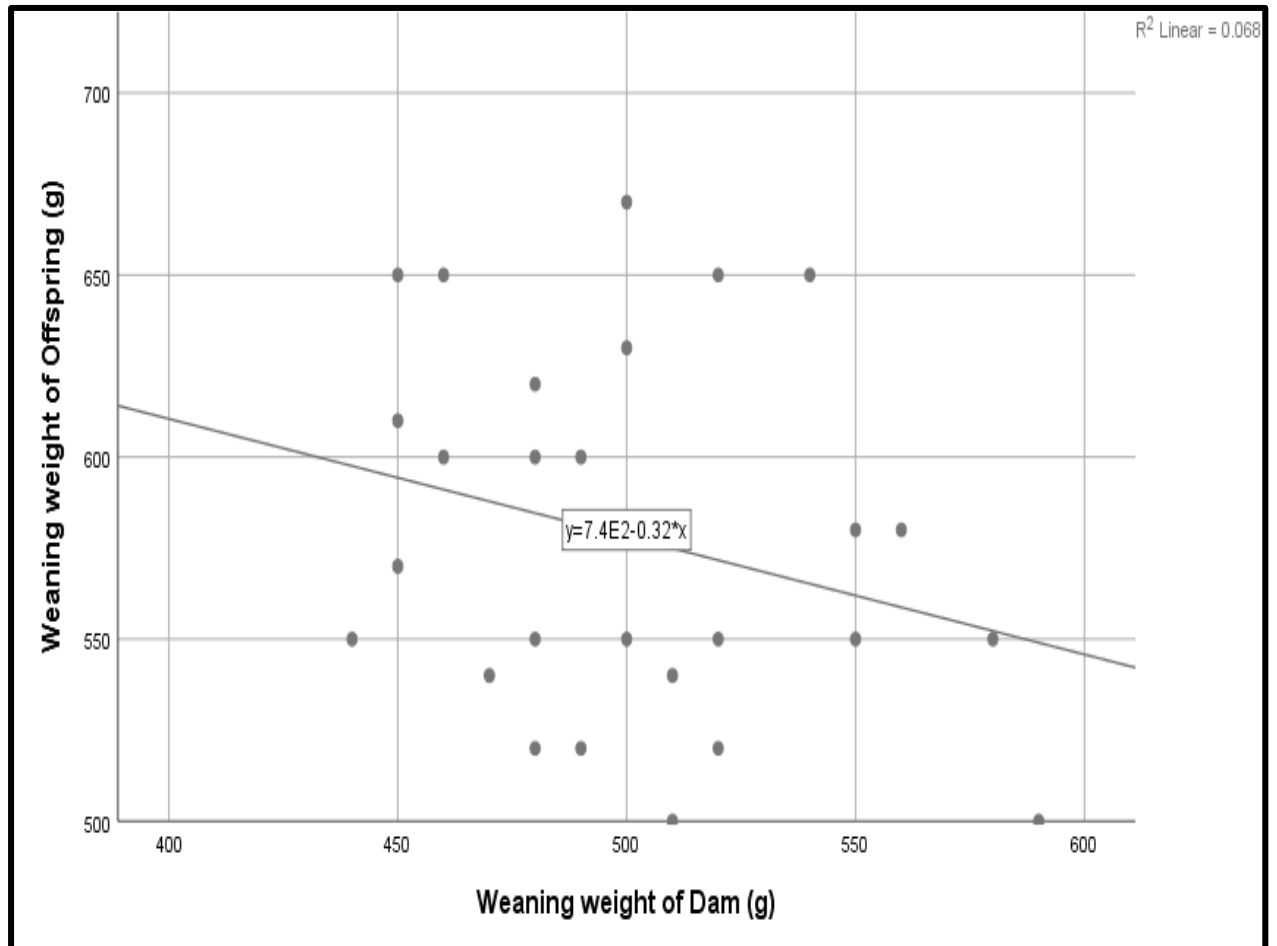
The analysis was done using Windows-based statistical package viz. Microsoft Excel and IBM SPSS statistics version 25. In this study, offspring – parent regression method will be used where we plot the weaning weight of offspring against weaning weight of dam and litter size against weaning weight of offspring, using the regression line to determine the resemblance between offspring and their parents.

#### **3.3.2 Evaluation of Environmental effects**

Windows-based statistical package viz. Microsoft Excel and IBM SPSS statistics version 25, linear regression analysis was used to evaluate any significant relationship between weaning weight of offspring with environmental factor (age of dam, body weight of dam) at  $P = 0.05$ .

## 4.0 RESULTS & DISCUSSION

### 4.1 Heritability Estimation for Weaning Weight



**Figure 1:** Scatterplot of Offspring Phenotypes (Weaning weight of offspring) and the Average of Parental Phenotypes (Weaning weight of dam)

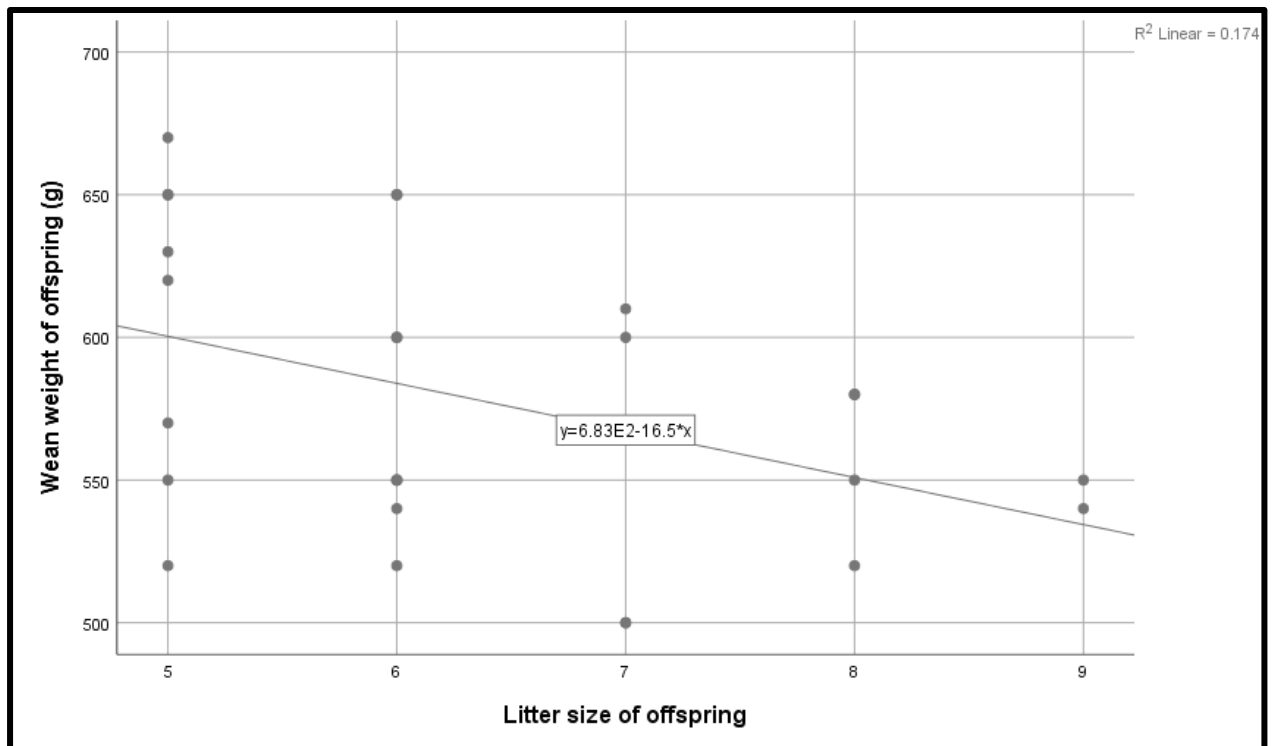
Parent-offspring regression method was used to estimate heritability ( $h^2$ ) for this study. The y-axis represents the weaning weight of offspring (g) against the x-axis which represents the weaning weight of dam (g) in the scatterplot to plot the observation of offspring by using this parent-offspring regression method. Linear regression consists of finding the best-fitting straight line through the points. The best-fitting line is called a regression line which shows the best fit linear relationship between y and x. The estimation of narrow – sense heritability can be interpreted from the slope of the regression line meaning the higher the slope, the more the offspring resembles the parent.

The equation of the regression line used is  $\hat{y} = bx + a$ , in which b value is the slope of the regression line. From figure 1, the regression equation was  $\hat{y} = -0.32x + 7.4E2$ , 7.4E2 meaning the exponential value in which the actual value of 739.902 rounded off to kg. The scatter plot in figure 1 data show a downhill pattern which indicates a negative relationship between X and Y. Hence, in this study the slope of the regression line was -0.32 which indicates the heritability estimates of weaning weight. In spite of that, the heritability estimates derived from the scatterplot does not represent complete heritability since the value from the study represents only half of the parent genes which is inherited to the offspring. In order to estimate complete heritability in this study, the value will be multiplied by two. Therefore, the heritability ( $h^2$ ) estimates of weaning weight of rabbit for this study was -0.65, which was negatively correlated. For this study which used New Zealand White cross Hycole rabbits, the heritability estimates is negative which is in disagreement with a study conducted by Kannegundla (2016), which state that heritability estimates of body weight in breed Soviet Chinchilla and Californian White rabbits

varies from low ( $\leq 0.30$ ) to high ( $\geq 0.60$ ) and along with a study of heritability estimates of weaning weight in rabbits of local Algerian population with result of 0.224. The disparities ascribed in the present findings could be maybe to the nature and number of populations studied which is only 27 data. Revelle and Robinson, 1973, and Iraqi, 2003 stated that variations in estimates of heritability and repeatability could be due to the method of estimation and the number of data to analyse them.



## 4.2 Heritability Estimation for Litter Size



**Figure 2:** Scatterplot of Offspring Phenotypes; Weaning weight of offspring against litter size of offspring

Linear regression method was used to estimate the correlation between litter size of offspring and weaning weight of offspring. The y-axis represents the weaning weight of offspring (g) against the x-axis which represents the litter size of offspring in the scatterplot to plot the observation of offspring. Linear regression consists of finding the best-fitting straight line through the points. The best-fitting line is called a regression line which shows the best fit linear relationship between y and x. The estimation of correlation can be interpreted from the slope of the regression line meaning the higher the slope, the more the correlation towards the litter size.

The equation of the regression line used is  $\hat{y} = bx + a$ , in which  $b$  value is the slope of the regression line. From figure 2, the regression equation was  $\hat{y} = -16.5x + 6.83E2$ ,  $6.83E2$  meaning the exponential value in which the actual value of 682.872 rounded off to kg. The scatterplot in figure 1 data show a downhill pattern which indicates a negative relationship between  $X$  and  $Y$ . Hence, in this study the slope of the regression line was  $-16.5$  which indicates the negative correlation of weaning weight towards the litter size. In spite of that, the heritability estimates derived from the scatterplot does not represent complete heritability since the value from the study represents only half of the parent genes which is inherited to the offspring. In order to estimate complete heritability in this study, the value will be multiplied by two. Therefore, the heritability ( $h^2$ ) estimates of weaning weight of rabbit for this study was  $-33$ , which was negatively correlated. For this study which used New Zealand White rabbit cross Hycole, the heritability estimates are negative which is in disagreement with a study conducted by Fayeye et. al., (2016), which states that heritability estimates of weaning weight in breed New Zealand White rabbit cross with Chinchilla and Californian rabbit are positively correlated with value of 0.38. The heritability estimates from the present findings may be due to high proportions of environmental factors acting on the rabbits, nature and number of populations studied which is only 27 data.

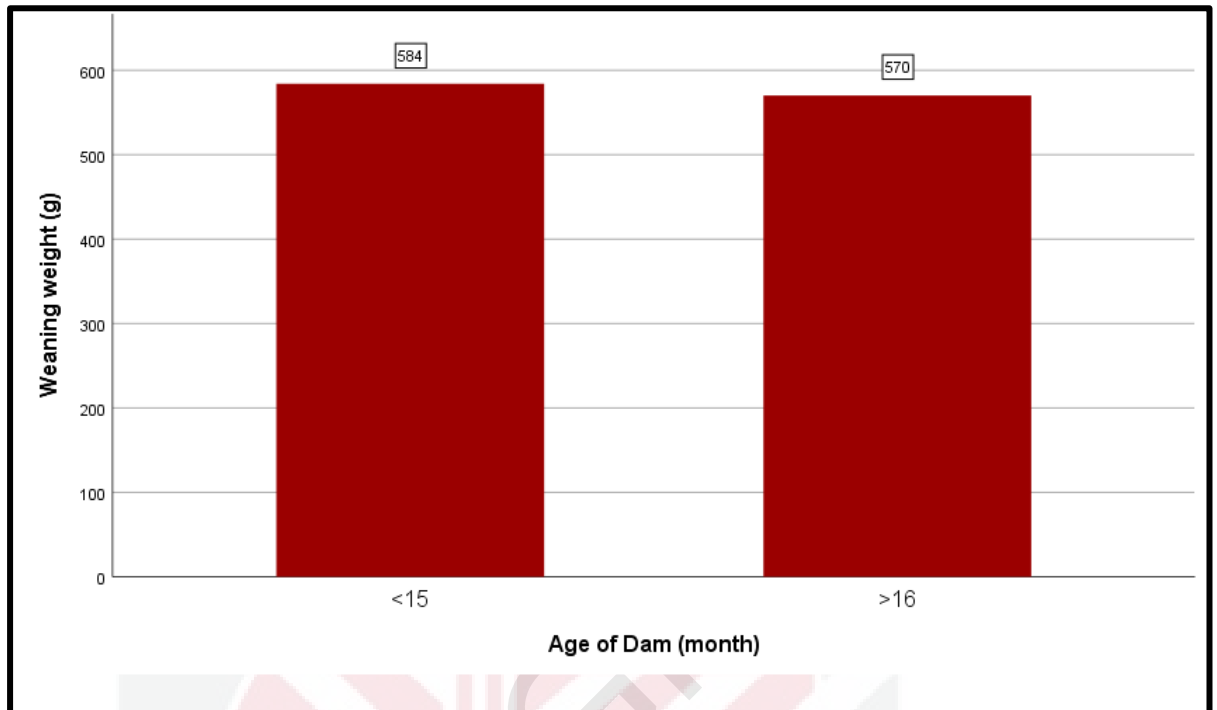
## 4.2 Evaluation of Environmental Factors

DESCRIPTIONS		MEAN $\pm$ SD (g)
<b>Overall mean</b>		572.824 $\pm$ 51.46
<b>Age of dam (months)</b>	<15 months	584.00 $\pm$ 50.96
	>16 months	570.00 $\pm$ 50.81
<b>Body weight of dam (g)</b>	$\leq$ 3000 g	573.33 $\pm$ 49.24
	3100 - 3400 g	589.29 $\pm$ 48.91
	$\geq$ 3500 g	547.50 $\pm$ 57.37

**Table 1:** The overall mean and standard deviation of weaning weight of offspring New Zealand White cross Hycole rabbits at different environmental factors.

The average weaning weight of offspring from the data collected in 2020 was 572.824  $\pm$  51.46 g. From a study conducted by Uday et. al., 2016, the average weaning weight of Soviet Chinchilla and Californian White rabbits are 420.15  $\pm$  8.72 and 415.63  $\pm$  8.44 g which was slightly lower than the finding in this study which is most probably due to the different breeds. The average weaning weight of the present study also is heavier than the recorded weaning weight of local Algerian rabbits that was 404 g by Abdelli et. al., (2014). There were two environmental factors (age of dam and body weight of dam) to be analysed in this study against the weaning weight of New Zealand white cross with Hycole rabbits. These factors are the ordinary factors that are being assessed in other studies to discover the significant effect of environmental factors towards weaning weight of rabbits.

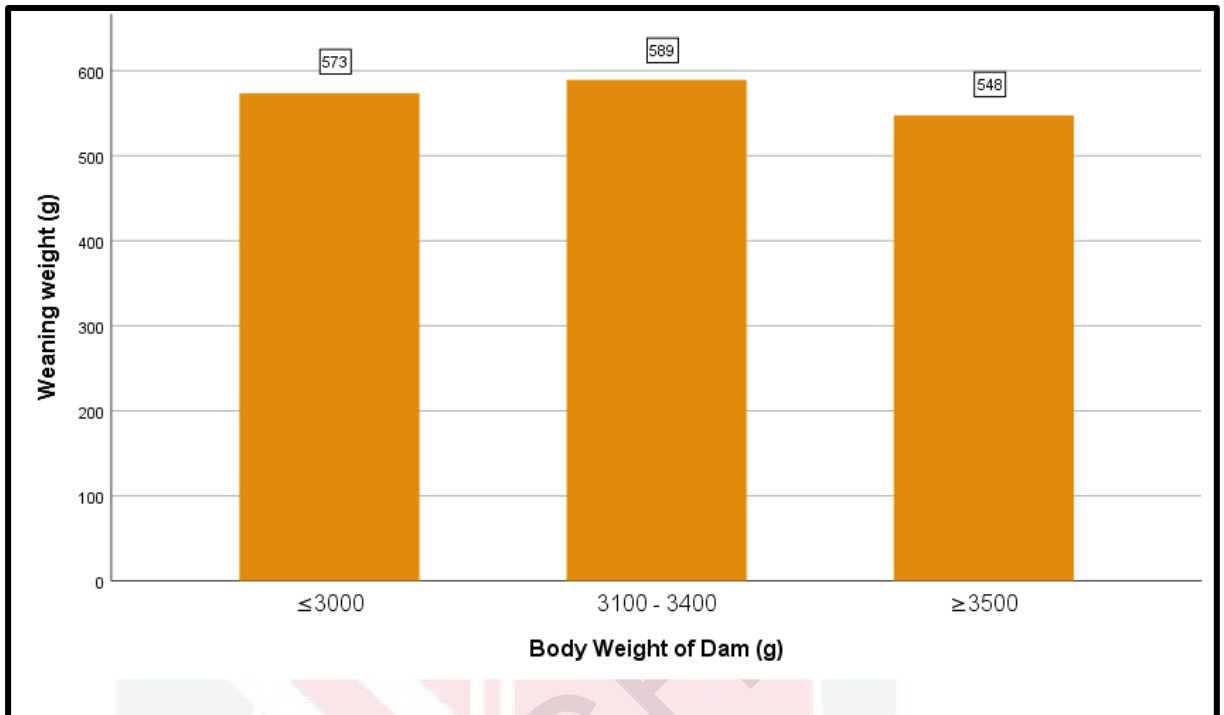
#### 4.2.1 Effect of Age of Dam



**Figure 2:** Comparative means of weaning weight at different age of dam

In this study, we found that the highest weaning weight of offspring with value of  $584.00 \pm 50.96$  g produce by dam with the age of <15 months old compared to weaning weight of offspring with value of  $570.00 \pm 50.81$  g produce from dam with the age of >16 months old. The age of a dam did not have a statistically significant effect ( $P < 0.05$ ) towards the effect of weaning weight of offspring. In contrast with the present study, according to Assan (2018), older dams have a greater maternal capability to milk which in return will result in better weaning weights. The other reason may be due to the parity orders, whereas stated from Assan (2018) that kits are heavier at weaning in third parity compared to other parity orders but in this study, parity order was not taken since absence of record of parity order of each doe.

#### 4.2.2 Effect of Body Weight of Dam



**Figure 3:** Comparative means of weaning weight at different categories of body weight of dam

From figure 3 shown above, we found that dam with body weight range from 3100 to 2400 g produce offspring with the highest weaning weight of  $589 \pm 48.91$  g compared to offspring with the lowest weaning weight of  $548 \pm 57.37$  g produce from a dam with body weight  $\geq 3500$  g. Nonetheless, the body weight of the dam did not have a statistically significant effect ( $P < 0.05$ ) towards weaning weight of offspring. This contrast with the result from studies conducted at Andhra Pradesh Agricultural University (APAU, 1989) and Rojan, 2013 that observed significant effects of dam weight towards the weaning weight of kits of White Giant, Soviet Chinchilla and Grey Giant breed. The differences in this result could be due to different types of breed and number of data analysed.

## 5.0 CONCLUSION

The average weaning weight for New Zealand cross Hycole kit was  $572.824 \pm 51.46g$ . The age of dam and body weight of dam did not significantly ( $p < 0.05$ ) influence the weaning weight of rabbits. The heritability of weaning weight and litter size was estimated to be -0.65 and -33 which is negatively correlated. In overall, genetics and environmental factors do not affect the weaning weight of a rabbit. The result obtained from this study was largely influenced by the small sample of data and lack of parameters of the environmental factors. Hence, in future, a larger sample of data is needed for future study. On top of that Furthermore, expand the field of study could be expanded by using other traits and compare with different types of breed and more environmental factors are required and need to be included in order to obtain a better result.

## 6.0 RECOMMENDATIONS

No research has been performed in Malaysia up to this day to study on the heritability estimates of the weaning weight of rabbits in Malaysia. All the findings from this study suggest that genetics and environmental factor do not affect the weaning weight of rabbits even though there should be at least either one that influence and had a major influenced towards the weaning weight rabbits. To reassure a good result and accuracy, a bigger sample size is required by widen the population coverage and incorporate larger numbers of data with several years of record and few generations. On top of that, several farms must be included in the targeted area. A huge number of data will lead to a better and accurate result. In order to analyse environmental factors, more parameter is needed as a whole which include the parity order, sex of the rabbit and year of birth. Besides that, further studies of heritability estimates should be conducted on other traits such as birth weight. Along with it, different breeds of rabbits in Malaysia should be analyse to compare and see the differences in the heritability of estimates. Last but not least, a study can be done to see the correlation between weaning weight and reproductive performance or productive performance.

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