PRODUCTIVE AND REPRODUCTIVE PERFORMANCE OF DAIRY GOAT AT AZ-ZAHRA FARM SANDAKAN

NUR AFINI BINTI AHMAD AKHIR

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Disahkan oleh:

NURULAIN BINTI ISMAIL
PUSTAKAWAN KANAN
UNIVERSITI MALAYSIA SABAH
(TANDATANGAN PUSTAKAWAN)

PROF. DR. M.A.M. YAHIA KHANDOKER
PENSYARAH
FAKULTI PERTANIAN LESTARI
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FAKULTI PERTANIAN LESTARI
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ABSTRACT

A field experiment was conducted at Az-Zahra Farm, Sandakan, Sabah to investigate the productive and reproductive performance of dairy goat. The objectives of this study were to study the productive and reproductive parameter of dairy goat and to find out the relationship among productive and reproductive parameters of dairy goat under village condition in Sandakan. The data collected for the study was compiled, tabulated and analysed in accordance with the objectives of the study. Descriptive statistics such as number, percentage distribution, mean, standard deviation were performed. The basic information of the goats were collected once such as body weight and ages by dentition. This experiment was run for 7 months starting from April until November 2016. The data of productive parameters such as body weight at different ages were collected once in June 2016 while birth weight was collected when does was delivered and for milk production of each individual per day was collected and recorded in three months started from August until October 2016. The data of reproductive parameters such as age at puberty, duration of estrus period, length of estrus cycle, age at first kidding, gestation length, litter size and kid mortality rate have been observed during this study. Microsoft excel 2013 was used to analysed the mean ± standard deviation of body weight and milk production. T-test was also conducted for evaluating the statistical significant difference between the groups. Result clearly indicate that body weight increases proportionately with the advancement of age and there was highly significant ($P<0.01$) when compare between body weight of females and males at different ages. For milk production, the highest daily milk yield was found at 2 to 3 years old and dam with multiple kids had more milk yield than dam with single kid. While for the data of reproductive performance, estrus cycle of Saanen goats was 21 days, the average estrus period duration was recorded as 2.75 days, age at puberty of Saanen goats in this study was 8.33 months, first kidding age was found 14.2 months and gestation period was 150 days on average. The result for litter size showed as dam age increase, the litter size at birth also increase. Meanwhile, birth weight mean increased as age of dam increased from 2.85 kg in 1 year olds to 3.26 kg in 3 year olds. Result also showed male kids were heavier than females (3.23±0.62 vs. 2.75±0.58 kg) and single kids (3.07±0.66 kg) were heavier than twin kids (2.70±0.28 kg). Low mortality rate of kids was also recorded in this farm (6.4%). Finally, it can be concluded that the overall productive and reproductive performance of Saanen goats in Az-Zahra farm is reasonable and the variation recorded in different parameters is very much usual.

ABSTRAK

Kajian ini telah dijalankan di Az-Zahra Farm, Sandakan, Sabah untuk menyiasat prestasi produktif dan pembiakan kambing tenusu. Objektif kajian ini adalah untuk mengkaji parameter pengeluaran dan pembiakan kambing tenusu dan untuk mengetahui hubungan antara parameter produktif dan pembiakan kambing tenusu di bawah keadaan kampung di Sandakan. Data yang dikumpul untuk kajian ini telah dikumpul, jadual dan dianalisis selaras dengan objektif kajian. Statistik deskriptif seperti nombor, pecahan peratusan, min, sisihan piawai telah dijalankan. Antara maklumat asas kambing telah dikumpulkan sekali seperti berat badan dan umur kambing. Eksperimen ini telah dijalankan selama 7 bulan bermula dari bulan April hingga November 2016. Data parameter produktif seperti berat badan pada umur yang berbeza telah dikumpulkan sekali pada Jun 2016 manakala berat lahir telah dikumpulkan selepas ibu kambing melahirkan anak, dan untuk pengeluaran susu setiap kambing dalam sehari telah dikumpulkan dan direkodkan dalam tempoh tiga bulan bermula dari Ogos hingga Oktober 2016. Data parameter pembiakan seperti umur baligh, jangka masa tempoh estrus, panjang kitaran estrus, umur pertama kali beranak, panjang usia kandungan, jenis anak-anak kambing dan kadar kematian anak kambing telah diperhatikan semasa kajian ini. Microsoft excel 2013 telah digunakan untuk menganalisis min ± sisihan piawai berat badan dan pengeluaran susu. Ujian-t juga telah dijalankan untuk menilai perbezaan yang signifikan antara kumpulan. Keputusan jelas menunjukkan bahawa berat badan meningkatkan berkadaran dengan peningkatan umur dan terdapat signifikan ($P<0.01$) apabila membandingkan antara berat badan kambing betina dan jantan pada umur yang berbeza. Untuk pengeluaran susu, hasil susu harian tertinggi ditemui pada usia 2 hingga 3 tahun dan ibu kambing yang melahirkan lebih dari satu anak mempunyai lebih banyak hasil susu berbanding ibu kambing yang melahirkan satu anak. Manakala bagi data prestasi pembiakan, kitaran estrus kambing Saanen adalah 21 hari, purata tempoh estrus dicatatkan sebagai 2.75 hari, umur baligh kambing Saanen dalam kajian ini adalah 8.33 bulan, umur pertama melahirkan anak didapati 14.2 bulan dan tempoh bunting adalah 150 hari secara purata. Hasil untuk jenis anak-anak kambing menunjukkan semakin meningkat umur ibu kambing, jenis anak-anak kambing ketika lahir juga meningkat. Sementara itu, berat lahir meningkat apabila usia ibu kambing meningkat daripada 2.85 kg semasa berumur 1 tahun kepada 3.26 kg semasa berumur 3 tahun. Keputusan juga menunjukkan anak kambing jantan adalah lebih berat berbanding anak kambing betina (3.23 ± 0.62 vs 2.75 ± 0.58 kg) dan anak kambing tunggal (3.07 ± 0.66 kg) adalah lebih berat daripada anak kambing kembar (2.70 ± 0.28 kg). Kadar kematian yang rendah anak kambing juga dicatatkan di ladang ini (6.4%). Akhirnya, kesimpulan yang dapat dihasilkan bahawa prestasi produktif dan pembiakan keseluruhan kambing Saanen di ladang Az-Zahra adalah munasabah dan variasi yang dicatatkan pada parameter yang berbeza adalah sangat biasa.

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%	Percentage
+	Plus
×	Multiplication
/	Per
^{o}C	Degree Celsius
ANOVA	Analysis of variance
day^{-1}	Per Day
ha	Hectare
g	Gram
kg	Kilogram
KMR	Kid Mortality Rate
MT	Metric Tons
ml	Mililiter
mm	Milimeter

LIST OF FORMULAE

CHAPTER 1

INTRODUCTION

1.1 Introduction

Malaysia is able to fulfil its own requirement for poultry and pigs products, but still depend on importation for its beef, lamb and milk. Livestock is very important in the agricultural sector, as it provide the largest source of protein for human consumption in Malaysia. However, livestock production is still insufficient to meet demand because of the increase population and consumption. For example, Malaysia produces 51,000 metric tons (MT) of beef, while the demand was more than 201,000 MT in 2013. The demand for mutton was around 28,000 MT, while the production was only 4,000 MT in the same year (Fadhilah, 2015). On the other hand, the production of poultry, swine and eggs has exceeded the self-sufficiency. Hence, Malaysia can export these product to nearby country, Singapore. Harsh environmental conditions with high temperatures and humidity, as well as the quality of supply that is not consistent in Malaysia are the challenges especially in producing ruminants. Therefore, to increase the local production and reduce the dependency on importation of beef, lamb and milk, there are necessary to innovate the livestock industry especially in ruminant sector.

In developing countries, particularly in Asia, goat undeniably plays an important role in the rural economy. Goat production is regarded as a feasible means to improve the income and nutrition of rural communities and to bring these communities into commercial marketing systems (Braker *et al.*, 2002). Goat industry, especially in Sabah, Malaysia is aiming to produce animal protein-based meat and dairy. Besides cattle and buffaloes, goats are also another type of livestock that are reared in rural areas and farming is a high potential for commercialization. Commonly farmers prefer

to rear goat as they are more easy to handle compared to other bigger size ruminant. Even though goat farming are practiced just only in a small scales but they could gain profitable production in every single goat product produced that are contribute to substantial income to the farmers themselves. Goats are important for both commercial and subsistent farming systems in Malaysia. Commercial farmers keep goats primarily for meat and fibre production, whereas subsistent farmers who cannot afford to keep cattle use them as a source of meat and milk, as well as cash for other expenses (Casey and Van Niekerk, 1988). There has been an increasing demand for goat meat and their products in Malaysia as a result from research finding and massive campaign, consumers begin to realize the good quality of goat meat and milk compared to other meat and milk and their products. Goat meat supply precious animal proteins and contains less fat compared to other meat and milk and their products. While the goat milk is a complete dietary supplement which has certain unique characteristics and is most like human milk composition (Ryan, 2015). Besides consumed as drinking, goat milk is also used in producing cosmetic products such as soap, shampoo and others. Rather than cow's milk, goat milk is richer in some important nutrients like vitamin A, niacin, choline and inositol (Harlan, 1990).

In Malaysia, dairy goat production is a small entity in the livestock sector and there is no local goat breed specifically bred for milk production. Since 1950, the interest in dairy goat farming was started by utilizing imported breeds such as Saanen, Anglo Nubian, British Alpine and Toggenburg. The common breeds that are reared especially in Sabah are Saanen, Alpine, and Toggenburg. In addition to the production of meat, dairy goat production is also one of the alternatives that are suitable for many small scale or part-time livestock operation. Dairy goat production under smallholder production system has been promoted in developing countries in order to increase consumption of animal protein and raise income of rural poor people through sales of milk, milk products, live animals and manure (Kosgey, 2004; FAOSTAT, 2010). Nowadays, there are some dairy goat producers that have been successful in pasteurizing goat milk and some others have ventured into the processing of dairy products for retail distribution, especially cheese and yogurt. Moreover, selling milk to processors is also one of the potential in this production.

The increased efficiency of goats is defined as an increased ratio of output (lifetime production) to input (labour, feed, and management). The productive performance will show the productivity efficiency of goat from measurement and expression of milk production and body weight. Adult body weight is an important economic factor which influences the growth and production pattern of any goat enterprise and has more influence mainly on the growth behaviour of kids (McGregor 1984). In many parts of the tropic regions, the traditional goat production system is characterized by random mating, mating of does at early age, high mortality rates, low body weights, low growth rates of kids and poor reproductive efficiency of does (Sebei *et al.*, 1994; Kosgey *et al.*, 2006; Chikagwa-Malunga and Banda, 2006).

Reproductive performance is one of the main determinants of productivity in dairy goat. Reproductive efficiency as such can be measured and expressed as the service per conception, conception rate, litter size, gestation length, non return rate, age at puberty, age at first kidding, birth types, parity of dam, birth weight and mortality rate. Birth weight and body weight of goat are considered as important traits because there is a positive correlation between birth weight and growth rate, age at maturity and mature body weight (Banerjee, 1989), which influence the future productive and reproductive performance of the animal. A large number of Saanen goat has been imported to this country because of their adaptability and performance. This breed also has found in Sabah especially Sandakan area which is being raised in rural areas and also at government livestock farms. It is essential to compile the parameters by which dairy goat can be described distinctively from others, which will be helpful to farmers for the selection of goat. The purpose of this study is to study the productive and reproductive parameters of dairy goat under village system in Sandakan. Moreover, to find out the relationship among productive and reproductive parameters of dairy goat in Sandakan area.

1.2 Justification

A large number of Saanen goat has been imported to this country because of their adaptability and performance. This breed also has found in Sabah especially Sandakan area which is being raised in rural areas and also at government livestock farms. However, there are few documentation on the status of production and reproduction of

dairy goat under village system in Sabah. This is an opportunity to conduct a study in order to clarify the problems in increasing rate of demand towards goat products besides improving the production performance of small-scale goat farming in Sandakan. Hence, it is proposed to study the productive and reproductive parameters of dairy goat under village system in Sandakan. Moreover, to find out the relationship among productive and reproductive parameters of dairy goat in Sandakan area.

1.3 Objective

i. To study the productive and reproductive parameters of dairy goat under village system in Sandakan.
ii. To find out the relationship among productive and reproductive parameters of dairy goat under village system in Sandakan.

1.4 Hypothesis

Ho: There are no differences among the productive and reproductive parameters in dairy goats.
Ha: There are differences among the productive and reproductive parameters in dairy goats.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

There were several researches have been carried out worldwide and reported in the literature on the productive and reproductive performance of the dairy goats. Few researches were carried out from various countries are reviewed in this chapter.

2.2 History and Origin of Saanen Goat

Goats are reared primarily for meat production, but now, there is also a niche market for goat's milk. Goat's milk is very good for nursing mothers and even for those who have difficulty in digesting cow's milk. In Malaysia, there is only one native breeds of goat which is the Kajang goat. It is a meat-type animal and is only found in small populations in several parts of Malaysia (DVS, 2006). Hence to improve the productivity of local goat and also to increase the population of dairy goat in Malaysia, farmers have been importing several breeds of exotic goats such as Jamunapari, Saanen, Toggenburg, Alpine and Anglo Nubian. These goat breeds are quite hardy and have been observed to acclimatize well to the Malaysian environment which has the temperature range 26°C - 32°C, an average total annual rainfall of 2500 mm and relative humidity of 80-90%.

Since 1950, the interest in dairy goat farming was started in Malaysia by utilizing imported breeds such as Saanen, Alpine and Toggenburg. Moreover, there are also the dual-purpose breeds that have been imported such as Anglo-Nubian, Jamunapari and more recently the Shami (Damascus) goat. In 2010, about 2000 heads of Jamunapari goats were imported by DVS into the country to meet the request of the

local dairy goat producer. The most breeds that are reared especially in Sabah area are Saanen and Jamunapari. Haas and Horst (1979) reported that the Saanen goat is the best known representative of dairy goat breeds. This breed has its origin in Switzerland (Ishag *et al.*, 2012), in the Saanen Valley. It has greater important on milk production even in tropical countries. Saanen goats have been used with success to increase milk yields of the indigenous tropical breeds of goats where adequate year-round feeding is assured (GoI, 1996). It is now becoming very popular dairy goat breed in many countries. Saanens became international attention in 1893 and several thousand head were taken out of the valley and were distributed across Europe. Saanen is the first of the improved dairy goat breeds and it was first brought to the US in 1904. Then, exportation of Saanens were continued to many countries all over the world like Australia, India, Ghana, Kenya, Israel and including Malaysia in grading-up the local breeds.

2.2.1 Characteristic of Saanen Goat

Saanen goats can adapt almost all types of weather condition around the world. Saanen goats can be bred all year round and can adapt to different climatic conditions easily (Berenson and Levine, 1996). Saanen goats are white or cream coloured breed of goats but sometimes biscuit coloured goats can be seen. There may some black spots in the nose, ears and udder of this goat. The ears are straight to upwards. Generally they have no horns, small sized legs, udder become very big sized, long sized neck and their whole body is covered with small sized hair. Saanens goats are highly intelligent, clean, agile, friendly and among the largest of the dairy goats. This breed is sensitive to excessive sunlight and performs best in cooler conditions. Saanen goat's milk is delicious and slightly sweet in taste (Figure 2.1).

Figure 2.1 Saanen goats
Source: Handbook of Australian Livestock, 1989

2.3 Productive Performance of Dairy Goat

2.3.1 Milk Production

Goat's milk is highly nutritious. Saanen goat is one of the best dairy goat breed because of its consistency in producing large amounts of milk in accordance with their sturdiness, easy keep ability and ability to tolerate environmental changes. Owing to its adaptability to different climatic conditions as one of the most significant characteristics of Saanen race, these goats can adapt to different places easily (Keskin *et al.*, 2004). Saanen goats are the largest among all the dairy goat breeds and they produces milk highly. They are mainly raised for commercial milk production like Toggenburg and Alpine goat. The main benefits of raising Saanen goat is their care and management is very easy even a child can take care of them. Milk fat in Saanen goat is almost 3.4 to 3.6% and this milk is very suitable for preparing all types of dairy or milk products.

A female Saanen goat are heavy milk producers and usually produces about 3.8 liter milk daily which is approximately 750 liter in its lactation period of 280 days. For Saanen, average milk yield is 750 liter per lactation and average lactation period is 280 days (Özcan, 1989). However, Saanen goat shows a varied lactation cycle. It produces

milk over various periods in a period of 8-9 months and are reported to yield about 70 pounds of milk each month. So, it can produce up to eight pounds of milk daily under certain circumstances. Milk yields increase up to the end of two months and then start to decline for average lactation lengths of 305 days.

There are contradicting reports on the milk production of Saanen goats. For instance, in 2004 milk yield for 305 days lactation were reported at 1156 kg for Saanen, 1043 kg for Alpine, 975 kg for Toggenburg and 843 kg for Nubian goat (ADGA, 2007). However, in a review by Shrestha and Fahmy (2007a), records for total milk yield of high grade European goats including Saanen, Alpine, Toggenburg, Nubian, and Granadina ranged from 339 to 513 kg. In other study the milk yield of 72 Saanen dairy goats from 3 to 15 weeks of lactation ranged between 2.38 vs 2.08 kg day^{-1} (Stella *et al.*, 2007).

Furthermore, goat milk production is also influenced by level of intake and quality of feed. Goat milk production and its fat content can rise when grass forage is fed at an early growth stage. When supply of concentrates in diets increases to 60% of total dry matter intake, fat content may decrease slowly and linearly, but if concentrate intake reaches 60–80%, fat content may decrease rapidly due to shortage of roughages in the ration.

2.3.2 Body Weight at Different Ages

Saanen goats are medium to large in size with rugged bone and plenty of vigour. Birth weight of Saanen kids ranges from 3 to 4 kg with male kids weighing about 0.5 kg heavier than female. Kids at weaning can weigh from 20 to 25 kg, depending on weaning methods and age (Lu and Potcoiba, 1988). At 7 month of age, bucklings weigh about 40 to 50 kg while doelings weigh about 35 to 45 kg. At this body weight, young does should be started to breed. At yearling, bucks weight can reach about 50 to 70 kg while does weight about 40 to 60 kg. Mature weights for bucks and does are 70-90 kg and 60-70 kg, respectively. The body weight measurements can be different because of influences of genetics, nutrition, health and disease, breeding age and management system (Christopher, 2002).

2.4 Reproductive Performances of Dairy Goat

Reproductive performance is directly related to viability of off-springs, kidding rate, age at puberty, age at first kidding, kidding interval and length of reproductive cycle (Abecia *et al.*, 2012; Kioumaris *et al.*, 2011). Improvement in reproductive performance can be achieved with increasing reproductive rate of the animals (Ince, 2010; Hirst, 2008). The reproduction and production performances of an animal are directly influenced by genetic potential of animal, nutrition, environment and management of farm and staff involved.

2.4.1 Age at Puberty

Puberty is caused by an increase in secretion of pituitary hormones, which in turn lead to an increase in size and activity of the gonads. Dairy goats will reach sexual maturity at 4-5 month of age. Young does should be bred at a body weighing 32-42 kg, which usually is at an age of 5-7 month. In normal circumstances, goat will show it first estrus at 5-7 month of age with about 17 days in interval (Hulet and Shelton, 1980). In females, puberty is related more closely to mature weight than to age. It usually occurs at about 60-70% of adult weight, which is relatively later than in males. Puberty is generally considered to be related more to growth than age in tropical goats with first estrus occurring with the attainment of 60-70% of adult live weight (Devendra and Burns, 1983). Social interaction is the important role in modifying expression of some reproduction traits in both sexes. There is evidence that the presence of the buck may modify the age of puberty in the goat (Greyling, 1996). In an early study, it was suggested that contact with the male goat has an effect on the timing of puberty and is associated with rapid and highly synchronous attainment of puberty in the majority of kids (Amoah and Bryant, 1984).

2.4.2 Birth Weight of Kids

Birth weight of kids is 2.73 to 4.01 kg (Uğur et al., 2004). Twins or triplets tended to have lower birth weights. Among the different types of birth, single kids showed the highest weight at birth followed by twins and triplets which is similar as obtained by

Husain *et al.* (1996). Curtis (1969) concluded that animals with low birth weights had lower energy reserves and were therefore less able to withstand harsh environments. Moreover, if the dam has a poor milk yield, she may be unable to provide adequate nutrition for twins even for triplets. Survival rate may be attributed to the decreased rate of twinning due to the fact that the kids may be available with more milk from dams as kid survival has been shown to be dependent on birth mass (Moaeen-udDin *et al.*, 2008). There was a tendency to increase weight with the advance of parity in all regions. Husain *et al.* (1996) reported that among the four parities, kid's birth weight was lower in 1st parity does compared to 2nd, 3rd and 4th parity.

2.4.3 Length of Estrus Cycle

There are different definitions for the estrus cycle that introduced by researchers working in the field of reproduction. Bearden and Fuquay (1997) defined the estrus cycle as the time between two estrus periods. While Arthur *et al.* (1998) defined estrus cycle as a recurring period of sexual receptivity. Roberts (1971) and Evans and Maxwell (1987) divided the estrus cycle into two phases, follicular or oestrogenic phase which is terminated by ovulation, and the luteal or the progestinal phase which occupies 13 days of the cycle. Arthur *et al.* (1998) and Hafez and Hafez (2000), reported that in tropical zone where variation in day length is less, indigenous goats tend to breed throughout the year and the does are polyoestrous with interoestrous intervals of 20-21 days. However, Devendra and Mcleory (1982) reported that the average length of estrus cycle of goats in the tropics is 18-21days. Moreover Lopes (2001), found that the mean length of estrus cycle was 19±0.35 days in Saanen goats.

2.4.4 Gestation Length

Gestation length is the time from conception to kidding. For goats, the gestation period is about 149 days with a usual range of 145-155 days or on the average 5 months. The length of gestation is variable according to breed and the individual. Gestation length or pregnancy period is the period calculated as the interval from fertile mating or conception to parturition or birth of kids (Roberts, 1971; Arthur *et al.*, 1998). Roberts (1971), added that gestation length is genetically determined though it can be modified by maternal, fetal genetic and environmental factors. The gestation length is known to be around 150 days (Hafez and Hafez, 2000).

In dairy goats, the gestation length was reported in different breeds by many authors, 148-150 days in Anglo-Nubian, France Alpine goats Criollo × Anglo-Nubian goats and Sikkim locals goats (Dickson *et al*, 2001; Esquivel and Camara, 1992, and Mishara *et al.*, 1989) while 150 days in Saanen (Wang *et al.*, 1991).

2.4.5 Litter Size

Litter size is the total number of kids born per kidding per goat. Saanen breed is a highly fertile goat breed with the number of kids per fertile goat is 1.2 to 2.4 (İnce, 2010). Litter size is an important factor which determines the reproductive efficiency of the farm (Hamad, 2001). Litter size has significant influence on goat prolificacy. Twinning rate is expressed as the ratio of twin births to the total number of live births. Does with singles have less milk production than those with multiple litter size (Argüello *et al.*, 2005). The high milk yield in does with twins is induced by high lactogenic activities during pre-partum stage which cause greater development of mammary gland and increase in the potential for milk synthesis and, hence, high milk yield during early postpartum. The small amount of milk produced by does with single kids have higher protein and lower fat contents (Salama *et al.*, 2005).

2.4.6 Age of First Kidding

Age at first kidding is expressed as the age at which does kid for the first time. The earlier the doe starts to kid the longer the productive span would be. Age at first kidding is an important factor in determining life time productivity. There is a large variation in age at first kidding among the production systems and breeds. It is usually later in animals living in harsh environments. Type of birth is one of the factor which affects age at first kidding. This effect can be contributed by birth weight and feeding regime before and after weaning. Before weaning female kids born single will grow faster than those born twins due to milk yield differences. This implies that twins receive little milk from the doe compared to the kids born single and this affects their growth rate before weaning. After weaning maternal influence ceases and as long as nutrition is not a limiting factor, twins kids tend to compensate for growth and there is no difference in terms of age at first kidding between twin female kids and those born

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