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## The Study of male and female Saanen Goat's growth performance at UniSZA dairy goat farm (UDGF)

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The main constraint of dairy goat industry in Malaysia is the insufficiency of good quality breeding stock to meet the demand for the dairy goat industry. In regards to this issue, UniSZA had initiated the establishment of UniSZA Saanen locally adapted dairy goat breed for Malaysia. To ensure the success of this establishment, the growth performance of the imported Saanen goats is one of the factors need to be determined. The objectives of this study were to determine the effect of litter size, gender and influence of blood parasites on growth performance of imported Saanen goats reared at UniSZA Dairy Goat Farm (UDGF). The data were collected at 15 days interval for 2 months. The results showed that male kids had higher ( $P \leq 0.5$ ) mean value compared to female kids, whilst, single kids showed higher ( $P \leq 0.05$ ) mean value compared to twin kids. The correlation and regression analysis indicates that male kids' weight gain is slightly higher compared to female kids, and live weight is positively correlated with body measurements of Saanen kids. There were positive correlations among female Saanen goats' live weight, body and mammary measurements with a stronger correlation observed in the kids. The live weight, scrotal circumference and testicular volume of male Saanen goat kids showed positive correlation with body measurements by time. All the bucks studied were positively infected with blood parasites but with low level of infestation. In conclusion, the imported Saanen goats is seem like to be well adapted to the new environment exposed. The data from this study is potentially useful as a guidance for farmers managing their Saanen goats to achieve optimum herd productivity and efficiency.

**Keywords:** litter size, gender, growth performance, mammary measurements, blood parasites, scrotal measurements

### INTRODUCTION

The Saanen goat breed is a Swiss breed which originated in the Saane Valley. It is now the most popular dairy goat breed in many countries, including Australia. In Malaysia, the government has been imported many exotic breeds of goats including Saanen breed to overcome the insufficiency of good quality breeding stock of the local breed to meet the demand for the dairy goat industry in the country (DVS, 2017). Due to its

heavy milk producer, Saanen goats become a prevalent breed by dairy goat entrepreneurs and community farmers in Malaysia. However, there is still lack of superior Saanen dairy goat breed available in Malaysia due to its high price, adaptability issues in local condition and poor breeding management system of producers. Moreover, there are limited number of studies investigated the adaptability potential or productive

performance of the imported Saanen goats in Malaysia.

In UniSZA, a breeding centre for Saanen goat is being established under UniSZA Dairy Goat Farm (UDGF). As a beginning to the project, UDGF, UniSZA had imported Saanen dairy goat breed from Australia to develop Saanen Dairy Goat Breeding Centre. However, the performance in regards to their growth, reproduction and production of these imported Saanen goats after being reared in Malaysia is unknown.

The growth performance of goats can be measured by using parameters such as body size and weight which are being considered as a vital indicator to improve productive traits in breeding. Thus, the measurement of one or two traits such as heart or chest girth, body length and weight could be informative for farmers to evaluate the livestock productivity (Birteeb et al., 2015). Whilst, breeding soundness evaluation (BSE) is a quantitative data for goat reproductive organs determination of fertility potential of breeding males. These data consist of scrotal circumference measurements, an elemental part of BSE of animals with a pendulous scrotum due to high relations between testicular size and sperm production capacity (Jainudeen et al., 1993; Goyal et al., 2007). Furthermore, body size and testicular measurements are the parameters commonly applied in BSE (Agga et al., 2011).

Besides that, one of the most important traits of dairy goat is the ability to produce large amount of milk. Thus, it is important to evaluate the main traits that are related to milk production such as udder, teat, live weight and their relationship with milk yield (Caja, et al., 1999). The shape of the udder and teat are correlated with milk yield and milk flow rate (Marie-Etancelein, et al., 2002).

The blood parasites can potentially be harmful to the livestock animals such as goats which could affect their performance. Blood parasite such as *Caprine anaplasmosis* has been widely distributed in Asia (Renneker et al, 2013) but due to its subclinical nature of the disease in goats, it is often considered to be of minor importance (Rajasokkappan et al., 2016). Anaplasmosis in goats caused by *A. ovis* and the infections were usually from mild to severe disease in goats. Theileriosis in goats caused by *T. ovis* but usually non-pathogenic. Infestation of *T. lestoquardi* in goats can cause high morbidity and mortality (Altay et al., 2007)

Thus, this study was conducted to determine the growth performance of the imported Saanen goats as well as their adaptation to local environment in regards to live weight, body

measurements, mammary measurements, scrotal circumference, testicular volumes and blood parasites infestation.

## MATERIALS AND METHODS

This study was conducted at UniSZA Dairy Goat Farm (UDGF), Pasir Akar Farm, UniSZA, Besut. All experimental procedures were approved by UniSZA Animal Plant Research Ethics Committee (UAPREC). The present study evaluated the growth performance of Saanen goat's kids, does and bucks based on their live weight, body measurements, mammary measurements, scrotal circumference and testicular volumes. In addition, the blood parasites of nine Saanen bucks that are available at UDGF have been identified and determined to evaluate their correlations with live weight, scrotal circumference and testicular size of the bucks. The Saanen goats used in this study have been studied without altering the existing management and feeding regime applied by the management of UniSZA Dairy Goat Farm (UDGF), Pasir Akar Farm, UniSZA.

### Measurements involved in the study:

1. The live weight was measured by using spring balance.
2. Body measurements were measured by using measuring tape (Gemeda et al., 2017).
  - Body length (BL)
  - Heart girth (HG)
  - Wither height (WH)
  - Rump height (RH)
3. Mammary measurements were measured by using caliper.
  - Udder circumference
  - Udder depth
  - Teat length
  - Teat diameter
4. Scrotal measurements were taken by using scrotal and measuring tape (Memon et al., 2007)
  - Scrotal circumference (SC)
  - Testicular volume (TV).
    - TV was calculated by using formula manipulated by Unanian et al. (2000);
    - $TV = [(left\ width)/2 \times \pi \times left\ height] + [(right\ width)/2 \times \pi \times right\ height]$ .

### Part I

#### The Growth Performance (Live Weight and Body Measurements) of Different Gender (Male vs. Female) and Litter Size (Single vs. Twin) of Saanen Goat Kids.

A total of 40 Saanen goat kids (n=20 males and 20 females; age: 6 to 7 months) were used in this study. The data on breeding records (including gender of kid, litter size, and birth weight) was obtained from UDFG's record. The growth performance of kids between 6 to 7 months of age were measured and recorded at 15 days interval for 2 months.

## Part II

### The Growth Performance (Live Weight, Body and Mammary Measurements) of Female Saanen Goat Kids and Does.

A total of 30 female Saanen goats (n=15 does and 15 kids) were used in this study. The data for this study were collected and recorded at 15 days interval for 2 months.

## Part III

### The Growth Performance (Live Weight, Body and Scrotal Measurements) of Male Saanen Goat Kids.

A total of 24 male Saanen goat kids (age: 6 to 7 months) were used in this study. All data were collected and recorded at 15 days interval for 2 months.

## Part IV

### The Correlation between Growth Performance (Live Weight, Body Measurements and Scrotal Circumference) and Blood Parasites of Saanen Bucks.

A total of 9 Saanen bucks (age between 1 (n=4) to 2.5 (n=5) year-old) were used in this study. Live weight, body measurements, scrotal circumference and blood collection were carried out and recorded at 30 days interval (Day 1 and Day 30).

The blood samples were collected through jugular veins by using sterile hypodermic needle and syringe. About 5 ml of EDTA blood was collected from each buck and smeared by using Giemsa stain. The infection intensity was estimated by calculating the number of blood parasites in 10 microscope fields with each field containing approximately 300 erythrocytes (Gharbi et al., 2015).

## Statistical Analysis

Statistical data analysis was calculated by using Minitab software. Descriptive statistics (means and standard deviation) were used to describe the variables. The effect of gender and litter size on birth weight were analyzed by using one-way ANOVA. The effect of gender and litter size on live weight at post-weaning age (6-7

months old), and the correlations between live weight and body measurements were correlated by using Correlation and Regression Analysis in Microsoft Excel. The relationship between body and mammary measurements were calculated using Microsoft Excel to obtain the correlation

The difference percentage of blood parasites between ages were analyzed using Two sample T-test. The correlations between blood parasites with growth performance and scrotal measurements are correlated by using Correlation and Regression Analysis in Microsoft Excel. Tests were carried out at 95% level of confidence ( $P < 0.05$ ).

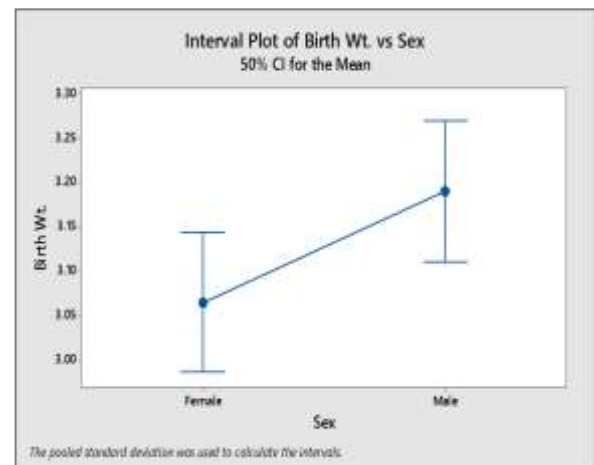
## RESULTS

### Part I

#### The Growth Performance (Live Weight and Body Measurements) of Different Gender (Male vs. Female) and Litter Size (Single vs. Twin) of Saanen Goat Kids.

##### The Effect of Gender on Birth Weight

Figure 1 shows that gender has a significant ( $P \leq 0.5$ ) effect on goat kids' birth weight. Male kids showed higher mean value ( $\bar{x}=3.19$ ) compared to female kids ( $\bar{x}=3.07$ ).



**Figure 1; The effect of gender (male vs. female) on birth weight (mean  $\pm$  s.e.) of Saanen goat kids.**

##### The Effect of Litter Size on Birth Weight.

Figure 2 shows that litter size has a significant ( $P \leq 0.05$ ) effect on kid's birth weight. Single kids showed higher mean value ( $\bar{x}=3.41$ ) compared to twin kids ( $\bar{x}=2.85$ ).

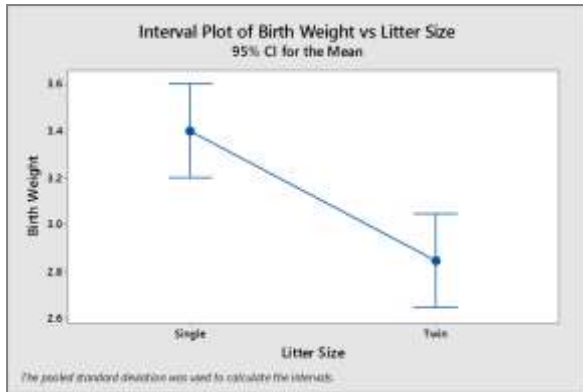


Figure 2; The effect of litter size (single vs. twin) on birth weight (mean ± s.e.) of Saanen goat kids.

**The Effect of Gender on Live Weight.**

Figure 3 shows the live weight of Saanen goat kids over time (days) on different gender (male vs. female). Based on the correlation and regression analysis of the gender, it indicates that male kid's weight gain is at 1.03 kg d<sup>-1</sup>, and female kid's weight gain is at 0.96 kg d<sup>-1</sup>. This showed that male kids' weight gain is slightly higher compared to female kids.

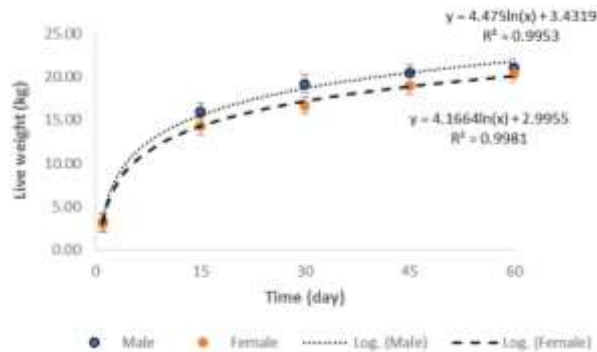


Figure 3; The live weight of Saanen goat kids over time (days) on different gender (male vs. female).

**The Effect of Litter Size on Live Weight.**

Figure 4 shows the effect of live weight over time (days) on litter size of the Saanen goat kids. Based on the correlation and regression analysis of single and twin Saanen goat kids, it is found that single kids' weight gain is at 0.91 kg d<sup>-1</sup>, and twin kids' weight gain is at 1.08 kg d<sup>-1</sup>. This showed that twin kids' weight gain is slightly higher compared to single kids.

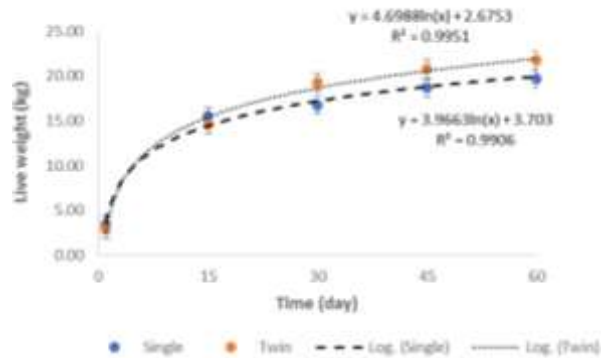


Figure 4; The live weight of Saanen goat kids over time (days) on litter size (single vs. twin).

**The Correlation between Body Measurements and Live Weight.**

Figure 5 shows the correlation between body measurements and live weight of Saanen goat kids at four different data collection times. Based on the correlation and regression analysis of different body measurements and live weight of the Saanen goat kids, it is found that with the increase of 1 kg of live weight the body length (BL) will increase at 0.59 cm, heart girth (HG) will increase at 0.94 cm, and wither height (WH) will increase at 0.67 cm.

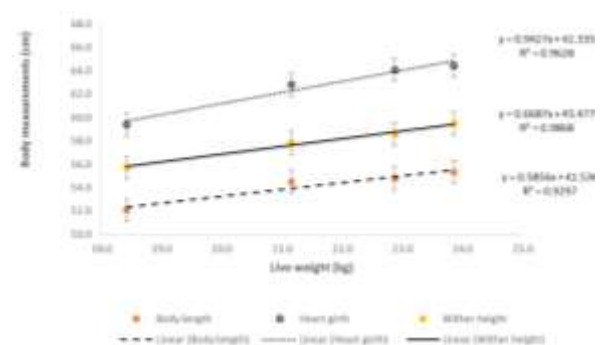


Figure 5; The correlation between body measurements and live weight of Saanen kids at four different data collection times.

**Part II**

**The Growth Performance (Live Weight, Body and Mammary Measurements) of Female Saanen Goat Kids and Does.**

**The Correlation between Saanen Goat Kids' Body Measurements and Live Weight**

Figure 6 shows the relationship of body measurements and live weight of Saanen kids. The value of R<sup>2</sup> obtained for wither height is 0.8539, followed by heart girth at 0.7554 and body length is 0.7057.

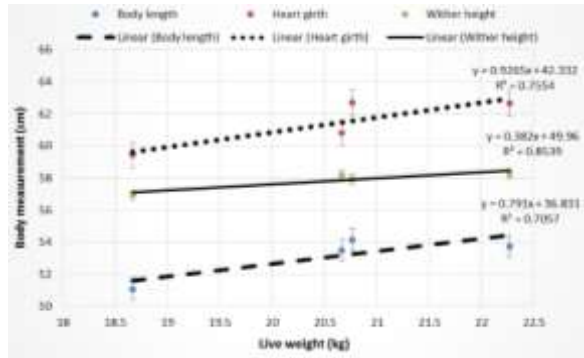


Figure 6: The relationship between body measurements and live weight of Saanen goat kids.

**The Correlation between Saanen Goat Kids' Live Weight and Mammary Measurements**

The relationship between live weight and mammary measurements of Saanen kids is presented in Figure 6. The R<sup>2</sup> value obtained show strongest relation with right teat diameter (0.9637), followed by left teat diameter (0.7489), right teat length (0.6638) and left teat length (0.5594).

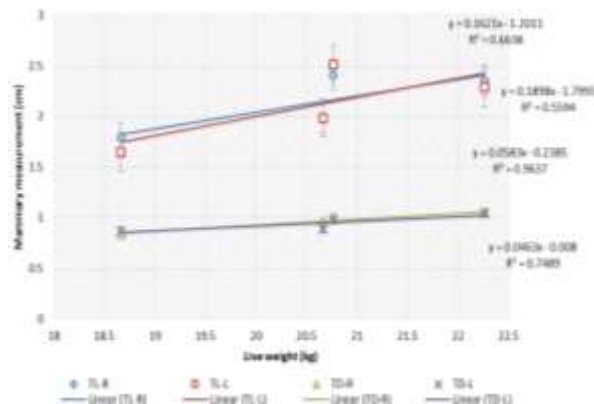


Figure 7: The relationship between live weight and mammary measurements of Saanen goat kids.

**The Correlation between Saanen Goat Does' Body Measurements and Live Weight**

The results show positive correlation between body measurements and live weight (Figure 8), with R<sup>2</sup> values for body weight = 0.7152; heart girth = 0.4176, and wither height = 0.071.

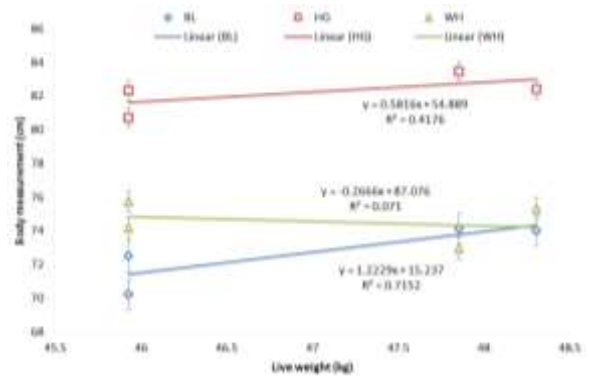


Figure 8; The relationship between body measurements and live weight of female Saanen goat does.

**The Correlation between Saanen Goat Kids' Live Weight and Mammary Measurements**

The relationship between mammary measurements and live weight of Saanen does are shown in Figure 9. The R<sup>2</sup> value obtained show the weakest relation with left teat diameter (0.0004), followed by right teat diameter (0.0167), left teat length (0.2573), udder circumference (0.0438), right teat length (0.4628), and udder depth (0.798).

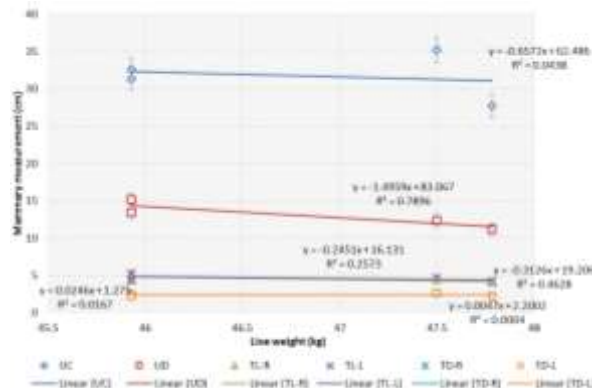


Figure 9; The relationship between mammary measurements and live weight of Saanen goat does.

**Part III**

**The Growth Performance (Live Weight, Body and Scrotal Measurements) of Male Saanen Goat Kids.**

The relationship between body measurements and live weight is shown in Figure 10. Body length shows the highest correlation to live weight (R<sup>2</sup>=0.979), followed by rump height (R<sup>2</sup>=0.966), HG (R<sup>2</sup>=0.948), and wither height (R<sup>2</sup>=0.941). Figure 11 illustrates significant relationship between scrotal circumference to the

live weight and body measurements ( $R^2=0.908$ ). The relationship between testicular volume with live weight and body measurements are shown in Figure 12 with correlation coefficient of  $R^2=0.941$ .

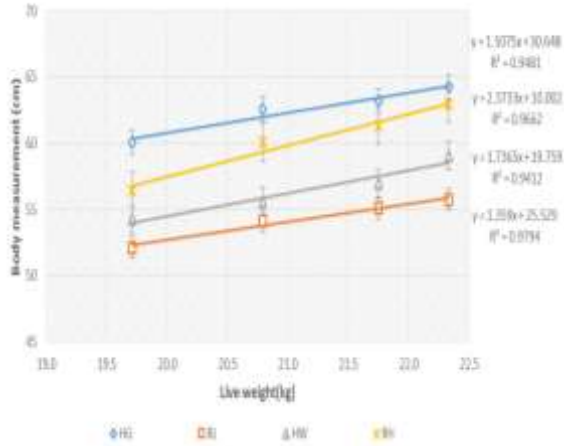


Figure 10; The relationship between body measurements (body length (BL), heart girth (HG), wither height (WH) and rump height (RH)) with live weight at four different data collection times.

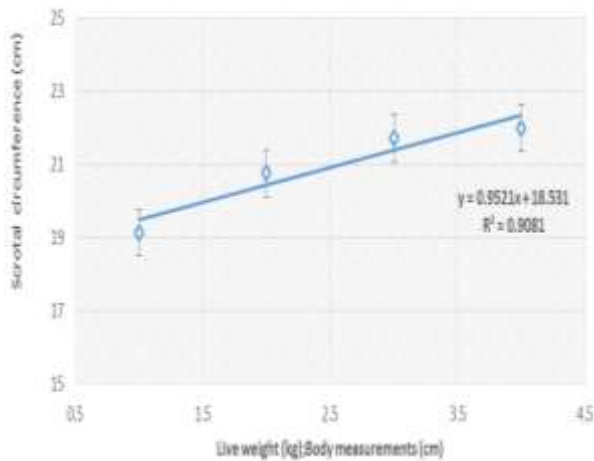


Figure 11; The relationship between scrotal circumference (SC) with live weight and body measurements (body length (BL), heart girth (HG), wither height (WH) and rump height (RH)) with live weight at four different data collection times.

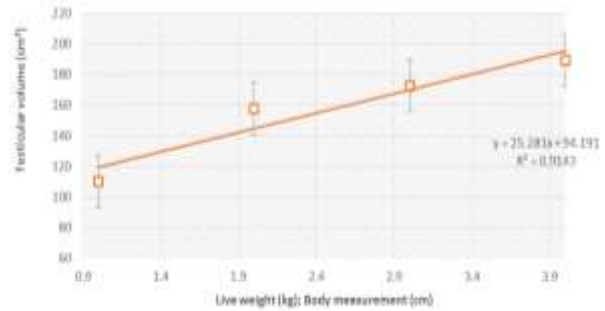


Figure 12; The relationship between testicular volume (TV) with live weight and body measurements (body length (BL), heart girth (HG), wither height (WH) and rump height (RH)) with live weight at four different data collection times.

Part IV

The Correlation between Growth Performance (Live Weight, Body Measurements and Scrotal Circumference) and Blood Parasites of Saanen Bucks

The results show that all bucks were positively infected with *Anaplasma spp*, whilst, only three of them were infected with *Theileriosis spp*. However due to the low level of infection, the infected bucks did not show any common clinical signs such as anaemia or pale mucous membrane.

There was no effect on scrotal measurements and growth performance of the bucks as shown by the low level of correlations observed (Figure 13 and Figure 14). There was no difference of blood parasites infestation at both collection times (Day 1 and Day 30) between young and adult Saanen bucks ( $P \geq 0.05$ ) (Figure 15).

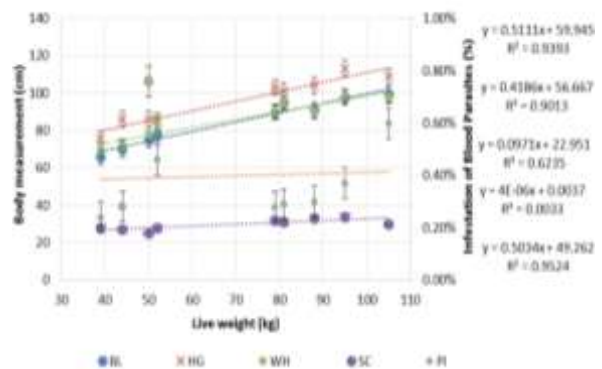
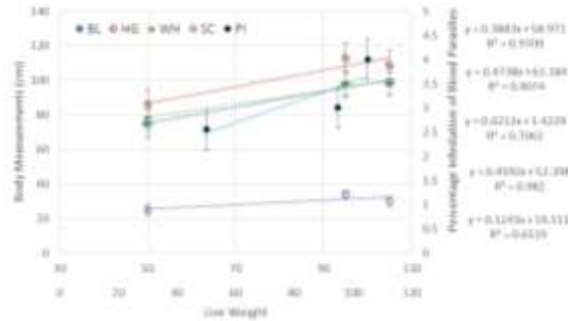
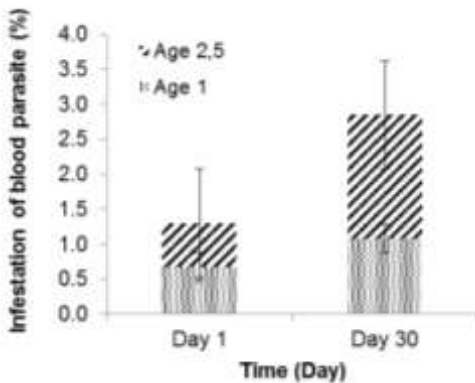


Figure 13; The effect of *anaplasmosis spp* infestation on live weight, body measurements (body length (BL), heart girth (HG), wither height (WH) and rump height (RH)) and scrotal circumference (SC).



**Figure 14;** The effect of *theileriosis spp* infestation (PI) on live weight, body measurements (body length (BL), heart girth (HG), wither height (WH) and rump height (RH)) and scrotal circumference (SC).



**Figure 15;** The difference of blood parasites infestation between two different ages (1 year vs. 2.5 years of age) with time (Day 1 vs. Day 30).

## DISCUSSION

Many studies have shown that male kids generally will have a higher birth weight compared to female which are similar with the present study. Bushara et al (2013) and Birteeb et al (2015) had stated that the dominance of males may be attribute to the point that male kids are more vigorous than female kids and thus resulting a rapid growth due to the greater access to their dam's milk. This is also comparable with previous studies (Cam et al., 2010; Birteeb et al., 2015; Kashani and Bahari, 2017) that clearly showed males were heavier than females due to their natural hormonal level. Hence, these studies support the fact that the male kids in the present study were heavier at birth.

According to Ashworth (2013), birth weight is an indicator of the rate of fetal growth itself regulated by genetic, epigenetic and environmental factors. The result from present study shows that

single kids had higher birth weight compared to twin kids. This is in agreement with Birteeb et al., (2015) who had reported that a significance result of type of birth on birth weight. In addition, heavier single born kids at birth than those born as twins that might be related to the absence of nutritional and space competition inside the uterus (Deribe and Taye, 2013; Syahirah et al., 2016). Furthermore, the amount of caruncles attached to each fetus is decrease as the number of fetus in utero increase, thus it will reduce the consumption of nutrients of offspring in large litter size (Robinson et al., 1977). This is also supported by Gluckman and Hanson, (2004) that shows increasing in litter size resulting a decreased of birth weight, which might be due to reduce in uterine space that limits variation in birth weight.

However, in the present study twin kids' weight gain after weaning is slightly higher compared to single kids. This finding is not in agreement with previous studies by Deribe and Taye (2013) and Kugonza et al., (2014), that showed single born kids were heavier than twins. These differences might be due to the differences in the mothering capability of the dams, climate, nutrition and general management conditions that could influence the weight of the kids after weaning (Birteeb et al., 2015).

Body measurements are the best way to describe performance of animals (Maksimović et al., 2015), thus, data collected on HG, BL, HW and RH could indicate the growth performance of the goat. Body measurements can also be used as a selection criteria for growth performance since it had high correlation with the body weight (Muhammad et al., 2006). When the breeding aim is to improve productive traits, the practical understanding of body size and weight of animals is importance to farmers and breeders because it helps to specified which animals to be selected for the breeding purposes (Birteeb et al., 2015). Salako (2006) stated that various body measurements are important indicators of production type and breed characteristics of animals. Therefore, the measurement of various traits such as heart girth, body length and weight could give valuable information for decision making by livestock farmers (Birteeb et al., 2015).

In the present study, the correlation and regression analysis results show that all the body measurements are strongly related to the live weight. This is consistent with the study by Cam et al., (2010) who stated that body measurements (i.e. wither height, heart girth and chest depth) had the highest correlations with animals' live weights. Though, Janssens and Vandepitte (2004) reported

that correlations between variations could be varied as body measurements vary from age, gender and also seasons in related to feeding status in adults. Based on the live weight's and correlation results in the present study; they are seemed to be acceptable which shows good adaptability progression of these imported goats.

In mammary measurements result, the correlation for the relationship between mammary measurements and live weight, Saanen kids show a stronger correlation than Saanen does. This may be due to that the Saanen does experience udder deterioration due to advancing age and/or lactating number (Mavrogenis et al., 1988). In addition, the performance of dairy goats is differ based on age, and can be influenced due to internal or external factors (Papachristoforou and Mavrogenis, 1981).

The testicular size (i.e. scrotal circumference or testicular volume) is a reliable parameter of the status of reproductive growth, spermatogenesis, and seminal characteristics (Daudu, 1984).—The present study showed that scrotal circumference and testicular volume is correlated with live weight and body measurements. This is parallel with a physiological perspective that scrotal and testicular characteristics are positively influenced by live weight, where heavier animals will have bigger testicular size (Jafariahngari et al., 2012).

The control of parasitic infestations in small ruminant farms is very important, as healthy animals will increase production, reduce costs for treatment, directly increase domestic mutton production and indirectly increase farmer's profit (Zainalabidin et al., 2015). In this study, although the bucks were positively infected with *Anaplasmosis sp.* and *Theileriosis sp.*, the level of infestation is low. Thus, the severity of the diseases is very mild and showed no correlation to the growth performance and scrotal measurements. Besides, animals with positive blood-smears but do not possess any clinical signs were considered as healthy carriers of the infection (Gharbi et al, 2015). Therefore, the Saanen bucks used in the present study are considered as a healthy carrier of the infection.

## CONCLUSION

In conclusion, this study suggests that, based on the growth performance of imported Saanen goats reared at UniSZA Dairy Goat Farm (UDGF), the Saanens goats are likely well adapted to the new environment exposed. However, studies are warranted to investigate further the adaptation

process not only for growth performance but also for the fertility potential and productivity of the Saanen goats by using a larger number of sample size with a longer period of study time.

## CONFLICT OF INTEREST

This study was performed in absence of any conflict of interest.

## ACKNOWLEDGEMENT

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## AUTHOR CONTRIBUTIONS

This study was designed by Asmad K and performed by Farah AG, Nurul ASA, Hasnita A, and Nur FSK. Data analysis was done with guidance of Lananan F. All authors have read and approved the final version.

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