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FACTORS INFLUENCING THE PRODUCTIVE PERFORMANCE OF SELECTED GOAT BREEDING SYSTEMS IN MALAYSIA

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SULTAN IDRIS EDUCATION UNIVERSITY
2017

FACTORS INFLUENCING THE PRODUCTIVE PERFORMANCE OF SELECTED GOAT BREEDING SYSTEMS IN MALAYSIA

MOHAMMED MUAYAD TAHA

THESIS SUBMITTED IN FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF PHD OF PHILOSOPHY (BIOLOGY)

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I, _**MOHAMMED MUAYAD TAHA, P20122001975, FACULTY OF SCIENCE AND MATHEMATICS**_ (PLEASE INDICATE STUDENT'S NAME, MATRIC NO. AND FACULTY) hereby declare that the dissertation / thesis for _**BIOLOGY (Animal physiology)**_ titled _ **FACTORS INFLUENCING THE PRODUCTIVE PERFORMANCE OF SELECTED GOAT BREEDING SYSTEMS IN MALAYSIA**_ is my original work. I have not plagiarised from any other scholar's work and any sources that contains copyright had been cited properly for the permitted meanings. Any quotations, excerpt, reference or re-publication from or any works that has copyright had been clearly and well cited.

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I _**HANIZA HANIM BINTI MOHAMMED ZAIN**__ (SUPERVISOR'S NAME) hereby certify that the work entitled _**FACTORS INFLUENCING THE PRODUCTIVE PERFORMANCE OF SELECTED GOAT BREEDING SYSTEMS IN MALAYSIA**_ (TITLE) was prepared by the above named student, and was submitted to the Institute of Graduate Studies as a partial / full fulfillment for the conferment of __**Ph.D.**__ (PLEASE INDICATE THE DEGREE), and the aforementioned work, to the best of my knowledge, is the said student's work.

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ABSTRACT

This research was carried out to investigate the factors that influence the productive performance of crossbreeding in goats under controlled feeding and managing. A total of 205 goats from Al Hilmi Agrofarm, Slim River, Perak were used in this study. These goats comprised of three indigenous breeds, namely, Katjang, Boer, and Jamnapari, and their hybrids. Sixty female goats were divided into 2 groups; treatment group (n = 30) which received Controlled Internal Drug Release (CIDR) for 9 consecutive days and artificial insemination was done on the 10th day, and a control group (n = 30) with normal breeding. Adult goats and their kids from each groups were weighed weekly and blood samples were withdrawn in every 2 weeks. Blood samples were collected into two types of tubes; containing ethylenediaminetetraacetic acid (EDTA) for hematological studies and without EDTA for protein profiling and gene polymorphism. ANOVA and t-test were used to see if there is any significant differences on studied parameters between age, sex and breed. Findings showed the used of CIDR improved the reproductive efficiency in breeds, such as estrus synchronization and twin rate. Boer gave higher in twin rate compared to other breeds. The results of body weight showed Boer and Boer X Jamnapari (BJ) goats were higher than other breeds. However, Katjang and its hybrids; Boer X Katjang (BK) and Jamnapari X Katjang (JK) were better than other goats in comparison of blood parameters, such as haemoglobin and white blood cells count. Findings of protein profile study showed that there is no significant difference among breeds with respect to the α-casein values. Findings of DNA polymorphism showed that only alleles A, B and C of α-casein were detected in all breeds, whilst allele F were detected only in Jamnapari and its hybrids (JK and BJ) only. As a conclusion, Boer and Jamnapari crossbreeds are better in producing twins, high body weight and more variations in α-casein allele. The implication of this study is, it will be a reference and guidelines for the farmers to increase their herd production or researchers to pursue further studies in goats production.

FAKTOR YANG MEMPENGARUHI PRESTASI PRODUKTIF DI DALAM SISTEM PEMBIAKAN KAMBING TERPILIH DI MALAYSIA

ABSTRAK

Kajian ini telah dijalankan untuk mengenalpasti faktor-faktor yang mempengaruhi prestasi pembiakan kacuk silang pada kambing di bawah pengurusan dan pemakanan yang terkawal. Sebanyak 205 ekor kambing daripada Al-Hilmi Agrofarm, Slim River, Perak telah digunakan sebagai sampel di dalam kajian ini. Kambing-kambing ini terdiri daripada tiga baka asli iaitu Katjang, Boer dan Jamnapari dan hibrid mereka. Enam puluh kambing betina telah dibahagikan kepada 2 kumpulan; kumpulan rawatan (n = 30) yang telah menerima *Controlled Internal Drug Release* (CIDR) selama 9 hari berturut-turut dan permanian beradas telah dilakukan pada hari ke 10, serta kumpulan kawalan (n = 30) dengan pembiakan normal. Kambing dewasa dan anak-anaknya telah ditimbang setiap minggu dan sampel-sampel darah telah diambil pada setiap 2 minggu. Sampel darah yang diambil dimasukkan ke dalam dua tiub yang berbeza, iaitu yang mengandungi *Ethylenediaminetetraacetic acid* (EDTA) untuk kajian hematologi dan tanpa EDTA untuk kajian profil protein dan polimorfisme DNA. ANOVA dan ujian-t telah digunakan untuk menentukan perbezaan di antara parameter yang dikaji dengan umur, jantina dan baka. Dapatan kajian menunjukkan bahawa penggunaan CIDR telah menambah baik kecekapan pembiakan baka kambing yang dikaji iaitu penyelarasan estrus dan kadar anak kembar yang dilahirkan. Boer telah menunjukkan kadar anak kembar yang dilahirkan lebih tinggi daripada baka yang lain. Bacaan berat badan Boer dan Boer X Jamnapari (BJ) juga adalah lebih tinggi daripada baka yang lain. Walau bagaimanapun, bacaan parameter darah seperti hemoglobin dan bilangan sel darah putih bagi kambing baka Katjang dan hibridnya, Boer X Katjang (BK) dan Jamnapari X Katjang (JK) adalah lebih baik daripada baka yang lain. Tiada perbezaan yang signifikan pada nilai α-kasein yang didapati melalui kajian profil protein di antara baka- baka kambing yang dikaji. Melalui kajian polimorfisme DNA, didapati bahawa hanya alel A, B dan C α-kasein hadir di dalam semua baka kambing kajian, manakala alel F hadir hanya di dalam baka Jamnapari dan hibridnya (JK dan BJ) sahaja. Kesimpulannya, kacukan Boer dengan Jamnapari adalah lebih baik dalam menghasilkan kadar anak kembar yang tinggi, berat badan yang tinggi dengan variasi alel α-kasein yang tinggi. Implikasi kajian ini ialah ia boleh dijadikan rujukan dan panduan kepada penternak kambing untuk meningkatkan pengeluaran hasil ternakan atau kepada penyelidik yang ingin mendalami kajian tentang pembiakan kambing.

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LIST OF ABBREVIATIONS

AI	Artificial Insemination
Basos	Basophils
BJ	Boer X Jamnapari
BK	Boer X Katjang
Bo	Boer
BW	Body Weight
CB	Crossbreeding
CIDR	Controlled Internal Drug Release device
CN	Casein
CON	Control group
eCG	Equine Chorionic Gonadotropin
Eos	Eosinophils
ES	Estrus Synchronization
FGA	Firs-generation Antipsychotic
GnRH	Gonadotropin-Releasing Hormone
Hb	Hemoglobin
HCG	Human Chorionic Gonadotropin
HSD	Honest Significant Difference
IU	International Unit
JK	Jamnapari X Katjang
Jmn	Jamnapari
KK	Katjang

LB	Local Breeding
LH	Luteinizing Hormone
Lymphs	Lymphocytes
MCH	Mean Corpuscular Hemoglobin
MCHC	MCH Concentration
MCV	Mean Corpuscular Volume
MW	Molecular weigh
Monos	Monocytes
MT	Meat Tone
PCR	Polymerase Chain Reaction
PCV	Packed Cell Volume
PGF2∝	Prostaglandin-F
PLT	Platelet
Polys	Polymorphs
RBC	Red Blood Cell
RDW	RBC Distribution Width
SC	Sodium Citrate
SD	Standard Division
SDS	Sodium Dodecyl Sulfate
SPSS	Statistical Packages For The Social Science
SSL	Levels of Self-Sufficiency
TRE	Treatment group
WBC	White Blood Cell

CHAPTER 1

INTRODUCTION

1.1 General Introduction

World goat population is estimated to be 1.0 billion and global genetic diversity of goats is characterized by more than 590 breeds (FAO DAD-IS, 2015). Goats provide meat, milk and skin, and other by-products (Boyazoglu, Hatziminaoglou & Morand-Fehr, 2005). Goat's meat, which is also called as chevon, capretto, and cabrito, is one of the most consumed red meat all over the world (Biswas et al, 2007; Ozcan et al, 2014). In 2013, the goat population reached around one billion worldwide. The highest number of goats can be found in developing continents, such as Asia and Africa, which account for 93% of the world goat population (FAOSTAT, 2013). Goat meat is widely distributed because goats have few environmental needs and can adapt to harsh environment (high resistance to environmental temperature and digestibility of pastures); as such, these animals can reproduce under different climate conditions, ranging from cold rain forest to dry desert (Shelton, 1978).

In other words, goats can be bred and farmed in all latitudes (Webb, Casey & Simela, 2005; Pieniak-Lendzion et al, 2009; Atay et al, 2011; Madruga & Bressan, 2011; Ozcan et al, 2014). Goat meat has lower fat and cholesterol content, as well as

saturated fatty acid levels, than other red meats. For example, 85 g of roasted Boer goat meat contains 23 g of protein, which is equivalent to the amount in beef, but possess 123 less calories and 13.42 less g of fat compared with beef (Malan, 2000). As such, goat meat is considered the perfect choice for a healthy diet.

Malaysia's livestock industry is an important and one of the fundamental industries in the country's agricultural development. It supplies the domestic requirements of meat to the population. The development of the meat industry will ensure the food security in the country and reduces dependency on meat imports (Shanmugavelu, 2014). Based on the Malaysian National Agro-food Policy 2011-2020 (NAP), the demand and production for meat are expected to increase. The demand is expected to increase from 1.4 million MT in 2010 to 1.8 million MT in 2020 with a growth of 2.4% per annum while meat production is forecast to increase from 1.6 million MT to 2.1 million MT respectively with a growth of 2.7% per annum in the same period (NAP, 2011-2020). Hence, a number of exotic goat breeds are imported and bred locally to satisfy the demand of the industry (Ariff et al., 2010).

Livestock industry in Malaysia includes ruminants and non-ruminants. The ruminant part which comprises of beef and dairy cows, dairy buffaloes, sheep and goats are still brought up in little scale (Mohamed, 2007). Great advance has been seen as of late, yet it is still not able to take care of the nearby demand. In this manner, Malaysia imports the greater part of the requirements of beef, mutton and dairy products from abroad particularly India, Australia and New Zealand to provide food for the deficiency. In 2014, the levels of self-sufficiency (SSL) for beef, mutton and milk were 24.84%, 13.10% and 12.93%, respectively (Table 1.1) (DVSM, 2016). The slack in this ruminant part is ordinarily connected with a few components, for

example, the absence of land assets, high nourish cost, less expensive import substitutes, poor private-division inclusion (Shanmugavelu, 2014), sickness counteractive action and control (Mohamed, 2007), and absence of value breeds, mastery and workforce (NAP, 2011-2020).

Table 1.1 Self-sufficiency levels of livestock products, 2006 – 2014 (%)

Commodity	**2006**	**2010**	**2014**
Beef	21.78	30.12	24.84
Mutton	8.99	12.13	13.10
Milk	4.66	8.49	12.93

Source: Department of Veterinary Services, Malaysia (DVSM) (2016)

Figure 1.1 demonstrates the pattern of utilization for domesticated animal products from 2005 to 2014. The utilization of mutton increments with a greater rate, which is 106% for small ruminant (from 17,000 MT to 35,000 MT).

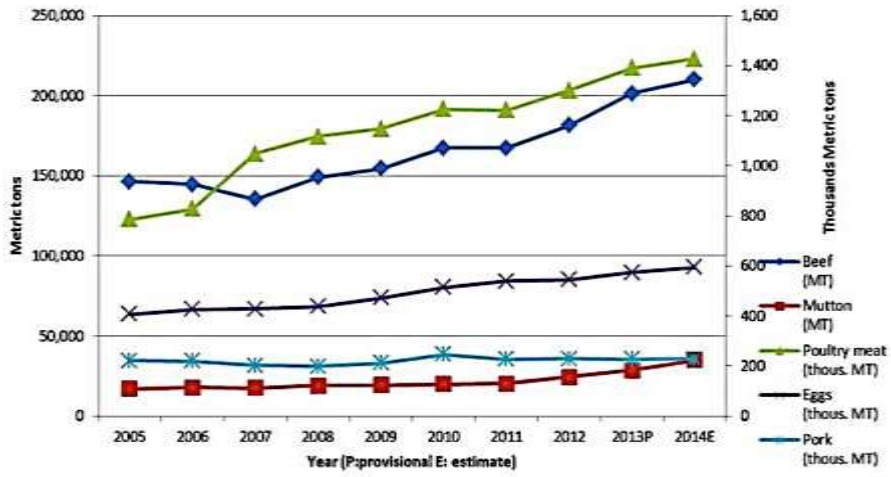


Figure 1.1 Livestock consumption in Malaysia (2005-2014) Source: DVSM (2016)

1.1.1 Reproductive efficiency

The increasing demand for livestock products, especially meat, has impelled researchers to develop alternative techniques, such as controlled feeding,

crossbreeding (CB) systems and reproductive efficiency, to provide for the needs of the society (DVSM, 2016).

The level of reproductive efficiency is dependent on the interaction of genetic and environmental factors (Riera, 1982). Goats are the most fertile of all domesticated ruminants under tropical conditions are able to breed throughout the year (Mamabolo & Webb, 2005). Generally, goats exhibit distinctive seasonal patterns of reproductive activity in the temperate region. In tropical regions, the breeding period of goats spans throughout the year and is dependent on latitude, climate, food availability, breed, and breeding system (Khan, Khan & Mahmood, 2008).

Recently developed reproductive technologies have been used to improve the reproduction rate of animals, thereby satisfying the increased demand for animal products. These technologies allow scholars to perform routine and easy breeding and produce animals with high economical yield (Gordon, 2005).

Common hormonal treatments in ovine reproduction programs use intravaginal devices impregnated with progesterone or other progestagens (Abecia, Forcada & González-Bulnes, 2012). However, many investigators found that controlled internal drug release device “CIDR” inserts did not increase pregnancy rates, but found that they decreased the amount of pregnancy loss (Bartolome et al., 2009).

Caprine estrus length exhibits great variations (Romano, 1993). Estrus duration is essential to artificial insemination (AI) technology (Chemineau et al., 1991). However, hormonal protocols are one of the most efficient techniques used to synchronize the time of estrus and ovulation of food-producing animals. Moreover,

synchronizing ovulation time is essential to ensure acceptable reproductive rates during fixed-time artificial insemination (Fierro et al., 2013). These two techniques present the following benefits: choice of the desirable times of birth for production efficiency, synchronization of time of births within the shortest period possible, management of genetic breeding systems (Fatet, Pellicer-Rubio & Leboeuf, 2011).

The Artificial Insemination (AI) is commonly used for breeding animals. AI and estrus synchronization (ES) eliminate or reduce the cost of maintaining bucks, increase genetic improvement rate and the number of does to which a buck could be bred, and allow the breeding of several does in one day (Chris & Robert 2014).

1.1.2 Physiological performance

The life of all flesh is blood, and its usefulness in assessing the health status, chemical evaluation for survey, physiological pathological conditions, and diagnostic and prognostic evaluations of various types of diseases in animals cannot be overemphasized (Tambuwal, Agale & Bangana, 2002). Blood also help in distinguishing the normal state form of stress, which can be maturational, environmental, or physical (Aderemi, 2004). Hematological values are widely used to determine systematic relationships and physiological adaptations, including the assessment of the general health condition of an animal (Kamal et al., 2007). Blood composition of an animal may be influenced by certain factors, such as nutrition, management, sex, age, diseases, and stress (Piccione et al., 2010a). A great variation exists in the hematological parameters, as observed among breeds of goats (Tambuwal, Agale & Bangana, 2002). In this regard, formulating a universal metabolic profile test for goat may be difficult (Opara, Udevi & Okoli, 2010).

1.1.3 Protein profiling

Protein variants have their use in the study of origin and evolution of breeds of goats. These markers have proved to be useful for parentage determination and population analysis (Groselande et al., 1990). Sodium Dodecyl Soleplate Polyacrylamide gel electrophoresis (SDS-PAGE) is a substantial molecular technique used for the identification at types level of whole cell proteins and it has the advantage of being properly simple and rapid to do. But for the identification this technique requires comprehensive data to cover all known target types. SDS-PAGE was used for visualizing albumin and transferrin bands (Leisner et al., 1994).

In mammals, about 95% of the milk proteins are made up of casein and whey proteins. Bovine milk is a significant source of protein in several parts of the world such as Asia, Africa and Europe. The major portion (80%) (Haug, Høstmark & Harstad, 2007) of bovine milk protein is designated by a casein (CN) group encoded by four tightly linked genes: α_{s1}-CN (CSN1S1), β-CN (CSN2), α_{s2}-CN (CSN1S2) and κ-CN (CSN3), located within a 250 kb piece of bovine autosome 6 (Caroli, Chessa & Erhardt, 2009).

1.1.4 Gene polymorphism

Investigation of molecular genetic diversity is a valuable complement to evaluate phenotypes and production systems. It provides insights into breed history, guides breed development and helps in conservation decision making (Ajmone-Marsan et al., 2014).

Molecular data can be particularly helpful in identifying potential conservation gaps when phenotypic knowledge is limited. Also, genetic characterization has a prominent role in Strategic Priority Area 1 of Global Plan of Action on Animal Genetic Resources (GPA on AnGR) and forms an important component in the development of national plans for management of animal genetic resources. With the exception of few studies that characterized nuclear (proteins, microsatellite, etc.) (Wei et al., 2014) and extra-nuclear (mitochondrial) (Joshi et al., 2004) genetic diversity of selected Asian goat populations, most indigenous goat breeds of Asia remain largely uncharacterized.

Another input and element in knowledge the value of breeds is to study the genetic variety by the determination of genetic variability, which is through polymorphism. Polymorphism in a population emphasize a pool of genetic variability, for if none exists, there would be no advance made through selection and breeding. This accentuates the need to study polymorphism among breeds as well as within breeds. Polymorphism studies can be assumed at various levels and expressed protein studies to the genetic level studies (Groselande et al., 1990).

The casein protein includes α_{s1}, α_{s2}, ß and κ -casein. In goats, α_{s1}-casein locus is characterized by seven alleles related with four quantitative levels of the identical protein. A, B and C alleles are related with high casein content at 3.6 g/litre, E allele is intermediate with 1.6 g/litre, low level of casein in D and F alleles at 0.6 g/litre and O which is a real null allele (Grousclaude et al., 1987; Mahé & Grousclaude, 1989). The variations in the α_{s1}-casein protein are fundamentally due to the occurrence of amino acid representations in A, B, C and E alleles and deletion of some amino acids in D and F alleles.

1.2 PROBLEM STATEMENT

Raising high-quality goat breeds mainly determines the success of commercial goat production. As such, a number of exotic goat breeds are imported and bred locally to satisfy the demand of the industry (Ariff et al., 2010). Therefore, in most Southeast Asian countries, crossbreeding (CB) programs have been used to improve the production efficiency of local breeds and generate crossbred genotypes with different gene proportions from the parent breeds. Nevertheless, information on the growth patterns of the resultant crossbred genotypes remains insufficient. This information is necessary and can be applied to determine feeding and management plans and design breeding strategies to improve the efficiency of the entire growth process (Lambe et al, 2006). Moreover, the parameters obtained from growth curves provide data regarding growth characteristics. Knowledge of factors affecting the growth and relationship among these parameters is necessary to improve the reproductive capability of animals (Morrow, McLaren & Butts, 1978).

As the popularity of goat meat increases, scholars have devoted increased attention in reliable technologies for estrus synchronization, artificial insemination, and crossbreeding systems in goat. However, these techniques are rarely performed in Malaysia because Malaysian farmers mainly depend on the natural estrous cycle of goats, and herds are usually consisting of a small number of goats. The high cost of animal feeds, especially pellets, has induced breeders to market the goats early, lack of awareness and scare among breeders in applications of different methods on their

animals and breeders rush selling of the animals for immediate profit, thereby neglecting future profits and foregoing the development of best herd through crossbreeding.

Poor data of Malaysian goats, such as reproductive efficiency, physiological parameters, protein profiling, and gene frequency will limit the knowledge of the problems of breeding, disease and harsh environmental conditions resistance and adaptation. Also hybridize animals randomly may result in the production of bad breeds and the loss of the good traits of the thoroughbreds' breeds.

The proper use of these technologies in the field of reproductive administration represented in the control of estrus and superovulation, artificial insemination and crossbreeding systems are working to increase reproductive efficiency of animals.

This condition should be overcome by educating the farmers and the best way is through the results of research on best technologies to improve the reproduction rate of animals. These techniques are including estrus synchronization (ES), artificial insemination (AI) and crossbreeding (CB) systems offer goat breeders the potential for use of genetically superior sires. They enable the small herd owner to obtain breeding services at a reasonable cost. By means of ES, AI and CB systems, breeders are able to identify superior animals that possess desirable traits (Chris & Robert 2014).

Goat genetic studies are still in their infancy and only a few studies investigating genetic diversity, phenotype-genotype association and signatures of selection are available (Lashmar, Visser & van Marle-Köster, 2016; Mdladla et al.,

2016). None of these investigations evaluated the genomic adjustment to particular situations nor endeavored to unravel the biological pertinence of the vast anomaly markers. The versatile hereditary capability of indigenous goats is paramount in ecosystems where harsh and extreme production environments are worsened by climate changes as experienced in tropical developing countries.

The mating of outstanding sires and dams, even miles apart, may be effectively performed by AI using diluted semen. Such mating has the potential to create desirable new lines, reduce inbreeding, and reduce spread of disease by minimizing animal movement. These technologies have an important role in goat breeding, especially in intensive systems of production, to control reproduction and, in conjunction with accurate progeny testing, to improve the production of meat, milk, and hair. At the farm level the control of reproduction in particular populations of goats allows kidding at a precise season of the year, a synchronization of kidding over a limited period of time, and facilitates supplementary feeding to meet the demands of lactation. Other advantages of AI and CB include more efficient genetic selection schemes, and the manipulation and storage of the genetic material.

Compared with natural mating, AI and CB give an increase in the numbers of offspring per sire, and allow a spatial and temporal in the case of frozen-thawed or diluted semen dissociation between collection of spermatozoa and fertilization. These advantages have consequences in genetic improvement programs, first to evaluate and select sires, and secondly to compare the genetic value of animals in different flocks by linkage through reference sires. The AI and CB allow rapid and widespread diffusion of improved genotypes and the exchange of genotypes without transmitting diseases.

When used correctly, ES, AI and CB have another benefits, including maximal use of outstanding sires, increased herd uniformity, elimination of bucks on the farm, relatively inexpensive semen costs, decreased potential for venereal transmitted diseases, and improved herd management.

1.3 OBJECTIVE

The objectives of this research are:

1.3.1 to evaluate the reproductive efficiency; such as estrus responses, conception, birth, twin rates and mortality among three goat breeds (Katjang, Boer, and Jamnapari) and their hybrids.

1.3.2 to assess the distinctions among three diverse goat breeds (including their pure and hybrid kids) in relation to physiological performance; such as body weight and hematological value, with comparison of age and sex.

1.3.3 to assess the distinctions among three diverse goat breeds (including their pure and hybrid kids) in relation to protein profiling and gene polymorphism, with comparison of age and sex.

1.4 RESEARCH QUESTIONS

1.4.1 How to evaluate the reproductive efficiency; such as estrus responses, conception, birth, twin rates and mortality among three goat breeds (Katjang, Boer, and Jamnapari) and their hybrids?

1.4.2 What are the differences between the three diverse goat breeds (including their pure and hybrid kids) in relation to physiological performance; such as body weight and hematological value, with comparison of age and sex?

1.4.3 What are the differences between the three diverse goat breeds (including their pure and hybrid kids) in relation to protein profiling and gene polymorphism, with comparison of age and sex?

1.5 LIMITATION

This study was conducted in Al-Hilmi Agrofarm, Slim River, Perak under its environmental and field condition, and biotechnology; such as protein profile and gene polymorphism, was done in University Pendidikan Sultan Idris. Only Katjang, Boer and Jamnapari goats were used. Goats' ages were; 1 day- 5 months old for kids, and 1.5- 3 years for adults, so it can't be generalized for all types of goats around the worldwide.

1.6 Conclusion

Animals' industry "especially goats" is a critical and one of the crucial enterprises in the nation's farming advancement in Malaysia. It supplies the household necessities of meat and milk to the people. The improvement of the goat's production will guarantee the sustenance security in the nation and lessens reliance on meat and milk imports.

Next chapter will explain the previous studies about goat's production and its parameters.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Goats are consumed for several needs, such as milk, meat, fiber, and skin (Dubeuf, Morand-Fehr & Rubino, 2004; Anaeto et al, 2010). Goat meat has lower fat and cholesterol content, as well as saturated fatty acid levels, compared with other red meats (USDA, 1989). Therefore, goat meat is considered the optimal substitute for beef in a healthy diet (Webb, Casey & Simela, 2005; Pieniak et al, 2010; Staniˇsi´c et al, 2012).

During slaughter, not only the meat is obtained but also the edible by-products (Goldstrand, 1988; Dalmas et al, 2011). These by-products are usually used to produce traditional foods, such as Morcilla de Burgos in Spain, Cavourmas in Greece, Morcella de Assar, goat Sarapatel, and bovine liver pâté in Portugal or goat pâté and Buchada in Brazil (Madruga et al, 2007; Aristoy & Toldra, 2011). Several studies indicated that by-products are an important source of essential nutrients (Stanisz, Slósarz & Gut, 2009; Dalmas et al., 2011). The livestock industry can increase profitability by converting as much edible by-products as possible into food products.

The use of by-products would also reduce the prohibitive costs of waste management and the negative environmental impact (Brasil et al, 2014).

2.1.1 Goats

Katjang goats are common throughout Southeast Asia and indigenous in Malaysia and Indonesia. Although Katjang features inherent characteristics of heat and tick tolerance and high fecundity under difficult circumstances, the growth potential of this species is comparatively poor (Devendra & Burns, 1983). The estimated mature weight of Katjang ranges from 27.0 kg to 31.8 kg (Lopez et al, 1992) (Figure 2.1).

Figure 2.1 Katjang goat

Bucks and does weigh of Boer goat about 40–50 and 35–45 kg, respectively, at the age of 7 months and then increased to 50–70 and 45–65 kg, respectively, at yearling (Lu, 2002). Slaughtering Boer goat at an early age produces tender and very tasty meat (Barry & Godke, 2013) (Figure 2.2).

If fed correctly, Boer goats show increased growth potential (Malan, 2000), body weight at slaughter, carcass weight, dressing percentage (Stanisz, Slósarz & Gut, 2009), muscularity (Blackburn & Gollin, 2009), and weight of primal cuts (Cameron et al, 2001).

Figure 2.2 Boer goat

Jamnapari goat is commonly known as “Pari” in its area of origin, namely, the "home tract," because of its majestic appearance; this species is the best dairy goat in India and the tallest breed. Female Jamnapari weighs about 2.72, 13.6, and 29.48 kg at birth, 6 months, and 12 months of age, respectively. Male kids have significantly higher body weight. The growth rate averages about 0.91 kg per week up to 3 months of age and 0.91 kg per 10 days thereafter. Male Jamnapari can reach 36.28 kg of body weight by 12 months of age under good feeding systems (Rout et al, 2013) (Figure 2.3).

Figure 2.3 Jamnapari goat

2.1.2 Reproductive performance

As goats are seasonal breeders, depending on latitude and breed, estrus induction of goats is justifiable because of physiological and commercial or technical reasons. Many hormonal treatments have been described, varying from the doses, type and/or period of progesterone/progestagen administered, the use of gonadotropin and prostaglandin, and management time (Gordon, 1997).

2.1.2.1 Estrus synchronization

Estrus synchronization (ES) in goats is aimed to control estrous cycle for natural breeding or artificial insemination (AI)-targeted genetic management by crossbreeding (CB) systems, as well as to control parturition dates to plan for meat and milk production, births, and marketing.

The key feature in concomitantly using an ovulation synchronization protocol to control follicular development, luteal recession, and ovulation in all treated females

is allowing AI to occur at a fixed time without requiring estrous detection (Pursley, Mee & Wiltbank, 1995). The Ovsynch and other progestagen-timed artificial insemination (TAI) protocols have been used to increase reproductive efficiency of small ruminants after insemination with fresh semen (Deligiannis et al, 2005; Holtz et al, 2008). Single-injection prostaglandin-based protocols are used in coupling with GnRH or Human Chorionic Gonadotropin (HCG) for TAI in goats by using frozen semen (Yacoub et al, 2011). However, these treatments resulted in a high rate of short heat animals and reduced kidding rates compared with estrus-bred controls (Perry et al, 2012).

During the 1990s, several studies were performed in ruminants in relation to low progesterone/progestagen concentrations with abnormalities in follicular development, ovulation, oocyte health, luteal function, and fertility. A short-term protocol has been developed using intravaginal devices for 5–7 days to avoid prolonged progesterone exposure of goats (Rubianes & Menchaca, 2003; Menchaca & Rubianes, 2004).

The use of hormones to control goat reproduction has increased (Reyes et al, 2012). Estrus administration in goats is generally performed by using progestagen-impregnated vaginal devices [polyurethane sponges or controlled internal drug release (CIDR) device] through injection of equine chorionic gonadotropin upon device removal (Corteel, Leboeuf & Baril, 1988; Holtz, 2005). Such treatment mostly results in good fertility, irrespective of seasonal effects (breeding or anestrus season). Nevertheless, some breeders are interested in developing alternative synchronization methods. Light control and buck impact have shown potential as alternative methods (Chemineau et al, 1999). However, passable fertility rates are only observed following

repeated AI to detect estrus but not following a single fixed-time AI (Leboeuf et al, 2003).

Pursley, Mee & Wiltbank (1995), devised a treatment regimen to control the follicular waves and life span of the corpus luteum in cattle. This regimen included a Gonadotropin-releasing hormone (GnRH)-prostaglandin F2∝-GnRH treatment sequence known as “Ovsynch” or “GPG” protocol (Pursley, Mee & Wiltbank, 1995; Stevenson, Kobayashi & Thompson, 1999). The first GnRH injection triggers ovulation and formation of an accessory corpus luteum when females are in heat, with a large follicle existing at the time of injection. This type of injection can reprogram follicle growth by initiating the evolution of a new follicular wave.

The Ovsynch treatment includes a prostaglandin injection 7 days after the first GnRH treatment to time luteal retreat (natural and accessory corpora luteal) in all females for full domination of ovarian function. Ovulation is timed by the second GnRH management. Promising synchronization results were acquired when applying such treatment in sheep (Deligiannis et al., 2005).

Moreover, studies showed that preovulatory luteal hormone (LH) surge mostly occurs over a 24–36 hours’ interval, between 36 and 84 hours after buck introduction, if goats are treated for 11 days with (Firs-generation antipsychotic (FGA) or natural progesterone (i.e., CIDR) immediately before joining (Pellicer et al., 2007). This synchronicity is close to the 12–24 hours’ interval observed after classical hormonal treatment (Leboeuf et al., 2003) and is theoretically compatible with one or two inseminations over a 24 hours’ period. These data suggest that progestagen treatment

would allow inseminations to focus at the first buck-induced ovulation, thereby reducing the number of inseminations necessary to optimize fertility.

The super ovulatory protocol in goats normally involves management of an intravaginal progestagen pre-treatment over an 11- to 21-days period, followed by superovulation treatment with gonadotropins 72–48 hours before progestagen removal (McNatty et al, 1989; Selgrath et al, 1990; Gonzalez et al, 2003). When intravaginal progestagen treatment is accomplished over a short period of time (9–11 days), Prostaglandin-F (PGF2∝) injection is usually administered and synced with the first superovulation treatment 24–48 hours before or at progestagen withdrawal to allow accurate timing of estrus onset (Krisher et al, 1994; Senthil et al, 2003).

In previous studies on Boer goats, the superovulation protocol included the utilization of a long synchronization period (17 days) during and outside the natural breeding season, without administering any PGF2∝ treatment (Lehloenya et al, 2006; Lehloenya, Greyling & Grobler, 2008).

Intravaginal progesterone devices (CIDRs) are used for estrus motivation in goats worldwide (Souzaa et al, 2011; Muayad, Haniza & Husni, 2016). Short-term (6 days) progestagen devices, which result in larger progestagen density at the time of device removal, is as effective as traditional devices (12–14 days) when obtaining out-of-season estrus (Ungerfeld & Rubianes, 1999). Several papers involving this method have been published in goats (Fonseca et al, 2005; Menchaca et al, 2007). Thus, hormonal treatments have efficiently induced an earlier start of estrus cycle about 1 week. The CIDR device, a vaginal insert made of nylon and silicone impregnated with 0.33 g of progesterone (Wheaton et al., 1993), is designed in New

Zealand and currently being marketed worldwide. This device is used for reproductive manipulation of cattle (CIDR-B), sheep (CIDR-S), and goats (CIDR-G) (Figure 2.4). This device is also used for synchronized ovulation and estrus-synchronized occurrence (Wheaton et al., 1993; Whitley & Jackson, 2004).

Figure 2.4 CIDR-G (Pfizer, NEW ZEALAND)

2.1.2.2 Artificial insemination (AI)

The Artificial Insemination (AI) is commonly used for breeding animals. AI and estrus synchronization (ES) eliminate or reduce the cost of maintaining bucks, increase genetic improvement rate and the number of does to which a buck could be bred, and allow the breeding of several does in one day (Chris & Robert 2014).

The history of AI in farm animals began with Arabian horses in the 1300s. In 1780, Italian biologist Lazzaro Spallanzani performed his first AI procedure in sheep. In 1907, veterinarian Elias Ivanov proved the viability of AI in reproduction when he opened a testicle of a dead, snow-frozen sheep and found live spermatozoids.

Most recently, AI is the most widespread-assisted reproductive technology used in domestic species (Holtz, 2005).

Compared with natural mating, AI increases the offspring number per sire and allows a temporal and spatial relationship between spermatozoa collection and fertilization in the case of frozen semen dissociation (Leboeuf, Restall & Salamon, 2000). These features contribute to genetic improvement programs, particularly in evaluating and selecting sires and in comparing the genetic value of animals in different flocks in relation to reference sires. Artificial insemination allows fast and wide-range diffusion of improved and exchange of genotypes without transmitting diseases. A successful AI program depends on the appropriate management of semen collection, storage, and use. Moreover, the detrimental interaction between seminal plasma and preservation media has been fixed; in this regard, efficient treatment methods and diluents have been elaborated for storage of goat semen (Leboeuf, Restall & Salamon, 2000). However, AI protocols remain less studied and validated under field conditions.

The AI has several important functions in goat breeding, especially in heavy systems of production. In particular, AI controls reproduction and synchronism with accurate progeny testing to improve the production of milk and meat. At farm level, the control of reproduction in specific populations of goats permit estrus at a specific season of the year, synchronization of estrus over a limited period of time, and facilitates supplementary feeding to meet the demands of lactation. Other advantages of AI involve effective genetic selection schemes, as well as manipulation and storage of genetic schemes (Leboeuf, Restall & Salamon, 2000).

The AI includes mechanical placement of semen from a male into the reproductive tract of a female, rather than natural mating. A thorough understanding of the different components of an AI program is important to goat breeders for

effective and efficient handling of herds. The genetic structure of highly productive breeds and breeds of cattle during the past 40 years has impelled AI to be a desirable tool for genetic improvement in other species. AI offers goat breeders the possibility to use genetically superior sires and enables small herd owners to obtain breeding services at a reasonable cost (Lou, 2007).

The AI exhibits more benefits than ES. First is the addition of genetic diversity into a herd. Producers can purchase genetically valuable semen carrying specific traits that are desirable for their operation. Second is the ability to eliminate bucks in a farm. Bucks are neither needed to service the does nor needed for heat checking purposes. Third is the elimination of estrus detection with or without a buck. Estrus is defined as the sexual receptivity of the female to mounting by the male and can be detected through several methods (Chemineau, 1991). Estrus can be detected by simply observing the flock twice daily for mounting, tail wagging, and other physical signs of estrus (Chemineau, 1991). The AI eliminates the extra time and labor associated with estrus detection and buck maintenance in a farm.

2.1.2.3 Crossbreeding systems (CB)

The formidable amount of variability among goat genetic resources provides an opportunity to accelerate genetic improvement of economically important traits of meat goats (Fahmy & Shrestha, 2000; Shrestha & Fahmy, 2005).

In the past, breeding strategies in the livestock and domestic animal types were slightly designed using methods appointed by plant breeders to produce hybrid corn. Earlier studies on hybridization indicated that the benefits of breeding were derived from heterosis in single cross involving two divergent inbred populations from pure

breeds. Unlike in plants, the development of an inbred line is not functional in the livestock types because of substantial losses in productivity, which is caused by increased inbreeding, minimum inherent ability for reproduction of the inbred parents, and increased exposure to diseases. In goats, CB mostly involves crossing bucks of the meat-type sire breeds with does of the fertile-type dam breeds to produce kids with increased growth rate and enhanced carcass quality while benefiting from the reproductive rate and maternal impact of the female parent (Shrestha & Fahmy, 2008).

In developing countries such as Malaysia, two-breed cross offspring, which originated from strange breeds, was proven to have significant potential for improved productivity in their country of origin, as well as indigenous goats with ascendant adaptability; these goats were more productive under local conditions and requirements (Shrestha, 1998). This result has led to sequential offspring of unintentional CB, resulting in upgrading to strange breeds and thereby reducing important characteristics, such as adaptability, fecundity, disease resistance, and narrowing of the genetic precept to the detriment of performance in crossbred population (Shrestha & Fahmy, 2008).

Evaluating the expected sources of breeding animals for CB from preferable breeds is necessary for each country. Some popular goats in the Asia-Pacific area with potential genetic eligibility are the Barbari, Beetal, Damani, Daira Deen Panah, Jamnapari, and Kamori breeds for milk and meat; the Black Bengal, Fijian, Katjang, Kheri, Marwari, Ma’tou, Nubian, Sirohi, Teddy, and Terai breeds for meat; the Chyangra, Kashmiri, and Singhal breeds for meat and pashmina; and the Black

Bengal, Malabari, Barbari, and Ma'tou breeds for fecundity (Shrestha & Fahmy, 2005).

The crossbreeding between Katjang and other exotic or temperate breeds was suggested by Hirooka et al (1997) and Devendra (1981) to increase productivity. Moreover, CB of Boer goats shows an improved carcass conformation over the straight-bred kids (Oman et al, 1999; Oman et al, 2000; Merlos-Brito et al, 2000; Browning & Leite, 2011). Moreover, CB of Boer goats shows an improved carcass conformation over the straight-bred kids (Oman et al, 1999; Oman et al, 2000; Merlos-Brito et al, 2000; Browning & Leite, 2011).

A CB program that involved Katjang and German Fawn goats was initiated in Malaysia in 1980 to improve efficiency in meat and milk production of the local breeds (Hirooka et al, 1997; Ismail, Sivaraj & Mukherjee, 1987). Boer is frequently used in CB because of its large mature size and potentially high growth rates (Mahgoub, Kadim & Webb, 2012).

This advancement has animated analysts to enhance the accessibility and nature of goat meat (Adeyemi et al., 2015; Sabow et al., 2016).

2.1.3 Protein profiling

Sodium Dodecyl Sulfate (SDS) is an anionic cleaner, meaning that when dissolved its molecules have a net negative charge within a wide pH range. A polypeptide chain binds amounts of SDS in ratio to its relative molecular mass. The negative charges on SDS destroy most of the composite structure of proteins, and are strongly attracted toward an anode (positively-charged electrode) in an electric area.

Polyacrylamide gels curb larger molecules quickly from migrating smaller molecules. Because the charge-to-mass proportion is nearly the same among SDS-denatured polypeptides, the final separation of proteins is following almost entirely on the differences in relative molecular mass of polypeptides. In a gel of regular density, the relative migration distance of a protein (Rf, the f as a subscript) is negatively commensurate to the log of its mass. If proteins of known mass are run jointly with the unknowns, the relationship between Rf and mass can be plotted, and the masses of unknown proteins predestined (David, 2012).

Protein separation by SDS-PAGE can be applied to evaluation relative molecular mass, to determine the relative abundance of major proteins in a sample, and to define the distribution of proteins among fractions. The purity of protein samples can be estimated and the progress of a fractionation or purification procedure can be followed. Various staining methods can be used to find out rare proteins and to learn something about their biochemical properties (David, 2012).

Goat milk creation demonstrates a stamped inconstancy, because of the breed and to the distinctive atmosphere and rearing conditions (Jenness, 1980). The impacts of lactation stage (Castagnetti, Chiavari & Losi, 1984) and nourishing and administration variables (serious or semi-concentrated) (Schmidely et. al., 1999; Bava et. al., 2001) were examined. The relative measures of the casein portions influence the physico-substance, wholesome and mechanical properties of milk of residential ruminants (Mariani et. al., 1987).

At present, the most exceedingly used approach for the study of low molecular weight proteins in the blood serum is based on the use of mass spectrometry (MS) coupled with various fractionation strategies such as electrophoretic and

chromatographic separation techniques. The MS analyses supply a dynamic range which is typically lower (nearly 5 orders of magnitude) than the dynamic range of proteins in blood serum. With the aim of overcoming this restriction, many methods for low-plenty and/or low-molecular weight serum proteins enrichment have been described. Some of these exploited various extraction buffers ranging from aquatic solutions to organic mixtures (Chertov et al., 2004; Williams et al., 2010), while others clarified the advantages of ultrafiltration steps (Tirumalai et al., 2003), or of the peptide library beads (Sennels et al., 2007). Other researchers compared multiple fractionation methods using heterogeneous systems for evaluations of results, such as sodium dodecyl sulfate (SDS-PAGE) (Merrell et al., 2004; Aristoteli, Molloy & Baker, 2007; Tucholska et al., 2007; Kawashima et al., 2010; Tucholska et al., 2010).

2.1.4 Gene polymorphism

Among caseins, the αs1-casein represents more than 40% in bovine milk (Farrell et al., 2004). In goat, it ranges from 0 to 25% due to the appearance of polymorphism in the gene that codes for this protein (Boulanger, Grosclaude & Mahé, 1984). As mentioned by Neveu et al. (2002), at least 18 alleles of the αs1-casein gene have already been detected in goat breeds, and categorized into four expression levels of 3.6, 1.6, 0.6, and 0 g/L/allele, and designate as “high”, “intermediate”, “low” and “null” alleles.

As mentioned by Moioli, Andrea & Pilla (2007), the protein content in goat milk is influenced by polymorphism in this gene, resulting in considerable cheese yield differences. Consequently, due to economic implications, the impact of polymorphism in the α_{s1}-casein locus has been investigated, and allelic frequencies

have been specified in several countries. The variations in the αs1-casein protein is fundamentally due to the occurrence of amino acid representations in A, B, C and E alleles and deletion of some amino acids in D and F alleles. Polymorphism of the αs1-casein alleles has been watched in several breeds of goats (Grousclaude et al. 1987; Jordana et al. 1991; Ramuno et al. 1991; Grousclaude et al. 1994). The importance of the αs1-casein alleles is in its influence on the goat cheese making process in terms of clotting property and total cheese yield. It was watched that goats with homozygous A allele yields 7% more cheese when compared to homozygous E and comparatively even higher in comparison with homozygous F (Maria et al. 2005).

The protein synthesized out of the expression of this gene consists of 199 amino acid remains. A, B, C, and E variants diverge only in amino acid representation, while D and F variants result from the deletion of 11 and 37 amino acids, respectively (Brignon et al., 1989; Brignon et al., 1990). O1 Allele, distinguished by Grosclaude et al. (1987) for the null production of αs1-Cn in milk, is the result of the deletion of approximately 8 kilobases (kb) in the 3' region of this gene (Martin, Ollivier-Bousquet & Grosclaude, 1999).

2.2 Conclusion

There is overwhelming evidence to suggest the development and application of quantitative genetic methodologies such as crossbreeding and formation of composite population that has achieved considerable success in the livestock species can help exploit the biological potential in meat and milk goats. In the developing countries, the improved and indigenous goats need evaluation, in relation to socio-economic

values, fiscal constraints, religious rituals, responsiveness to indigenous knowledge and the traditional skills of the producer.

At the same time, small holders under sedentary, nomadic and semi-nomadic management must rely on breeding animals with sufficient genetic merit to improve the efficiency of meat and milk production from goat through crossbreeding and development of composite populations. In the developed countries, there is opportunity for import replacement after the rapid improvement of economical traits based on the application of advanced animal breeding breeding technology for the commercial production of meat and milk from goats.

CHAPTER 3

METHODOLOGY

3.1 Introduction

A total of 205 goats were used (Table 3.1). The goats belong to six breeds; three indigenous, namely, Katjang (KK), Boer, and Jamnapari, and their hybrids were BK (Boer X Katjang), JK (Jamnapari X Katjang), and BJ (Boer X Jamnapari).

Table 3.1 Goat breeds details

Breed	**N.**
Katjang	52
Boer	46
Jamnapari	49
BK	17
JK	22
BJ	19
Total	205

A measure meat of the target animals is important for both producers and breeders in livestock production. Growth pattern provides sequential information of growth per se, whereas some growth traits such as birth weight, weaning weight, mature weight, and daily gain are fragmentary aspects of each growing point. Several growth curve models have been used to describe animal growth patterns. Studies on growth pattern analysis are widely available in cattle (Beltran et al., 1992; Meyer, 1995; Berry, Horan & Dillon, 2005) but scarcely in goats.

Estrus synchronization (ES) protocols used progesterone, prostaglandin F2 ∝, and Equine chorionic gonadotropin (eCG) and effectively controlled luteal activity and follicular dynamics, resulting in synchronous ovulation ~60 hours after device withdrawal (Menchaca et al., 2007) and high pregnancy rates following timed artificial insemination (AI) (Menchaca & Rubianes, 2007). Intravaginal devices containing 0.3 g of progesterone (i.e., Controlled internal drug release devices for goat (CIDR-G)) were developed for long treatments and for blocking of estrus and ovulation in treatments prolonged for ~30 days (Wheaton et al., 1993). Therefore, the use of a CIDR-G for 5 to 7 days could leave residual releasable progesterone, and the reuse of such device could be proposed (Corteel, Leboeuf & Baril, 1988).

Hormonal goat treatments have been developed to induce and synchronize ovulation during or outside the breeding season for AI in genetic selection programs. Currently, the most commonly used hormonal treatments (Corteel, Leboeuf & Baril, 1988) involve the delivery of a synthetic progestational agent [i.e., fluorogestone acetate (FGA)] through a vaginal sponge left in place for 11 days (Figure 3.1).

Figure 3.1 Controlled Internal Drug Release device “CIDR” and its Applicator

3.2 Research design

Based on the theories regarding goat production including meat, milk and offspring, this is the framework used in this research (Figure 3.2).

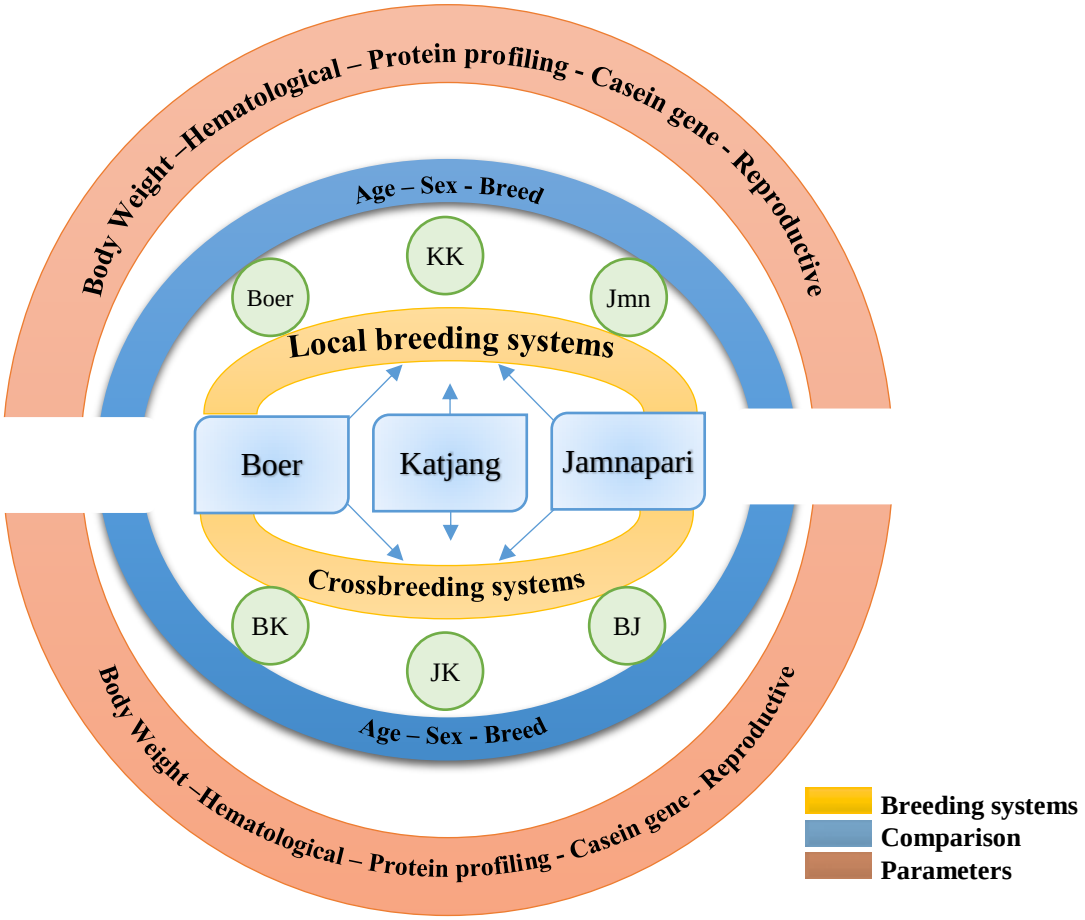


Figure 3.2: Research design of the study

"KK = Katjang, Jmn = Jamnapari, BK = Boer X Katjang, JK = Jamnapari X Katjang, BJ = Boer X Jamnapari"

So as to understand different factors affecting the goat production, various studies have focused on the factors: that is, breeds and breeding systems. The comparatives characteristics discussed above include: body weight, hematology, protein quality, gene polymorphism and reproductive efficiency.

3.3 Research samples and protocols

3.3.1 Location and Animals

This experiment was conducted at Al-Hilmi Agrofarm, Slim River, Perak under the direct supervision of Universiti Pendidikan Sultan Idris, Perak, Malaysia. A total of 205 goats were used, from December 2013-April 2016. The goats belong to six breeds; three indigenous, namely, Katjang (KK) (n = 52), Boer (n = 46), and Jamnapari (n = 49), and their hybrids were BK (Boer X Katjang) (n = 17), JK (Jamnapari X Katjang) (n = 22), and BJ (Boer X Jamnapari) (n = 19). Out of 205 goats, 60 adults' doe, 24 bucks; and 121 kids were used in this study. The animals were apparently healthy; there are no signs of disease; such as running nose, cough, fever, diarrhea, etc. Animals that seemed sick were excluded; such as having running nose, cough, fever, diarrhea, etc. The age of the adult and kids were 1 year up to 3 years old and 1-day up to 5 months old, respectively. During research period, weather temperature almost same in all years, the range was 32 °C–37 °C throughout the day, and 23 °C–26 °C throughout the night.

3.3.2 Adaptation period

The well-being of the animals was monitored to avoid chronic stress which can suppress ovarian follicular development and affect Gonadotropin-releasing hormone (GnRH) and luteinizing hormone (LH) pre-ovulatory pulse amplitude and frequency (Roger, 2012; Dobson et al., 2012). Thus, adaptations were carried out during two weeks' prior of the experiment. Animals were fed and remained at the same location up to 3 hours until the goats were calm.

3.3.3 Body weight (BW)

The animals were grouped in their respective cages. The adult goats were fed with pellets and green fodder, and the kid goats were fed with milk, pellet and green fodder from CAP PERSAHABATAN company, Malaysia (Table 3.2). The goats had access to mineral salt and water *ad libitum*. Animals were weighed weekly. The Adults were weighed starting with 1.5 up to 3 years old, whereas the kids were weighed starting with the day of birth up to 5 months old (Figure 3.3). Animals that seemed sick or

pregnant, and twins were excluded because they will give different results.

Figure 3.3 Hanging Scale Weigh (Big5, China)

Table 3.2 Specifications of goat feed supplement

Specifications	**Percentage %**
Moisture	13% max
Crude Protein	14% min
Crude Fiber	20% max
Calcium	0.75% min

Total Phosphorus	0.5% min

3.3.4 Reproduction procedures

Goats show a seasonal pattern in reproductive activity related to the annual variations of photoperiod. Onset and length of their breeding period throughout the year is dependent on different environmental and physiological factors (latitude and climate, food availability, breed and breeding system) (Fateta A., Pellicer-Rubioa M. T. & Leboeuf B., 2011). The fact that their sexual activity is seasonal affects the distribution of their production over the year and this is a problem both in dairy and meat production systems which attempt to have a constant production year-round.

The last section of the review deals with possible strategies to control the sexual activity in goats related to specific environmental constraints. Hormonal and non-hormonal treatments allow breeders to control sexual activity in does and lengthen their productive period.

3.3.4.1 Estrus synchronization (ES)

Does (n = 60) were randomly divided into two groups; treatment (TRE) and control (CON). The TRE group were given with CIDR containing 0.3 g of progesterone; n = 30 (each breed = 10) and CON group were not given with CIDR; n = 30 (each breed = 10) as in table 3.3 below. On day zero (D0), a CIDR device was inserted in each doe in the TRE group. After 9 days (D9), the CIDR was removed (Figure 3.4). In the CON group, the does underwent estrus naturally. Both groups were monitored for the occurrence of estrus based on the appearance of estrus signs, including vaginal

secretions, vagina lining congestion, vulva swelling (Bearden, Fuquay & Willard, 2004).

Table 3.3 Female goats' groups for estrus synchronization

Breed	**Number of female goats per group**	
	Treatment	Control
Katjang	10	10
Boer	10	10
Jamnapari	10	10

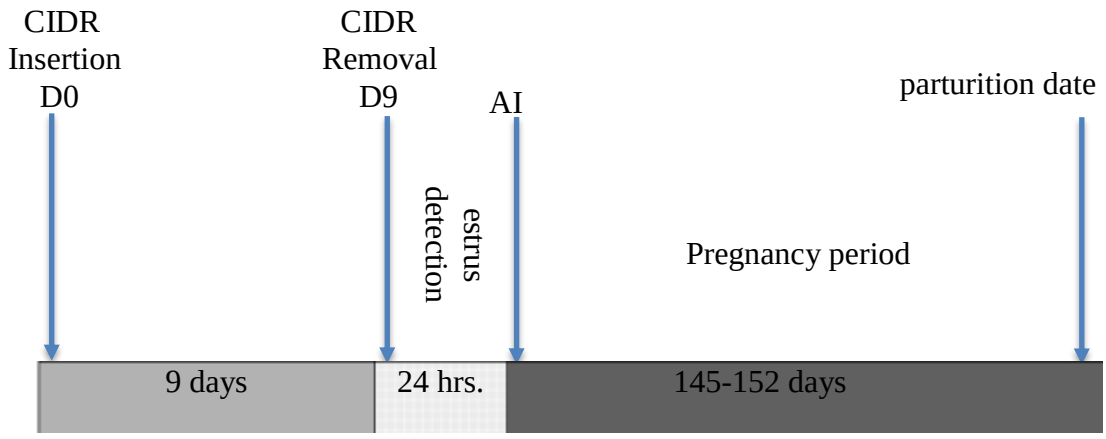


Figure 3.4 General experimental design and activities performed in goats subjected to intravaginal progestagen device synchronization treatment (CIDR), artificial insemination (AI), pregnancy period, and parturition date.

3.3.4.2 Semen collection and preservation

After getting estrus from does, 24 semen samples were collected from different males. Semen was collected from the selected males (n = 9; each breed = 3), which have a good body conditions, with an artificial vagina (KRUUSE, Denmark) (Figure 3.5).

The samples were immediately transported to the farm laboratory room for semen evaluation and determination of the volume of ejaculate, time liquidity, color,

concentration, pH, mass motility, and individual motility, using hemocytometer and microscope.

Egg yolk–citrate extender diluents (Anuberta et al., 1985) were utilized as protective solutions to extend the shelf life of semen. This extender was prepared using; 20 gm Sodium Citrate (SC) (SIGMA, USA) and 0.4 g KCL was placed in a test tube, chicken egg was washed in lukewarm water and then with distilled water, the yolk placed above the blotting paper and set off a yolk membrane allowing the yolk infiltration across the blotting paper within the tube, 10 ml of yolk were added to 90 ml of SC solution to get 100 ml of Egg yolk-SC solution, 3 g of glucose were added to yolk-SC solution, 50 000 International Unit (IU) penicillin (WG Critical Care, USA) were added to yolk-SC solution, distilled water were added to yolk-SC solution to be 1000 ml. Calibrated pH of the solution so that it = 6.8. The yolk-SC solution was mixed well and stored in a brown bottle in a dark place.

Figure 3.5 Artificial Vagina for goats (KRUUSE, Denmark)

Diluted semen was checked for sperm motility before being used. The diluted solution was stored at 5 °C–7 °C up to 4 days.

3.3.4.3 Artificial insemination (AI)

The AI was conducted 24 hours (D10) after CIDR withdrawal. Diluted semen, which contained the sperm concentration of 300 × 10^6 sperm of ejaculate, was deposited. Single intravaginal insemination of does was conducted 24 hours after estrus detection (Figure 3.4).

3.3.4.4 Local breeding (LB)

The does (n = 30) of each indigenous breed were inseminated artificially with the bucks of the same breed to obtain the following indigenous kids: Katjang (KK), Boer and Jamnapari (Jmn) as shown in Figure 3.6.

3.3.4.5 Crossbreeding (CB)

The does (n = 30) of Katjang, Boer and Jamnapari were inseminated artificially with bucks of other breeds to obtain the following hybrid kids: BK, JK and BJ as shown in Figure 3.6.

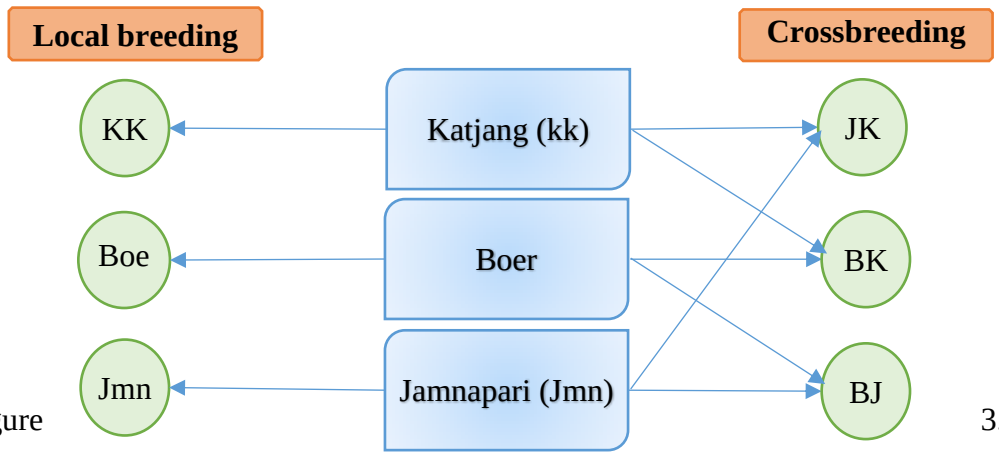


Figure 3.6 Breeding systems

"KK = Katjang, Jmn = Jamnapari, BK = Boer X Katjang, JK = Jamnapari X Katjang, BJ = Boer X Jamnapari"

3.3.4.6 Repeat the experiments

The LB and CB experiments were repeated two times to produce new kids.

3.3.5 Blood sampling

Blood samples were collected from goats of different ages and breeds. The blood was withdrawn through their jugular veins, as a stander method, with a syringe with 18G needle for every two weeks, starting with the day of birth up to 5 months old. The blood samples of 3.5 ml were collected into two types of plastic tubes (BP laboratory, Malaysia); containing EDTA for hematological studies, and without EDTA to separate serum for protein profiling and gene polymorphism.

3.3.5.1 Hematology

Hematological tests included total red blood cell (RBC) count, hemoglobin (Hb), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), MCH concentration (MCHC), RBC distribution width (RDW), total white blood cell (WBC) count, polymorphs (Polys), lymphocytes (Lymphs), monocytes (Monos), eosinophils (Eos), basophils (Basos), and platelet count (PLT) were determined immediately after collection via microscopic and CBC blood machine (Agappe Bc-3000 plus, Mindray, China) of BP laboratory, Tanjung Malim, Perak.

3.3.6 Protein profiling

The separation of macromolecules in an electric area is called electrophoresis. An extremely common method for separating proteins by electrophoresis uses an intermittent polyacrylamide gel as a support medium and sodium dodecyl sulfate

(SDS) to denature the proteins. The method is known sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE). The extremely commonly used system is also called the Laemmli method after U.K. Laemmli, who was the first to publish a paper using SDS-PAGE in a scientific study (David, 2012).

Sodium Dodecyl Sulphate Polyacrylamide gel electrophoresis (SDS PAGE) was used for visualizing albumin and transferrin bands from 118 blood serum samples. SDS-PAGE was performed to determine the molecular weight and relative content of various blood serum proteins. Blood serum samples were subjected to SDS-PAGE according to the method previously described (Laemmli, 1970) using a 10% polyacrylamide gel.

3.3.6.1 Sample collection and preparation:

Observance of proper procedures during the collection of blood and separation of serum is of utmost importance since it influences the result and reproducibility of the proteomic experiments. Proper care during sample handling prevents the denaturing of proteins in serum. The blood samples of 3.5 ml were drawn from the jugular vein of goats then collected into sterile plastic tubes.

The tubes that used for collecting blood do not contain any external anti-coagulating agent. Generally, syringe with 18G needle used to bring about efficient and rapid withdrawal of blood. Immediately after blood collection, the tubes were placed on ice packs until reach the lab (~30 min) (Nanji & Whitlow, 1984). Blood coagulates and fibrin clots formed during this incubation time, which is essential for the separation of serum. Samples were left at room temperature for 10 min. The coagulated blood was then centrifuged at 2500 rpm at 20 °C for 10 min. Blood clot

containing the different types of blood cells and clotting factors forms the pellet while the serum forms the dark, yellowish, viscous supernatant. Without disturbing the pellet, the supernatant was carefully aspirated out using a micropipette and collected into a fresh, clean, labeled micro centrifuge tube. Usually about 1.5 to 2 mL of serum is obtained from 5 mL of whole blood. The serum containing tubes stored at −80 °C until further use.

A volume of 1 µl blood serum protein samples was mixed with 20 µl of sample buffer containing 10% SDS, 20% glycerol and 10% mercaptoethanol (950 µl 2x Laemmli and 50 µl 2-Mercaptoethanol). The samples were incubated at 95 °C for 5 minutes and the samples were left at room temperature prior to loading onto the gel.

3.3.6.2 SDS-RUN:

Glass plates were clamped onto the gel running unit. This assembly was inserted into the electrophoresis tank (BIO-RAD, Malaysia) and filled both the chambers with 1X running buffer (containing 100 ml of Tris-Glycine and 900 ml of DDH_2O). The comb was removed carefully to make sure that the wells do not get disturbed (Figure 3.7).

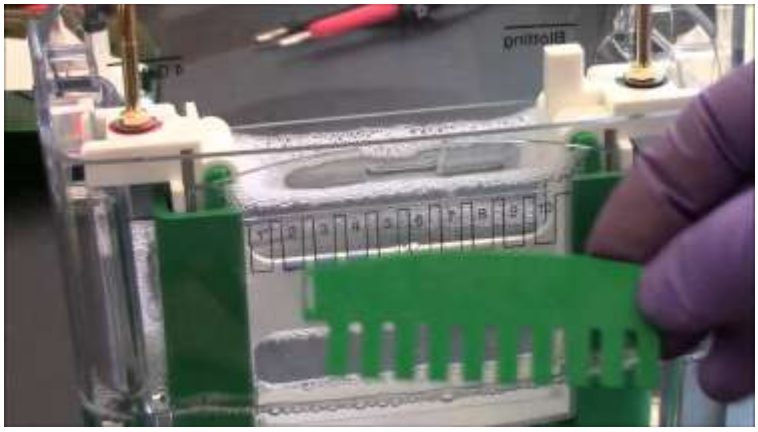


Figure 3.7 Electrophoresis tank and SDS-gel

The samples were loaded into the wells using a micropipette and ensured that they do not get dispersed in the buffer tank. Tank was covered with the lid and the electrodes were connected to the power pack. The power pack (BIO-RAD, Malaysia) set to a constant voltage of 90V and the run was beginning. The run was continuing till the tracking dye front reaches the bottom of the gel.

3.3.6.3 Staining gel:

After the electrophoretic run was completed, the separation patterns of the protein samples were visualized by staining the gels. It was done by exposing the gels to specific dyes which bind to proteins embed in the gels and help visualization of maximum number of protein spots. Coomassie brilliant blue was used for staining (Najafov & Hoxhaj, 2017).

Gels were then subjected to a corresponding de-staining step (De-stained in a mixture of 25% methanol, 10% acetic acid and distilled water) until no background was detectable before they were scanned using a gel documentation instrument.

3.3.6.4 Scanning of the gel

The gel was placed on the imaging platform, taking care that it would not tear during the transfer. An image of the gel was captured and stored with an appropriate label using Image lab program (version 5.2.1, Bio-Rad, USA).

Gel images were analyzed to determine molecular weight and relative protein content.

3.3.7 Gene polymorphism

A total of 86 blood serum samples were used for DNA extraction and Polymerase Chain Reaction (PCR) in order to prepare casein gene.

3.3.7.1 Genomic DNA extraction

The DNA extraction had been done using GeneJET Whole Blood Genomic DNA Purification Mini Kit (Thermo Fisher Scientific Inc., Lithuania, 2016), as per instruction.

3.3.7.2 Protocols

The protocols for genomic DNA purification from blood serum were; A 20 µl of Proteinase K Solution were added to 200 µl of blood serum then mixed by vortexing. A 400 µl of Lysis Solution were added and mixed thoroughly by pipetting and vortexing to obtain a uniform suspension (Figure 3.8).

The sample was incubated at 56 °C for 10 minutes while vortexing occasionally until the cells completely lysed. A 200 µl of ethanol (96-100%) were added and mixed by pipetting. The prepared mixture transferred to the spin column, centrifuged for 1 min at 6,000 × g (~8,000 rpm). The collection tube containing the flow-through solution was discarded. The column was placed into a new 2 mL collection tube. They were then washed using wash Buffer twice. The DNA was diluted into the Elution Buffer and kept for farther analysis (Figure 3.8).

A 500 µl of Wash Buffer WB I (with ethanol added) were added. Centrifuged for 1 min at 8,000 × g (~10,000 rpm). The flow-through was discarded and placed the column back into the collection tube. A 500 µl of Wash Buffer II (with ethanol added)

were added to the column then centrifuged for 3 min at maximum speed (≥20,000 × g, ≥14,000 rpm). The collection tube containing the flow-through solution was discarded and transferred the column to a sterile 1.5 mL micro centrifuge tube. A 200 µl of Elution Buffer were added to the center of the column membrane to elute genomic DNA then Incubated for 2 min at room temperature and centrifuged for 1 min at 8,000 × g (~10,000 rpm) (Figure 3.8).

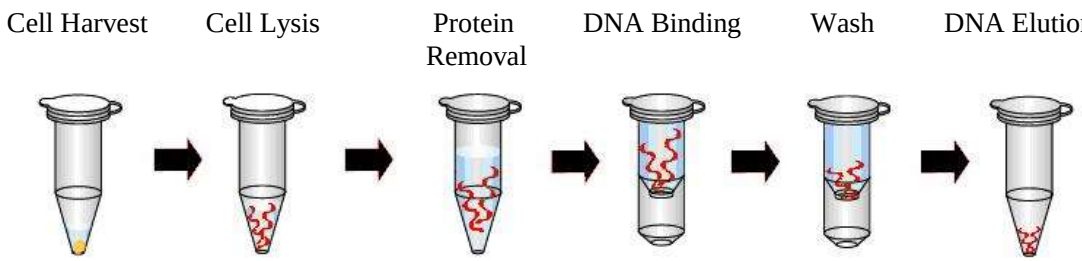


Figure 3.8 DNA extraction protocols

The purification column was discarded. The purified DNA was used immediately in downstream applications using Image scanning (BIO-RAD, USA) then stored at -20 °C for PCR purpose.

3.3.7.3 Polymerase Chain Reaction (PCR)

The PCR amplification using 8 different alleles (Amie Marini et. al., 2011) (Table 3.4) was performed in a 50 ml reaction mixture consisting of 1 µl genomic DNA, 10 µl DDH_2O, 10 µl Master Mix and 20 pmol of the specific primers for each allele. Thermal cycling conditions were as follow as; denaturation step of 95 °C for 4 min, followed by 32 cycles of 95 °C for 30 s, 60 °C for 30 s, 72 °C for 2 min and a final extension at 72 °C for a 2 min. The PCR products were subjected to electrophoresis on a 2% agarose gel and stained with ethidium bromide. The Image Lab Software of

the Gel Documentation System (version 5.2.1, Bio-Rad, USA) was used to visualize the presence of DNA fragment according to size.

Table 3.4 List of primers used in the PCR mixture

System	Primer
A3-O1	BT33 5'-gatattgggagtgaatcaactgag-3' BT66 5'-ctcacttgacgaactgcttccagc-3'
A2-O	BT25 5'-gaagatgtgccctctgagcgttac-3' BT60 5'-ctctttcatactgtgaagttgttc-3'
System 3	BT51 5'-gagaacatcaatgaactgatgaag-3' BT32 5'-cagctggggcacgttgtatttttttcag-3'
System 5	BT25 5'-gaagatgtgccctctgagctgtac-3' BT74 5'-cagatggggcacgttgtatttttttcag-3'
B3-C	BT66 5'-actcactggagagagtccttggat-3' BT97 5'-gtggctgttgctcttgccaggcc-3'
A0-A1-D	BT65 5'-ctcagggtagaagtaggccag-3' BT36 5'-gaacaacttcacagtatgaaagag-3'
Allele E	BT99 5'-ctatcatgtcaaaccattctatcc-3' BT72 5'- caatttcacttaaggatgttacac-3'
Allele F	BT58 5'-aagtttcatggttgtcaagat-3' BT73 5'-gaattccttgatcatcaacccagc-3'

3.4 Statistical analysis

Data analysis was performed using IBM SPSS software program (version 22.0 for Mac). All values were expressed as mean ± standard division of mean (SD).

ANOVA were performed with SPSS and the significance used was at $p < 0.05$. The analysis determined the significant differences based on the body weight, hematological pictures, protein profiling, gene polymorphism and reproductive efficiency, which were influenced by age and breed, of the goats in Malaysia. When

significant differences were detected, Tukey's HSD and Duncan post-hoc follow-up test to detect significant differences within or among groups.

Also, t-test (Levene's Test for Equality of Variances) were performed with SPSS and the significance used was at $p < 0.05$. The analysis determined the significant differences based on the body weight, hematological pictures, protein profiling, gene polymorphism and reproductive efficiency, which were influenced by sex and estrus synchronization methods, of the goats in Malaysia.

3.5 Conclusion

In order to optimise the productive potential of the goats in Malaysia, it is essential that a productive management programme be implemented that takes into account the productive aspects; such as reproductive efficiency, body physiological parameters, protein profiling, and gene polymorphism, in related to breeds, ages, and sexes.

Therefore, this chapter focused on techniques used to evaluate and improve goats' production in Malaysia. Moreover, next chapter will explain research findings and illustrate the productive qualities of goats in Malaysia.

CHAPTER 4

RESULTS

4.1 Introduction

This chapter clarifies the discoveries of the research and depicts the statistic attributes of the factors; such as reproductive efficiency, physiological parameters, protein profiling and gene polymorphism data of the different breeds, ages and sex groups.

The chapter is divided into three principle parts; Part A, B and C. Part A discusses the evaluation of the reproductive efficiency among goat breeds. Part B discusses the effect of breeds, ages and sex on the physiological parameters of goats. Whereas, Part C discusses the effect of breeds, ages and sex on the protein profiling and gene polymorphism of goats in Malaysia.

Part A

4.2 Effect of breeds on the Reproductive efficiency

This part depicted the data and its statistical value of the reproductive efficiency of goat breeds. The level of reproductive performance is dependent on the interaction of genetic and environmental factors, but this performance is particularly susceptible to the latter, for example, the seasonal availability of nutrients can affect reproduction considerably.

Although indigenous goat breeds have an excellent ability to accommodate and adapt to fluctuation in environment, this often involves some degree of reproductive failure

A total of 84 goats were used. The goats belong to three indigenous breeds (each breed; n = 28); namely, Katjang (KK), Boer, and Jamnapari, and two sex groups; male = 8 and female = 20, for each breed.

4.2.1 Reproductive efficiency of breeds

Table 4.1 shows the values of reproductive efficiency of three goat breeds. In addition, results of reproductive efficiency were; estrus; 90, 100 and 80%, pregnancy; 70, 75 and 75%, singleton; 70, 40 and 65%, and twin; 0, 30 and 10%, for Katjang, Boer and Jamnapari, respectively.

Table 4.1 Values of reproductive efficiency (percentage ±SD) of different breeds

Reproductive efficiency		**Estrus (%)**	**Pregnancy (%)**	**Singleton (%)**	**Twin (%)**
Breed	Katjang (n=20)	90±.51	70±.47	70±.47	0±.00
	Boer (n=20)	100±.51	75±.44	40±.50	30±.47*
	Jamnapari (n=20)	80±.50	75±.44	65±.49	10±.31

* Values in the same column significantly higher ($P < 0.05$)

One-way ANOVA was conducted to confirm whether there is any significant difference among breeds on the reproductive parameters. Results showed no significant difference ($p > 0.05$) on estrus synchronization, pregnancy rate and singleton rate among breeds. Moreover, results indicated there was significant difference ($p < 0.05$) twin rate among breeds. (Appendix A).

Therefore, a Tukey HSD post hoc comparison was done. Tukey HSD post hoc comparisons test results show that the significant difference occurs among breeds in

twin rate. Boer goats were significantly higher ($p < 0.05$) than other breeds in producing twins.

Table 4.2 shows the reproductive efficiency of the following of two estrus control methods; treatment group (TRE) with CIDR, and control group (CON) without CIDR. In addition, the reproductive efficiency were; estrus; 90 and 0%, pregnancy; 73 and 73%, singleton; 50 and 67%, and twin; 35 and 5%, for TRE and CON groups, respectively.

Table 4.2 Reproductive efficiency percentage (percentage ±SD) of different methods

Reproductive efficiency		**Estrus (%)**	**Pregnancy (%)**	**Singleton (%)**	**Twin (%)**
Group	TRE (n=30)	90±.31*	73±.45	50±.51	35±.43*
	CON (n=30)	0±.00	73±.45	67±.48	5±.18

* Values in the same column significantly higher ($P < 0.05$)

T-test analysis was conducted to confirm whether there was any significant difference between groups of goats on the reproductive efficiency. Results showed significant difference ($p < 0.05$) among goat groups with respect to the estrus synchronization and twin rate (Appendix A). However, TRE group were significantly higher ($p < 0.05$) than CON group in the incidence of estrus control and twin rate. Moreover, there is no significant difference ($p > 0.05$) among goat groups with respect to the pregnancy and singleton rates.

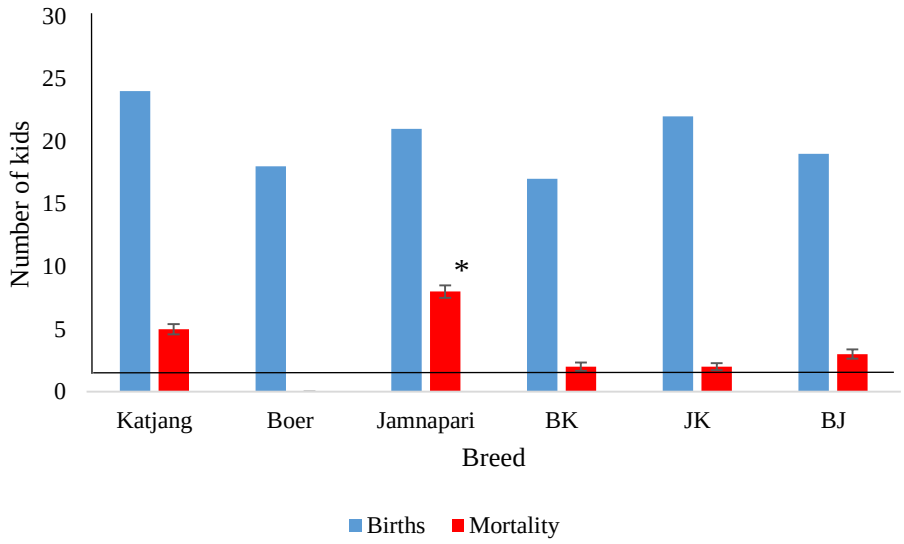
4.2.2 Mortality rate

Table 4.3 shows the mortality rates of different breeds have been calculated in this study. In addition, mortality rates were; 21, 0, 38, 12, 9 and 16% for Katjang, Boer, Jamnapari, BK, JK and BJ breeds, respectively (Figure 4.1). The total rate of mortality was 17%.

Table 4.3 Descriptive statistics of mortality rates of different breeds

Breed	Births (No.)	Mortality (No.)	Mortality rate (%) ±SD
Katjang	24	5	21±.41
Boer	18	0	0±.00
Jamnapari	21	8	38±.50*
BK	17	2	12±.33
JK	22	2	9±.29
BJ	19	3	16±.37
Total	121	20	17±.37

* Values in the same column significantly higher (P < 0.05)



* Value means significantly higher (P < 0.05)

Figure 4.1 Mortality rates of different breeds

One-way ANOVA was conducted to confirm whether there is any significant difference among breeds on the mortality rates. Results were showed there were a significant difference ($p < 0.05$) on the mortality rate (Appendix A).

Thus, a Tukey HSD post hoc comparison was done. Tukey HSD post hoc comparisons test results showed that the significant difference occurred among breeds

in mortality rate. Jamnapari kids were significantly higher ($p < 0.05$) than other breeds in mortality rates.

4.2.2.1 Effect of gender on the mortality

Table 4.4 shows the statistics data of mortality rates of different genders. In addition, mortality rates were; 22% and 12% for male and female, respectively.

Table 4.4 Mortality rates of different genders

Sex	Births (No.)	Mortality (No.)	Mortality rate (%)±SD
Male	54	12	22±.42
Female	67	8	12±.33
Total	121	20	17±.37

T-test analysis was conducted to confirm whether there is any significant difference between sex groups of goats on the mortality rates. Results showed no significant difference ($p > 0.05$) between sex groups with respect to the mortality rate (Appendix A).

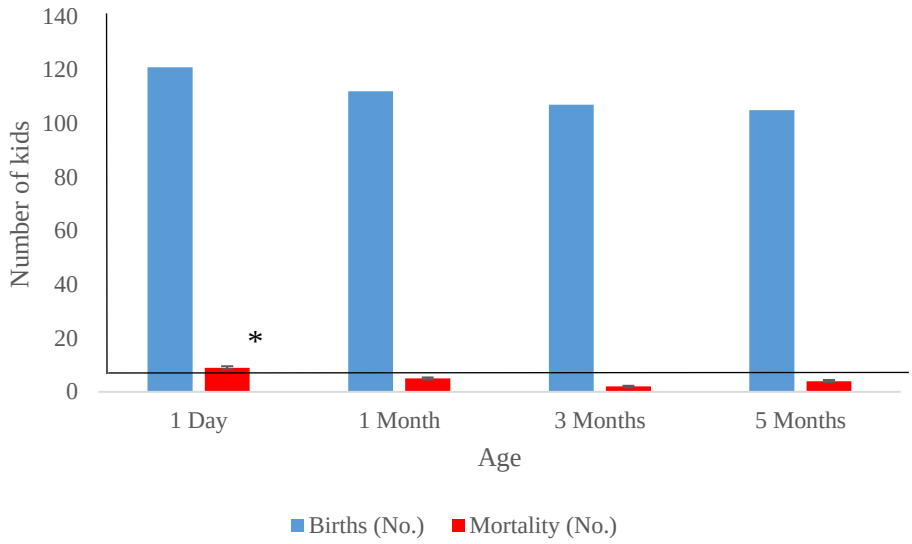
4.2.2.2 Effect of age on the mortality

Table 4.5 shows the mortality rates of different age. The mortality rates were; 7, 4, 2 and 4, for 1 day, 1 moth, 3 and 5 months old, respectively (Figure 4.2).

Table 4.5 Mortality rates of different age

Age	Births (No.)	Mortality (No.)	Mortality rate (%)±SD
1 Day old	121	9*	7±.51*
1 Month old	112	5	4±.44
3 Months old	107	2	2±.31
5 Months old	105	4	4±.41
Total births	121	20	17±.15

* Values in the same column significantly higher ($P < 0.05$)



* Value means significantly higher (P < 0.05)

Figure 4.2 Mortality rates of different ages

One-way ANOVA was conducted to confirm whether there is any significant difference among age groups on the mortality rates. Results were showed there were a significant difference ($p < 0.05$) on the mortality rate among groups (Appendix A). Thus, a Tukey HSD post hoc comparison was done. Tukey HSD post hoc comparisons test results show that the significant difference occurs among age groups in mortality rate. A 1 day old kid goats were significantly higher ($p < 0.05$) than other age groups in mortality rates.

In conclusion, finding of this study showed the use of CIDR was improved the reproductive efficiency in breeds, such as estrus synchronization and twin rate. Breed type was affected twin rate, which Boer goat were higher ($p < 0.05$) than other breeds. Moreover, breeds also affected mortality rate, which Jamnapari goat were higher than the other breeds.

Part B

This part will discuss the effect of breeds and ages; such as ages of adults (1.5, 2, 2.5, and 3 years old) and kids (1 day, 1,2,3, and 5 months old); on physiological performance of goats.

4.3 Effect of breeds and ages on physiological performance

4.3.1 Body weight of breeds

A total of 875 times of body weights were recorded in the present study. The weights were compared among goat breeds at different age.

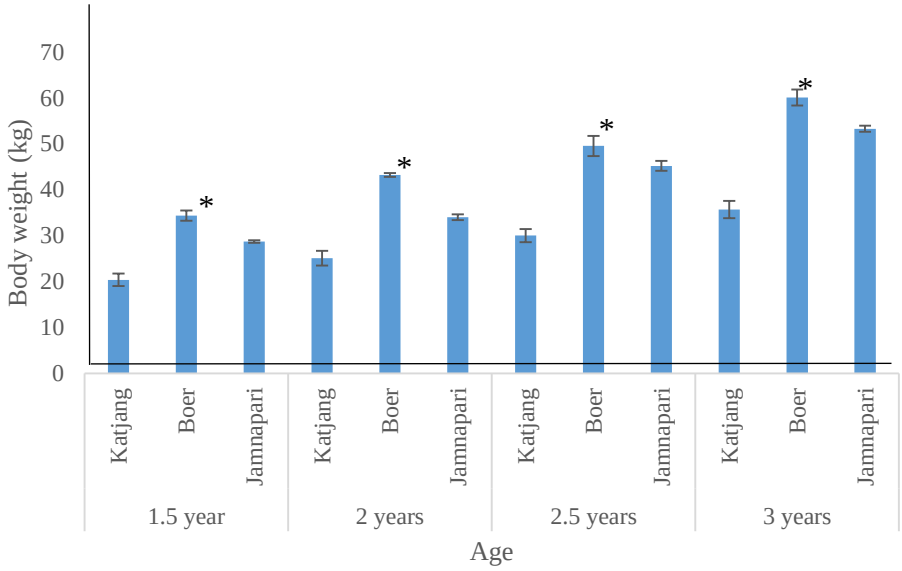
4.3.1.1 Type of adults

Table 4.6 demonstrates the descriptive statistics of 84 adult goats (does = 60; and bucks = 24) that have been included in this study (Figure 4.3).

Table 4.6 Body weights of goat breeds at different age (Year) of adults

Breed	1.5 year	2 years	2.5 years	3 years
Katjang (n=28)	20.39±1.39	25.10±1.58	30.04±1.43	35.72±1.88
Boer (n=28)	34.38±1.14*	43.23±.42*	49.57±2.18*	60.15±1.73*
Jamnapari (n=28)	28.72±.29	34.02±.64	45.21±1.08	53.33±.66

* Values in the same column significantly higher ($P < 0.05$)



* Value means significantly higher (P < 0.05)

Figure 4.3 Body weights of different ages of adult goats

To answer the research questions, one-way ANOVA was conducted to confirm whether there is any significant difference among age of adult goats on the body performance of different breeds. However, there was a significant difference ($p < 0.05$) among different breeds with respect to the age of adult goats. (Appendix B). Therefore, a Tukey HSD post hoc comparison was done. Tukey HSD post hoc comparisons test results show that the significant difference occurs among goats in various age and breeds. Moreover, Boer goats weight were significantly higher ($p < 0.05$) than Katjang and Jamnapari goats in all age.

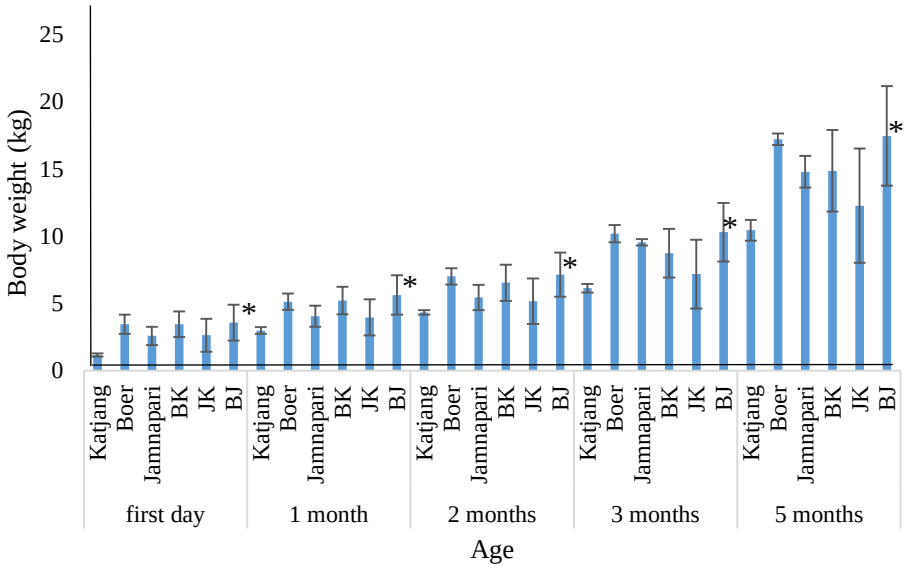
4.3.1.2 Type of kids

Table 4.7 demonstrates the descriptive statistics of 121 kid goats (Katjang = 24, Boer = 18, Jamnapari = 21, BK = 17, JK = 22, and BJ = 19) that have been included in this study (Figure 4.4).

Table 4.7 Body weights (mean ±SD) of goat breeds at different age of kid goats

Breed	1 day	1 month	2 months	3 months	5 months
Katjang (n=24)	1.18±.12	2.99±.26	4.34±.17	6.14±.32	10.44±.77
Boer (n=18)	3.45±.71	5.13±.61	7.02±.61	10.19±.64	17.21±.44
Jamnapari (21)	2.59±.67	4.05±.78	5.45±.94	9.54±.24	14.79±1.18
BK (17)	3.45±.95	5.22±1.02	6.54±1.35	8.73±1.81	14.86±3.03
JK (22)	2.64±1.23	3.96±1.34	5.17±1.69	7.18±2.55	12.27±4.25
BJ (19)	3.57±1.34*	5.63±1.47*	7.15±1.64*	10.30±2.17*	17.45±3.70*

* Values in the same column significantly higher (P < 0.05)



* Value means significantly higher (P < 0.05)

Figure 4.4 Body weights of different ages of kid goats

To answer the research questions, one-way ANOVA was conducted to confirm whether there is any significant difference among age of kid goats on the body performance of different breeds. Moreover, there was a significant difference (p <0.05) among different breeds with respect to the age of kid goats. (Appendix B). Therefore, a Tukey HSD post hoc comparison was done. Tukey HSD post hoc comparisons test results show that the significant difference occurs among goats in

various age and breeds. However, BJ kids (Boer X Jamnapari) was a significantly higher ($p < 0.05$) than all other breeds over the whole age.

4.3.2 Hematology of breeds

A total of 1410 blood samples (adults = 630, and kids = 780), had been collected from 205 goats (adults = 84, and kids = 121), were used in present study. Hematological tests included total red blood cell (RBC) count, hemoglobin (Hb), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), MCH concentration (MCHC), RBC distribution width (RDW), total white blood cell (WBC) count, polymorphs (Polys), lymphocytes (Lymphs), monocytes (Monos), eosinophils (Eos), basophils (Basos), and platelet count (PLT).

4.3.2.1 Adults goat blood profile

4.3.2.1.1 Red Blood Cells

Tables 4.8 demonstrate the descriptive statistics of 84 adult goats that have been included in this study. In addition, the mean value for red blood cells showed various results among ages and breeds. However, Boer and Jamnapari goats showed the highest value of RBC count, PCV, and MCV, at different age. Whereas, Katjang showed a high value of Hb, MCH, and MCHC, at different age groups.

Table 4.8 Red blood cells count of goat breeds at different ages of adults

Ages (years)	Breed	RBC (M/cmm)	Hb (g/dl)	PCV (%)	MCV (fl)	MCH (pg)	MCHC (%)	RDW (%)
1.5	Katjang	3.38	10.4	32.29	95.13	31.24	33.55	23.03
	(n=60)	±.28	±.25*	±5.99	±16.32	±2.69*	±6.24*	±3.00
	Boer	4.08	9.40	42.4	103.03	23.06	22.24	22.00
	(n=50)	±.32*	±1.63	±3.68	±8.34	±5.24	±5.17	±2.91
	Jamnapari	3.98	9.88	43.76	108.93	26.08	25.82	21.77
	(n=47)	±.84*	±.45	±9.73*	±7.99*	±6.81	±6.24	±3.13
2	Katjang	3.42	10.41	32.45	96.17	31.32	33.35	22.92
	(n=45)	±.3	±.25*	±6.1	±17.19	±2.71*	±6.35*	±3.21
	Boer	4.09	9.46	42.32	102.64	23.19	22.35	22.05
	(n=55)	±.32*	±1.63	±3.72	±8.22	±5.29	±5.23	±2.95
	Jamnapari	3.94	9.90	43.36	108.53	26.41	25.96	21.90
	(n=58)	±.83*	±.44	±9.66*	±7.84*	±6.70	±6.31	±3.11
2.5	Katjang	3.40	10.39	32.02	95.25	31.51	33.66	22.65
	(n=50)	±.3	±.25*	±5.89	±17.00	±2.47*	±6.36*	±2.93
	Boer	4.08	9.32	42.43	103.85	23.07	22.01	22.00
	(n=51)	±.33*	±1.66	±3.66	±8.77	±5.17	±5.25	±2.83
	Jamnapari	3.99	9.88	43.86	108.21	25.89	25.32	21.81
	(n=57)	±.82*	±.46	±9.52*	±8.37*	±6.83	±6.56	±3.22
3	Katjang	3.38	10.41	32.2	94.60	31.08	33.66	22.93
	(n=53)	±.29	±.25*	±6.07	±16.36	±2.61*	±6.33*	±3.01
	Boer	4.10	9.49	42.41	103.25	23.28	22.26	21.90
	(n=49)	±.33*	±1.59	±3.77	±8.63	±5.23	±5.33	±3.01
	Jamnapari	3.94	9.90	43.36	108.53	26.44	25.67	21.90
	(n=55)	±.83*	±.46	±9.61*	±8.21*	±6.66	±6.53	±3.20

* Values in the same column significantly higher ($P < 0.05$)

As shown in appendix C; one-way ANOVA was conducted to confirm whether there is any significant difference among age of adult goats on the red blood cells of different breeds. Moreover, there was a significant difference ($p < 0.05$) on the age groups among different breeds of adult goats. Therefore, a Tukey HSD post hoc comparison was done. Tukey HSD post hoc comparisons test results show that the significant difference occurs among goats in various age and breeds. Results showed that Boer and Jamnapari goats were a significant difference ($p < 0.05$) compared to Katjang of value of RBC count, PCV, and MCV, at different age. Whereas, Katjang was significantly ($p < 0.05$) higher in value of Hb, MCH, and MCHC, at different age than the other breeds.

4.3.2.1.2 White Blood Cells

Tables 4.9 demonstrate the descriptive statistics of 84 adult goats have been included in this study. In addition, the mean value for WBC types showed various results among ages and breeds. However, Katjang were significantly ($p < 0.05$) higher than other breeds in WBC and Lymphocytes at different age. Boer goats showed a high value ($p < 0.05$) of Polymorphs and Monocytes at different age compared to other breeds. Jamnapari showed a high value of lymphocytes and Eosinophils. Moreover, Basophils did not appear at all age of different breeds.

Table 4.9 White blood cells count ± SD of goat breeds at different ages of adults

Ages (years)	**Breed**	**WBC (cmm)**	**Polymorphs (%)**	**lymphocytes (%)**	**monocytes (%)**	**eosinophils (%)**
1.5	Katjang (n=60)	17537.93 ±2288.07*	46.03 ±10.68	51.63 ±11.15*	1.72 ±.60	.48 ±.55
	Boer (n=50)	16141.37 ±1830.79	71.17 ±6.21*	24.67 ±4.68	2.96 ±2.32*	1.03 ±1.04
	Jamnapari (n=47)	11206.89 ±1189.51	39.50 ±12.92	51.89 ±9.22*	.48 ±.55	3.05 ±2.31*
2	Katjang (n=45)	17721.42 ±2396.96*	46.60 ±10.92	51.16 ±11.12*	1.78 ±.58	.50 ±.56
	Boer (n=55)	16092.85 ±1845.30	70.71 ±5.80*	24.80 ±4.71	2.85 ±2.29*	1.07 ±1.04
	Jamnapari (n=58)	11182.14 ±1203.71	39.14 ±13.01	51.89 ±9.39*	.46 ±.55	3.10 ±2.34*
2.5	Katjang (n=50)	17642.85 ±2382.71*	45.81 ±10.84	51.92 ±11.25*	1.78 ±.58	.48 ±.56
	Boer (n=51)	16178.57 ±1827.43	71.71 ±6.53*	24.48 ±4.73	2.92 ±2.21*	1.00 ±1.04
	Jamnapari (n=57)	11275.00 ±1220.99	40.28 ±13.24	52.28 ±9.02*	.51 ±.56	3.01 ±2.29*
3	Katjang (n=53)	17521.42 ±2328.30*	45.68 ±10.70	52.10 ±11.05*	1.75 ±.60	.44 ±.53
	Boer (n=49)	16121.42 ±1867.53	71.25 ±6.04*	24.82 ±4.69	2.89 ±2.30*	1.07 ±1.04
	Jamnapari (n=55)	11182.14 ±1191.34	39.14 ±12.85	52.82 ±8.83*	.46 ±.54	3.17 ±2.27*

* Values in the same column significantly higher ($P < 0.05$)

To answer the research questions, one-way ANOVA analysis was conducted to confirm whether there is any significant difference among age of adult goats on the white blood cells value of different breeds. Moreover, there was a significant

difference ($p < 0.05$) among different breeds with respect to the age of adult goats (Appendix D).

Therefore, a Tukey HSD post hoc comparison was done. Tukey HSD post hoc comparisons test results showed that the significant difference occurs among goats in various age and breeds. White blood cells count and lymphocytes of Katjang were significantly higher ($p < 0.05$) than Boer and Jamnapari goats at different age. Polymorphs (Polys) and Monocytes (Monos) of Boer goats showed significant difference ($p < 0.05$) compared to other breeds at different ages. Also, Lymphocytes (Lymphs) and eosinophils (Eos) of Jamnapari showed significant difference ($p < 0.05$) compared to other breeds at different ages. However, there is no significant difference ($p > 0.05$) in basophils (Basos) at all ages of different breeds.

4.3.2.1.3 Platelets

Table 4.10 demonstrates the descriptive statistics of 84 adult goats that have been included in this study. In addition, the mean value for platelets showed various results among ages and breeds.

Table 4.10 Platelets (/cmm) of goat breeds at different age of adults

Age/years		**Mean (/cmm) ±SD**
1.5	Katjang (n=60)	685034.48±133675.10
	Boer (n=50)	738586.20±93944.70
	Jamnapari (n=47)	672344.82±152293.01
2	Katjang (n=45)	678857.14±132486.67
	Boer (n=55)	736714.28±95116.24
	Jamnapari (n=58)	676642.85±153286.03
2.5	Katjang (n=50)	689928.57±133402.73
	Boer (n=51)	742250.00±95146.13
	Jamnapari (n=57)	668750.00±151043.68
3	Katjang (n=53)	690500.00±132787.35
	Boer (n=49)	738892.85±97525.05
	Jamnapari (n=55)	680357.14±149275.83

One-way ANOVA analysis was used to confirm whether there is any significant difference on the platelets among age of adult goats of different breeds. However, results were showed no significant differences ($p > 0.05$) among breed groups (Appendix D).

4.3.2.2 Kids goat blood profile

4.3.2.2.1 Red Blood Cells

Tables 4.11 explain the descriptive statistics of 121 kid goats that have been included in this study. In addition, the mean value for red blood cells showed various results among ages and breeds. At different age, BK breed showed the highest value of RBC, Hb, PCV, and MCV.

Table 4.11 Red blood cells count ± SD of goat breeds at different ages of kids

Ages	Breed	RBC (M/cmm)	Hb (g/dl)	PCV (%)	MCV (fl)	MCH (pg)	MCHC (%)	RDW (%)
1 day	Katjang	4.20	10.30	41.75	94.25	26.12	26.00	22.77
	(n=42)	±1.24	±.38*	±12.50	±14.1	±2.32	±6.48	±2.02
	Boer	4.02	8.58	52.20	80.00	13.60	19.10	27.44
	(n=33)	±.22	±1.84	±28.59	±29.66	±.67	±8.18	±3.5*
	Jamnapari	3.40	9.30	30.00	88.00	29.00	31.37	22.85
	(n=43)	±.32	±.08	±6.53	±16.32	±3.26*	±.75	±1.89
	Boer-Katjang (BK)	6.62	10.70	55.25	98.75	25.25	26.00	21.73
	(n=32)	±.51*	±1.03*	±8.30*	±10.04*	±6.60	±1.82	±3.62
	Jamnapari-Katjang (JK)	4.53	8.37	44.00	98.75	20.25	35.00	22.75
	(n=36)	±1.31	±.77	±6.68	±10.34*	±2.21	±8.12*	±1.72
	Boer-Jamnapari (BJ)	5.10	10.10	46.00	94.33	26.33	18.16	23.10
	(n=44)	±.10	±.20	±1.00	±5.13	±3.21	±2.02	±1.00
1 month	Katjang	4.84	10.74	52.4	102.8	20.70	22.40	24.78
	(n=38)	±1.14	±.81*	±18.28*	±22.68	±3.93	±6.42	±2.51
	Boer	4.03	8.25	47.00	68.5	13.50	23.91	27.0
	(n=28)	±.38	±1.81	±28.7	±35.74	±.63	±10.05	±3.55*
	Jamnapari	3.32	8.70	30.00	91.0	26.75	29.31	22.70
	(n=33)	±.23	±.46	±3.62	±4.89	±2.81*	±2.71	±2.59
	Boer-Katjang (BK)	6.60	9.95	52.83	105.0	25.58	26.33	22.21
	(n=31)	±.37*	±.93*	±5.6*	±17.92*	±12.15	±3.57	±2.59
	Jamnapari-Katjang (JK)	4.58	7.83	37.66	90.33	25.00	37.0	22.16
	(n=32)	±.29	±.57	±3.78	±11.01	±2.00	±11.0*	±1.32
	Boer-Jamnapari (BJ)	4.60	8.38	39.37	86.37	22.12	30.81	22.63
	(n=35)	±.62	±1.11	±6.36	±7.59	±3.05	±7.46	±3.04
3 months	Katjang	4.36	10.33	39.00	94.66	23.33	26.66	20.46
	(n=39)	±.89	±.27*	±9.67	±4.5	±4.92	±6.08	±4.25
	Boer	3.88	9.36	63.66	90.16	13.75	17.16	29.13
	(n=30)	±.29	±1.35	±23.1*	±27.28	±.68	±7.86	±2.0*
	Jamnapari	3.12	8.92	33.75	82.50	28.0	30.75	23.42
	(n=33)	±.18	±.55	±3.86	±9.98	±2.16*	±2.62	±3.53
	Boer-Katjang (BK)	6.20	11.00	54.00	102.33	26.50	27.66	25.00
	(n=32)	±.45*	±.95*	±7.21	±18*	±7.36	±.57	±4.07
	Jamnapari-Katjang (JK)	4.83	7.91	38.33	91.33	22.16	33.33	22.03
	(n=37)	±.20	±.14	±1.52	±9.29	±2.84	±6.11*	±1.41
	Boer-Jamnapari (BJ)	5.00	8.68	34.00	80.50	22.16	27.83	23.33
	(n=35)	±.17	±1.04	±9.01	±16.02	±1.86	±8.28	±3.32
5 months	Katjang	4.02	10.57	43.50	101.75	24.00	25.50	23.65
	(n=24)	±1.05	±.77*	±14.91	±23.3*	±3.64	±4.86	±.83
	Boer	3.92	9.20	60.75	88.50	13.87	18.75	28.85
	(n=22)	±.41	±1.75	±26.73*	±32.02	±.62	±8.23	±3.15*
	Jamnapari	3.52	9.20	28.20	92.40	29.00	31.70	24.56
	(n=26)	±.30	±.42	±3.56	±9.09	±2.64	±2.41	±2.51
	Boer-Katjang (BK)	6.90	10.83	59.33	95.33	34.66	28.33	19.61
	(n=23)	±.40*	±.50*	±8.32*	±10.26	±11.4*	±4.04	±2.51
	Jamnapari-Katjang (JK)	4.48	7.79	38.33	87.66	22.66	33.83	22.40
	(n=25)	±.42	±.52	±5.2	±11.37	±3.02	±10.3*	±1.68
	Boer-Jamnapari (BJ)	5.08	9.57	41.62	86.87	24.00	21.93	24.37
	(n=27)	±.23	±1.07	±8.51	±10.57	±4.27	±5.26	±3.52

* Values in the same column significantly higher ($P < 0.05$)

To answer the research questions, one-way ANOVA was conducted to confirm whether there is any significant difference among age of kid goats on the red blood cells of different breeds (Appendix E). Moreover, values of RBC were significantly differences ($p < 0.05$) among kid groups at various age.

Therefore, a Tukey HSD post hoc comparison was done. Tukey HSD post hoc comparisons test results show that the significant difference occurs among goats in various age and breeds. The BK kid goats were significantly ($p < 0.05$) higher of value of RBC, Hb, PCV, and MCV at different age compared to other breeds. However, other values of RBC were significantly differences ($p < 0.05$) among different kid groups at various age.

4.3.2.2.2 White Blood Cells

Tables 4.12 demonstrates the descriptive statistics of 121 kid goats that have been included in this study. In addition, the mean value for white blood cells showed various results among ages and breeds. However, BK kids showed the highest value of white blood cells count, lymphocytes, and monocytes at different age. The Boer kids showed the highest value of polymorphs (Polys) and eosinophils (Eos) at different age. Moreover, basophils (Basos) did not appear at all age of different breeds.

Table 4.12 White blood cells count ± SD of goat breeds at different ages of kids

Ages	Breed	WBC (cmm)	polymorphs (%)	lymphocytes (%)	monocytes (%)	eosinophils (%)
1 day	Katjang	16350.00	39.00	56.75	1.50	1.00
	(n=42)	±1744.51	±5.47	±5.43	±1.00	±.40
	Boer	12760.00	56.00	33.20	3.00	2.60
	(n=33)	±1558.20	±4.84*	±7.23	±1.0	±.96*
	Jamnapari	8800.00	37.75	58.75	.00	1.00
	(n=43)	±1632.99	±4.27	±3.77*	±.00	±.40
	Boer-Katjang (BK)	18350.00	53.00	57.00	3.87	.25
	(n=32)	±3503.8*	±5.75	±12.35	±.85*	±.50
	Jamnapari-Katjang (JK)	11675.00	44.37	44.50	2.75	.25
	(n=36)	±1577.70	±5.25	±4.20	±1.51	±.50
	Boer-Jamnapari (BJ)	14600.00	52.13	38.00	1.00	2.00
	(n=44)	±2000.00	±7.73	±2.00	±.00	±.25
1 month	Katjang	15560.00	37.20	59.20	3.00	1.00
	(n=38)	±1848.78*	±4.81	±8.31*	±1.87	±.00
	Boer	12566.66	65.83	33.00	3.00	2.50
	(n=28)	±1562.90	±3.86*	±2.09	±.31	±.83*
	Jamnapari	9100.00	44.12	50.62	1.50	1.75
	(n=33)	±1214.20	±3.44	±6.80	±.92	±.88
	Boer-Katjang (BK)	15600.00	52.91	49.58	4.33	.66
	(n=31)	±3356.18*	±11.75	±18.27	±.87*	±.81
	Jamnapari-Katjang (JK)	11100.00	43.16	47.00	2.66	.66
	(n=32)	±529.15	±3.01	±3.60	±1.18	±1.15
	Boer-Jamnapari (BJ)	11975.00	51.32	45.00	2.37	1.25
	(n=35)	±1744.17	±13.15	±5.97	±1.22	±1.06
3 months	Katjang	15133.33	39.33	58.66	2.00	.83
	(n=39)	±2873.78	±6.34	±8.11*	±1.54	±.25
	Boer	13250.00	61.33	34.00	3.08	3.00
	(n=30)	±1528.07	±8.86*	±6.44	±.66	±.63*
	Jamnapari	8200.00	42.50	53.75	.50	1.37
	(n=33)	±1143.09	±4.43	±8.84	±1.00	±.75
	Boer-Katjang (BK)	17500.00	53.66	56.83	4.16	.33
	(n=32)	±2622.97*	±7.42	±12.06	±1.60*	±.57
	Jamnapari-Katjang (JK)	11100.00	42.33	48.33	2.41	.66
	(n=37)	±1153.25	±2.08	±5.85	±.94	±1.15
	Boer-Jamnapari (BJ)	11500.00	55.56	43.16	2.31	2.04
	(n=35)	±2100.47	±8.10	±4.86	±1.03	±.33
5 months	Katjang	15575.00	35.50	62.25	1.75	1.12
	(n=24)	±1976.10	±4.30	±5.92	±1.38	±.23
	Boer	12450.00	62.50	31.00	3.25	2.50
	(n=22)	±1586.40	±9.57*	±5.03	±.50*	±.57*
	Jamnapari	9480.00	44.00	54.80	.40	1.10
	(n=26)	±1100.90	±7.38	±7.12	±.89	±1.02
	Boer-Katjang (BK)	20566.66	58.83	69.33	3.66	.00
	(n=23)	±1159.02*	±6.75	±6.42*	±.57*	±.00
	Jamnapari-Katjang (JK)	11316.66	40.91	48.50	3.04	1.00
	(n=25)	±519.29	±3.78	±4.50	±1.23	±1.10
	Boer-Jamnapari (BJ)	13975.00	59.62	40.12	1.50	1.96
	(n=27)	±2677.81	±9.67	±4.15	±.92	±.31

* Values in the same column significantly higher ($P < 0.05$)

To answer the research questions, one-way ANOVA was conducted to confirm whether there is any significant difference among age of kid goats on the white blood cells of different breeds. Moreover, WBC were significantly differences ($p < 0.05$) among kid groups at various age. (Appendix F).

Therefore, a Tukey HSD post hoc comparison was done. Tukey HSD post hoc comparisons test results show that the significant difference occurs among goats in various age and breeds. However, BK kids were significantly higher ($p < 0.05$) than other kid goats at different age in white blood cells count, lymphocytes, and monocytes. Boer kids were significantly higher ($p < 0.05$) than other kids at different age in polymorphs (Polys) and eosinophils (Eos).

4.3.2.2.3 Platelets

Table 4.13 demonstrates the descriptive statistics of 121 kid goats that have been included in this study. In addition, the mean value for platelets showed various results among ages and breeds. However, results showed a high value at 1 day and 3 months old of Jamnapari kids. Whereas, BK kids showed a high value at 5 months' old.

Table 4.13 Platelets (/cmm) ± SD of different age of kid goats

Breed	1 day	1 month	3 months	5 months
Katjang (n=42)	835500 ±374480.52	603200 ±365900.53	710000 ±313570.40	886000.00 ±352904.68
Boer (n=33)	600600 ±117893.17	612000 ±62440.37	574000 ±78523.88	608500 ±62040.30
Jamnapari (n=43)	1116000 ±4898.97*	891000 ±183225.07*	1089500 ±49081.56*	1057200 ±134859.92
BK (n=32)	1042500 ±431306.15	730000 ±401945.26	916666.66 ±305013.66	1320000 ±173205.08*
JK (n=36)	627000 ±180971.45	671666.66 ±9814.95	605000 ±120677.25	707833.33 ±148571.08
BJ (n=44)	601000 ±100000.00	580775 ±254693.99	237133.33 ±245494.13	483300 ±278167.20

* Values in the same column significantly higher ($P < 0.05$)

To answer the research questions, one-way ANOVA was conducted to confirm whether there is any significant difference on the platelets among age groups of kid goats of different breeds. Moreover, platelets were significantly differences ($p < 0.05$) among kid groups at various ages (Appendix F).

Therefore, a Tukey HSD post hoc comparison was done. Tukey HSD post hoc comparisons test results show that the significant difference occurs among goats in various age and breeds. However, Jamnapari kids were significantly higher ($p < 0.05$) than other kid goats in platelets at 1 day and 3 months old. Moreover, BK kids were significantly higher ($p < 0.05$) than other kid goats in platelets at 5 months' old.

4.4 Effect of sex groups on physiological performance

4.4.1 Body weight of sex groups

A total of 764 times of body weights were recorded in present study.

4.4.1.1 Type of adults

Table 4.14 demonstrates the descriptive statistics of 84 adult goats (does = 60; and bucks = 24) that have been included in this study. In addition, male group showed higher of body weight at different ages (1.5 and 2.5 years old; 28.12 and 41.89kg, respectively) than the female group (Figure 4.5).

Table 4.14 Body weight (kg) ± SD of different sex groups perceptions of adults

Sex	1.5 year	2 years	2.5 years	3 years
Male (n=31)	28.12±6.08	33.69±7.21	41.89±8.82	48.73±12.29
Female (n=67)	26.99±6.10	33.64±8.13	40.73±8.91	48.68±10.71

To answer the research questions, t-test analysis was conducted to confirm whether there is any significant difference between sex groups of adult goats on the

body weight of different breeds (Appendix C). Results were showed that there is no significant difference (p >0.05) between sex groups in all age.

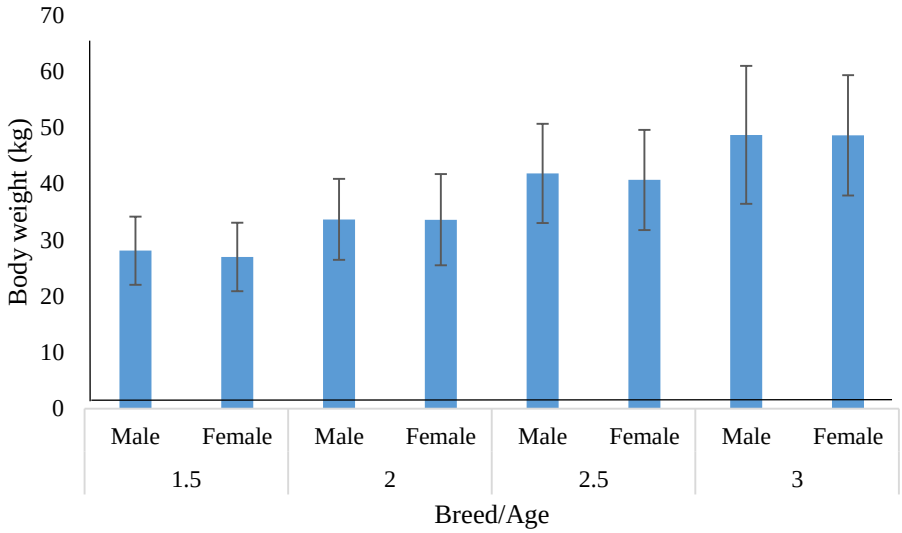


Figure 4.5 Body weight (kg) of different ages and genders of adults

4.4.1.2 Type of kids

Table 4.15 demonstrates the descriptive statistics of 121 kid goats (females = 67; and males = 54) that have been included in this study. In addition, the mean value for body weights of male group were higher than female group at 1 day old (3.12 and 2.61, respectively). Moreover, the mean values were almost same between sex groups at ages 1, 2, 3 and 5 months old (Figure 4.6).

Table 4.15 Body weight (kg) of sex groups perceptions at different age of kids

Age	Sex	Mean (kg) ±SD
first day	Male (n=60)	3.12±1.24*
	Female (n=64)	2.61±1.16
1 month	Male (n=43)	4.79±1.30
	Female (n=51)	4.33±1.35
2 months	Male (n=33)	6.23±1.56
	Female (n=37)	5.81±1.56
3 months	Male (n=24)	8.99±2.23
	Female (n=29)	8.48±2.18
5 months	Male (n=13)	15.10±3.66
	Female (n=18)	14.15±3.68

* Values in the same column within age group significantly higher (P < 0.05)

To answer the research questions, t-test analysis was conducted to confirm whether there is any significant difference between sex groups of kid goats on the body weight (Appendix G). However, results showed the values of males' group at age 1 day were significantly higher on body weight (p <0.05) than female groups. Moreover, there is no significant difference (p >0.05) between male and female at ages of 1, 2, 3 and 5 months old.

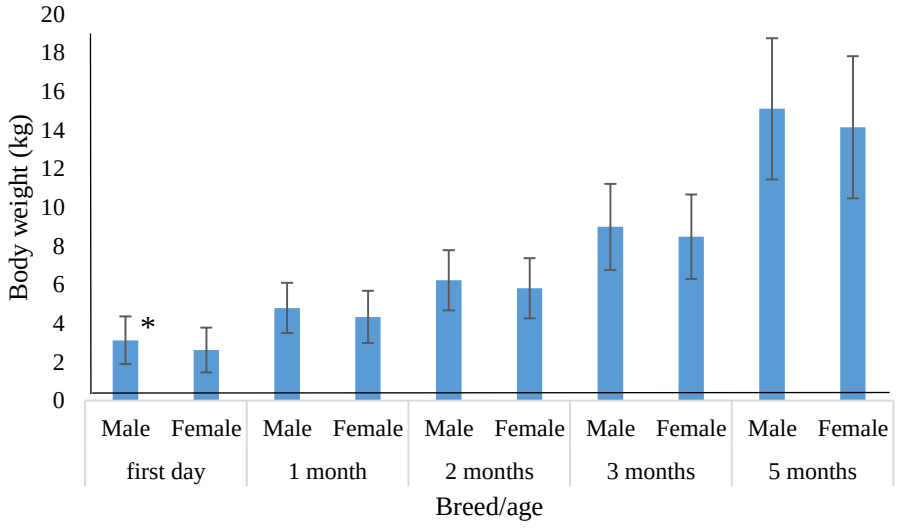


Figure 4.6 Body weight (kg) of different ages and genders of kids

4.4.2 Hematological value of sex groups

A total of 1410 blood samples (adults = 630, and kids = 780), had been collected from 205 goats (adults = 84, and kids = 121), then were used in present study.

4.4.2.1 Type of adults

4.4.2.1.1 Red Blood Cells

Tables 4.16 demonstrate the descriptive statistics of 84 adult goats that have been included in this study. In addition, the mean value for red blood cells showed various results between sex groups. However, female groups were showed a high value of RBC count, PCV, and MCV, at different age as compared to male group. Whereas, male group showed higher of Hb, MCH, MCHC and RDW at different age than the female group.

Table 4.16 Red blood cells count of sex groups at different ages of adults

Ages (year)	**Sex**	**RBC (M/cmm)**	**Hb (g/dl)**	**PCV (%)**	**MCV (fl)**	**MCH (pg)**	**MCHC (%)**	**RDW (%)**
1.5	Male (n=52)	3.50 ±.43	10.49 ±.45*	34.00 ±6.2	96.67 ±13.86	30.33 ±3.84*	32.00 ±6.25*	22.90 ±2.67*
	Female (n=105)	4.14 ±.61*	9.25 ±1.16	45.36 ±6.65*	108.48 ±7.8*	23.01 ±5.95	22.07 ±4.97	21.60 ±3.28
2	Male (n=52)	3.51 ±.44	10.49 ±.45*	34.11 ±6.23	96.91 ±13.92	30.32 ±3.88*	31.86 ±6.26*	22.92 ±2.69*
	Female (n=106)	4.16 ±.59*	9.30 ±1.16	45.16 ±6.61*	108.55 ±7.89*	23.30 ±6.05	22.13 ±5.06	21.60 ±3.38
2.5	Male (n=52)	3.50 ±.44	10.48 ±.46*	33.84 ±6.28	96.30 ±14.04	30.37 ±3.88*	32.16 ±6.34*	22.88 ±2.72*
	Female (n=106)	4.17 ±.58*	9.21 ±1.17	45.30 ±6.47*	108.88 ±8.09*	23.11 ±6.00	21.59 ±4.95	21.40 ±3.09
3	Male (n=52)	3.50 ±.43	10.49 ±.45*	34.00 ±6.2	96.67 ±13.86	30.33 ±3.84*	32.00 ±6.25*	22.90 ±2.67*
	Female (n=105)	4.17 ±.61*	9.29 ±1.13	45.46 ±6.45*	108.44 ±8.09*	23.03 ±5.68	21.67 ±5.06	21.50 ±3.39

* Values in the same column significantly higher ($P < 0.05$)

To answer the research questions, t-test analysis was conducted to confirm whether there is any significant difference between sex groups of adult goats on the hematological value (Appendix H). However, female groups showed significantly higher ($p < 0.05$) than male groups in the RBC count, PCV, and MCV. Whereas, male groups showed significantly higher ($p < 0.05$) than female groups in the Hb, MCH, MCHC and RDW.

4.4.2.1.2 White blood cells

Table 4.17 demonstrate the descriptive statistics of 84 adult goats that have been included in this study. In addition, the mean value for white blood cells showed various results between sex groups. However, female groups were showed a higher WBC, polymorphs and monocytes at all age than male group. However, male groups reported higher of lymphocytes and eosinophils at all age than female group.

Table 4.17 White blood cells count of sex groups at different ages of adults

Ages (year)	**Sex**	**WBC (cmm)**	**polymorphs (%)**	**lymphocytes (%)**	**monocytes (%)**	**eosinophils (%)**
1.5	Male	13900.00	44.00	49.33	1.00	2.33
	(n=52)	±3218.41	±17.66	±15.63*	±.89	±2.24*
	Female	16100.00	61.06	35.67	2.50	.65
	(n=105)	±2966.64*	±11.19*	±11.97	±2.08*	±.57
2	Male	13829.55	44.18	49.00	.98	2.39
	(n=52)	±3220.33	±17.82	±15.65*	±.88	±2.24*
	Female	16285.00	60.93	35.60	2.50	.65
	(n=106)	±3050.31*	±10.66*	±11.75	±2.02*	±.56
2.5	Male	13965.12	43.81	49.63	1.02	2.28
	(n=52)	±3243.96	±17.51	±15.64*	±.89	±2.26*
	Female	16151.22	61.82	35.84	2.50	.68
	(n=106)	±3017.96*	±11.34*	±12.46	±1.96*	±.59
3	Male	13900.00	44.00	49.33	1.00	2.33
	(n=52)	±3218.41	±17.66	±15.63*	±.89	±2.24*
	Female	16143.59	61.29	36.23	2.51	.68
	(n=105)	±2986.79*	±11.13*	±12.51	±2.06*	±.58

* Values in the same column significantly higher ($P < 0.05$)

T-test analysis was conducted to confirm whether there is any significant difference between sex groups of adult goats on the WBC (Appendix I). However, female groups reported significantly higher ($p < 0.05$) than male groups for WBC count, Polymorphs and Monocytes. Whereas, male groups reported significantly higher ($p < 0.05$) than female groups for lymphocytes and Eosinophils.

4.4.2.1.3 Platelets

Table 4.18 demonstrate the descriptive statistics of 84 adult goats that have been included in this study. In addition, the mean value for platelets showed various results between sex groups. However, male groups showed higher platelet than female group.

Table 4.18 Platelet count (/cmm) of different sex groups of adult goats

Age (year)	Sex	Mean (/cmm) ±SD
1.5	Male (n=52)	760000.00±81030.29*
	Female (n=105)	632928.57±142184.25
2	Male (n=52)	757954.55±80783.36*
	Female (n=106)	630800.00±143061.08
2.5	Male (n=52)	761162.79±80886.73*
	Female (n=106)	636487.80±143181.55
3	Male (n=52)	760000.00±81030.29*
	Female (n=105)	637769.23±144028.23

* Values in the same column within sex group significantly higher ($P < 0.05$)

T-test analysis was conducted to confirm whether there is any significant difference between sex groups of adult goats on the platelet (Appendix I). However, results showed the male groups were significantly higher ($p < 0.05$) than female groups in the platelet.

4.4.2.2 Type of kids

4.4.2.2.1 Red Blood Cells

Tables 4.19 demonstrate the descriptive statistics of 121 kid goats that have been included in this study. In addition, the mean value for red blood cells showed various results between sex groups. However, there is no much differences between groups in all parameters.

Table 4.19 Red blood cells count of sex groups at different ages of kids

Ages	Sex	RBC (M/cmm)	Hb (g/dl)	PCV (%)	MCV (fl)	MCH (pg)	MCHC (%)	RDW (%)
1 day	Male	4.42	9.65	45.84	93.28	23.49	25.78	23.72
	(n=103)	±1.21	±1.14	±16.28	±13.45	±6.21	±8.29	±3.16
	Female	4.12	9.33	44.00	90.55	22.30	26.27	24.01
	(n=127)	±1.08	±1.18	±18.84	±19.67	±6.91	±9.17	±3.28
1 month	Male	4.72	9.14	42.89	88.81	22.30	27.37	23.67
	(n=92)	±1.18	±1.50	±16.61	±24.26	±7.53	±7.35	±3.29
	Female	4.19	8.47	41.30	93.20	22.90	31.45	23.03
	(n=105)	±1.12	±.71	±12.82	±7.54	±4.73	±9.88	±2.72
3 months	Male	4.59	9.55	45.12	89.88	22.44	26.33	24.30
	(n=98)	±1.12	±1.23	±16.04	±18.40	±6.11	±7.69	±4.34
	Female	4.92	9.23	41.83	94.17	21.83	27.25	22.46
	(n=108)	±.77	±1.72	±18.38	±5.08	±5.18	±6.54	±3.59
5 months	Male	4.59	9.57	45.17	90.86	26.08	27.23	23.21
	(n=68)	±1.31	±1.39	±15.43	±15.59	±8.66	±7.05	±3.69
	Female	4.92	9.74	45.00	93.62	27.77	27.67	22.59
	(n=79)	±1.36	±1.15	±13.29	±11.37	±6.78	±7.80	±2.85

T-test analysis was conducted to confirm whether there is significant difference between sex groups of kid goats on the RBC (Appendix J). However, results showed no significant differences ($p > 0.05$) between sex groups of kid goats regarding RBC.

4.4.2.2.2 White Blood Cells types

Tables 4.20 demonstrate the descriptive statistics of WBC of 121 kid goats that have been included in this study. In addition, the mean value for white blood cells showed various results between sex groups. However, there is no much differences between groups in all parameters.

Table 4.20 White blood cells types of sex groups at different ages of kids

Ages	**Sex**	**WBC (cmm)**	**polymorphs (%)**	**lymphocytes (%)**	**monocytes (%)**	**eosinophils (%)**
1 day	Male (n=103)	13596.00 ±3781.92	46.48 ±8.96	49.22 ±11.92	1.82 ±1.44	1.22 ±1.06
	Female (n=127)	12618.18 ±3374.85	44.05 ±8.86	48.50 ±12.40	1.84 ±1.67	1.32 ±1.06
1 month	Male (n=92)	13070.37 ±3100.85*	50.67 ±12.58	47.43 ±12.76	2.78 ±1.52	1.37 ±.98
	Female (n=105)	10630.00 ±1816.62	46.70 ±9.33	46.50 ±6.88	2.53 ±.85	1.30 ±1.25
3 months	Male (n=98)	13157.69 ±3548.88	50.15 ±10.51	49.37 ±12.13	2.56 ±1.64	1.49 ±1.06
	Female (n=108)	13283.33 ±3503.38	50.25 ±10.70	46.67 ±9.02	2.54 ±.94	1.42 ±1.39
5 months	Male (n=68)	14514.29 ±4230.41	52.22 ±12.30	53.02 ±14.10	2.43 ±1.40	1.16 ±1.00
	Female (n=79)	14969.23 ±4431.05	49.41 ±10.90	54.42 ±12.36	2.13 ±1.59	.95 ±.96

T-test analysis was conducted to confirm whether there is any significant difference between sex groups of kid goats on the WBC types (Appendix K). However, male group was significantly higher ($p < 0.05$) than female groups at age 1 month old of kid goats regarding WBC. However, there's no significant differences ($p > 0.05$) between groups at other age.

4.4.2.2.3 Platelets

Table 4.21 demonstrate the descriptive statistics of platelet of 121 kid goats that have been included in this study. In addition, the mean value for platelet showed various

results between sex groups. However, there is no much differences between groups in all parameters.

Table 4.21 Platelet count (/cmm) of different sex groups of kid goats

Age	Sex	Mean (/cmm) ±SD
1 day	Male (n=103)	835440.00±307025.25
	Female (n=127)	812818.18±301899.26
1 month	Male (n=92)	691229.63±291828.73
	Female (n=105)	686000.00±194834.97
3 months	Male (n=98)	692100.00±345440.79
	Female (n=108)	477566.67±362443.25
5 months	Male (n=68)	839161.90±409756.16
	Female (n=79)	955230.77±319957.04

T-test analysis was conducted to confirm whether there is significant difference between sex groups of kid goats on the platelet (Appendix K). However, results showed no significant differences ($p > 0.05$) between sex groups of kid goats regarding platelets.

In conclusion of this part, the results of physiological parameters; such as body weight and blood value, were various. The body weight of Boer and BJ (Boer X Jamnapari) goats were higher ($p < 0.05$) than other breeds. However, the results of hematological value of Katjang goat and its hybrids (BK and JK) were higher than other goats, such as Hb and WBC.

Part C

This part discusses the statistical data of the effect of breeds, ages and sex groups on protein profiling and gene polymorphism.

4.5 Effect of breeds and ages on protein profiling and gene polymorphism

A total of 3 breed types of adult goats and 6 different breed types of kid goats were included in this study.

4.5.1 Protein profiling of breeds

A total of 276 blood serum of different breeds, ages and sex were used.

4.5.1.1 Type of adults

4.5.1.1.1 Protein profile value

Table 4.22 demonstrates the descriptive statistics of 108 samples from different breeds of adult goats that have been used in this study. Molecular weight (MW) and band were recorded. The results showed various values among breeds. In addition, the mean value for MW was the highest in Jamnapari goats (111.80 Kilodaltons) (Figures 4.7, and 4.8).

Table 4.22 Protein profiling value of different breeds of adult goats

Parameter	Breed	Mean ±SD
MW (Kilodaltons)	Katjang (n=36)	95.73±92.99
	Boer (n=36)	106.69±106.55
	Jamnapari (n=36)	111.80±104.42
Band %	Katjang (n=36)	9.52±5.96
	Boer (n=36)	10.81±9.91
	Jamnapari (n=36)	13.79±13.85

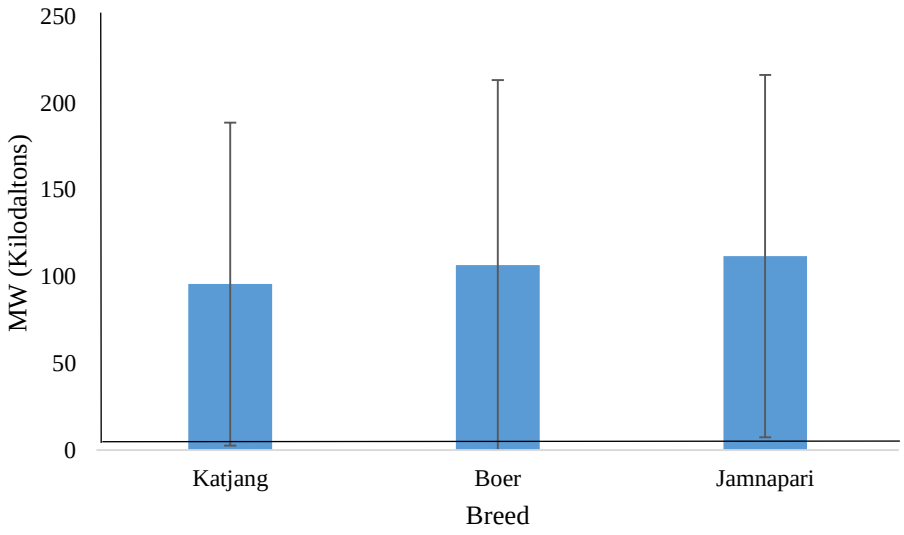


Figure 4.7 Molecular weight of protein profile of different breeds of adults

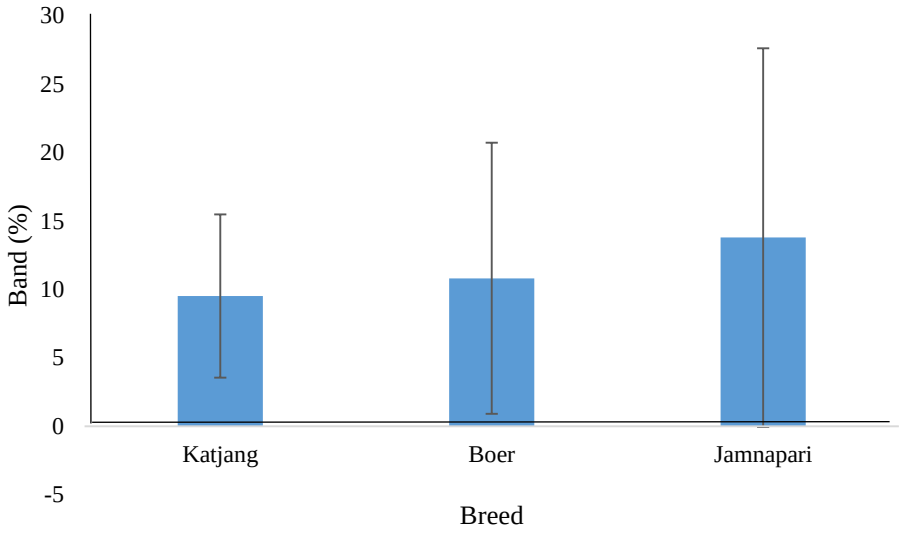


Figure 4.8 Band of protein profile of different breeds of adults

To answer the research questions, one-way ANOVA was conducted to confirm whether there is any significant difference among breeds of adult goats on the protein profiling. However, there was no significant difference ($p > 0.05$) among breeds of adult goats. (Appendix L).

4.5.1.1.2 αs1 - Casein gene

Table 4.23 demonstrates the descriptive statistics of 108 samples from different breeds of adult goats that have been used in this study. Molecular weight (MW) regarding α_{s1} - Casein were analyzed. The results showed various values of MW among breeds. In addition, the mean value for α_{s1} - Casein was the highest in Jamnapari goats (23.67 Kilodaltons).

Table 4.23 Descriptive of α_{s1} - Casein value of different breeds of adult goats

Breed	Mean ±SD
Katjang (n=36)	23.55±.22
Boer (n=36)	23.48±.38
Jamnapari (n=36)	23.67±.25

Thus, one-way ANOVA was conducted to confirm whether there is any significant difference among breeds of adult goats on the α_{s1} - Casein. However, there was no significant difference ($p > 0.05$) of α_{s1} - Casein among breeds of adult goats. (Appendix L).

4.5.1.2 Type of kids

4.5.1.2.1 Protein profile value

Table 4.24 shows the descriptive statistics of 168 samples from different breeds of kid goats that have been used in this study. Molecular weight (MW) and band, were recorded. The results showed various values among breeds. In addition, the mean value for MW was almost the same in all breed types (Figures 4.9, and 4.10).

Table 4.24 Protein profiling value of kid goats

Parameter	Breed	Mean ±SD
MW (Kilodaltons)	Katjang (n=28)	88.22±97.83
	Boer (n=28)	82.54±93.41
	Jamnapari (n=28)	70.44±86.93
	BK (n=28)	90.41±93.54
	JK (n=28)	82.44±94.16
	BJ (n=28)	72.37±100.25
Band %	Katjang (n=28)	10.25±15.45
	Boer (n=28)	8.33±6.85
	Jamnapari (n=28)	10.34±7.75
	BK (n=28)	11.76±10.96
	JK (n=28)	11.11±13.18
	BJ (n=28)	11.68±15.66

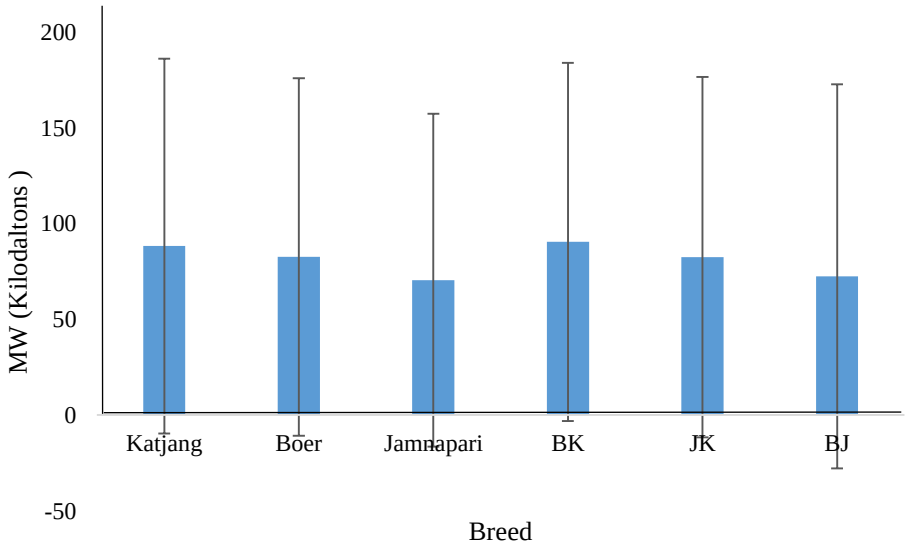


Figure 4.9 Molecular weight of protein profile of different breeds of kids

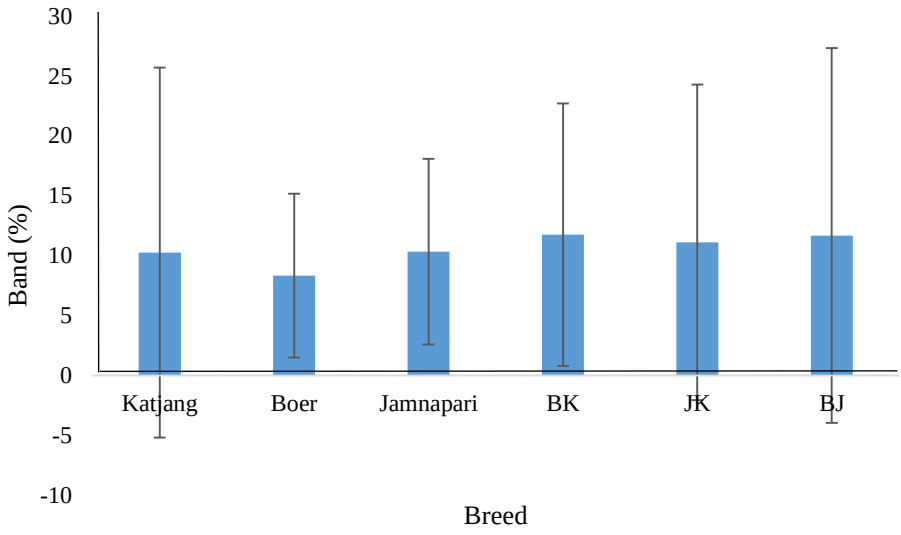


Figure 4.10 Band of protein profile of different breeds of kids

One-way ANOVA was conducted to confirm whether there is any significant difference on the protein profiling among breeds of kid goats. Results showed no significant difference ($p > 0.05$) among breeds of kid goats. (Appendix L).

4.5.1.2.2 αs1 - Casein gene

Table 4.25 demonstrates the descriptive statistics of 168 samples from different breeds of kid goats that have been used in this study. Molecular weight (MW) regarding α_{s1} - Casein were analyzed. The results showed various values of α_{s1} - Casein among breeds.

Table 4.25 α_{s1} - Casein value of different breeds of kid goats

Breed	Mean ±SD
Katjang (n=28)	23.21±.29
Boer (n=28)	23.15±.24
Jamnapari (n=28)	23.31±.26
BK (n=28)	23.27±.24
JK (n=28)	23.32±.24
BJ (n=28)	23.26±.24

Thus, one-way ANOVA was conducted to confirm whether there is any significant difference on the α_{s1} - Casein among breeds of kid goats. However, there was no significant difference ($p > 0.05$) on the α_{s1} - Casein among breeds of kid goats. (Appendix L).

4.5.2 Gene polymorphism of breeds

A total of 133 samples of different breeds, ages and sex were used.

4.5.2.1 Type of adults

4.5.2.1.1 Alleles detecting

Table 4.26 demonstrates the descriptive statistics of 36 samples from different breeds of adult goats that have been used in this study. Six alleles of α_{s1} - Casein were included; such as A, B, C, D, E and F. Alleles A, B, C and F were detected. In addition, results showed various results among breeds regarding allele type. However, alleles A, B and C were detected in all breeds. While, allele F were detected only in Jamnapari goats. Moreover, alleles D and E did not detect in all breeds (Figure 4.11).

Table 4.26 Gene polymorphism detecting of different breeds of adult goats

Breed	**Alleles**					
	A	**B**	**C**	**D**	**E**	**F**
Katjang (n=12)	√	√	√	X	X	X
Boer (n=12)	√	√	√	X	X	X
Jamnapari (n=12)	√	√	√	X	X	√

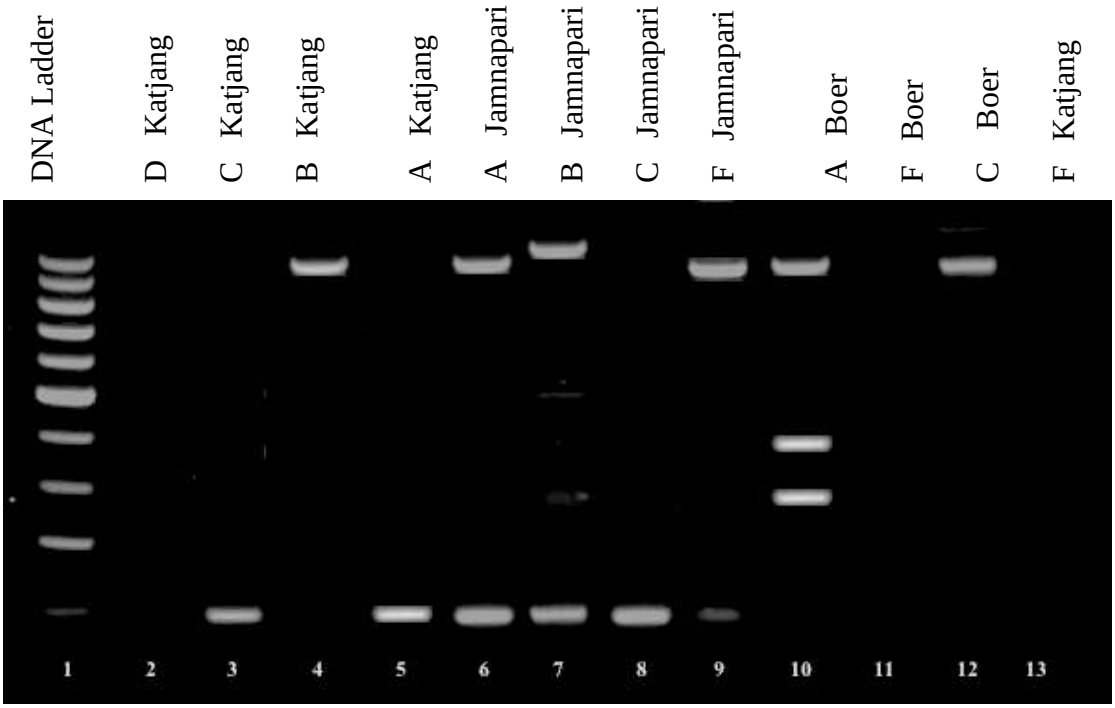


Figure 4.11 Allele detection in different breeds of adult goats

4.5.2.1.2 Molecular weight value in adult goat breeds

Table 4.27 shows the descriptive statistics of molecular weight values of α_{s1} - Casein alleles from different breeds of adult goats that have been analyzed. In general, the total mean value of MW of allele C was higher compared to alleles A and B. Moreover, allele F was detected only in Jamnapari goats (Figure 4.12).

Table 4.27 Molecular weight value (Kilodaltons) of adult goat breeds

Allele	Breed	Mean ±SD
Allele A	Katjang (n=12)	41.47±78.52
	Boer (n=12)	107.55±117.80
	Jamnapari (n=12)	39.36±74.79
Allele B	Katjang (n=12)	73.32±109.20
	Boer (n=12)	74.14±101.16
	Jamnapari (n=12)	27.19±28.65
Allele C	Katjang (n=12)	133.04±120.88
	Boer (n=12)	60.83±99.84
	Jamnapari (n=12)	102.74±100.37
Allele F	Katjang (n=12)	0.00±0.00
	Boer (n=12)	0.00±0.00
	Jamnapari (n=12)	104.18±98.74

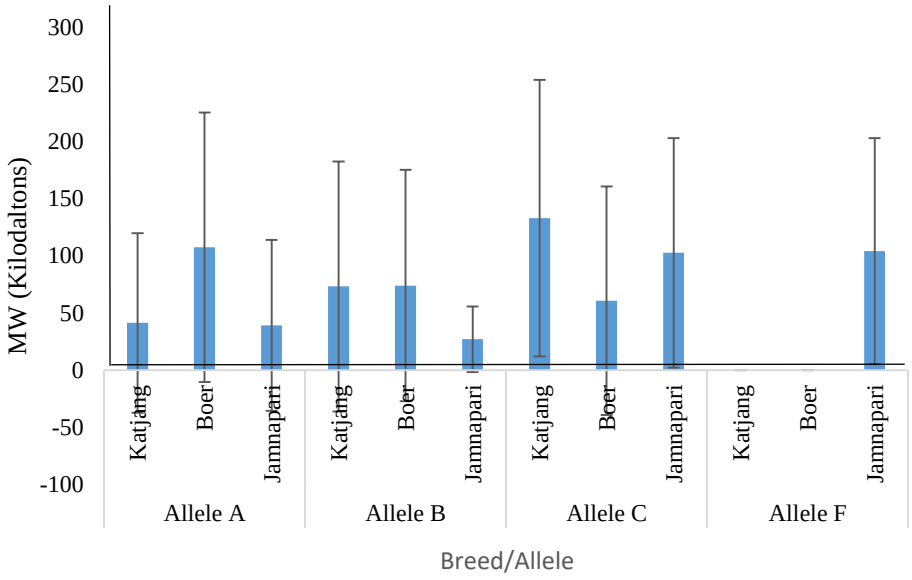


Figure 4.12 Molecular weight of α_{s1} - Casein alleles of adults

One-way ANOVA was conducted to confirm whether there is any significant difference among breeds of adult goats on the gene polymorphism value. Results were showed there was no significant difference ($p > 0.05$) on alleles types among breeds of adult goats. (Appendix M).

4.5.2.1.3 Frequency of αs1 - Casein alleles in adults

Table 4.28 shows the descriptive statistics of frequency values from different breeds of adult goats that have been analyzed in this study. However, frequency of allele C of Boer goats was higher (67.52%) than other breeds. Moreover, frequency of allele F of Jamnapari goats was higher (18.83%) than other breeds (Figure 4.13).

Table 4.28 Frequency value (%) of adult goat breeds

Allele	Breed	Frequency ±SD
Allele A	Katjang (n=12)	66.85±43.93
	Boer (n=12)	47.29±43.79
	Jamnapari (n=12)	68.60±34.16
Allele B	Katjang (n=12)	49.99±41.40
	Boer (n=12)	43.86±42.03
	Jamnapari (n=12)	66.50±26.02
Allele C	Katjang (n=12)	24.99±29.56
	Boer (n=12)	67.52±39.87*
	Jamnapari (n=12)	37.71±25.01
Allele F	Katjang (n=12)	0.00±0.00
	Boer (n=12)	0.00±0.00
	Jamnapari (n=12)	18.83±31.26

* Values in the same column within allele significantly higher (P < 0.05)

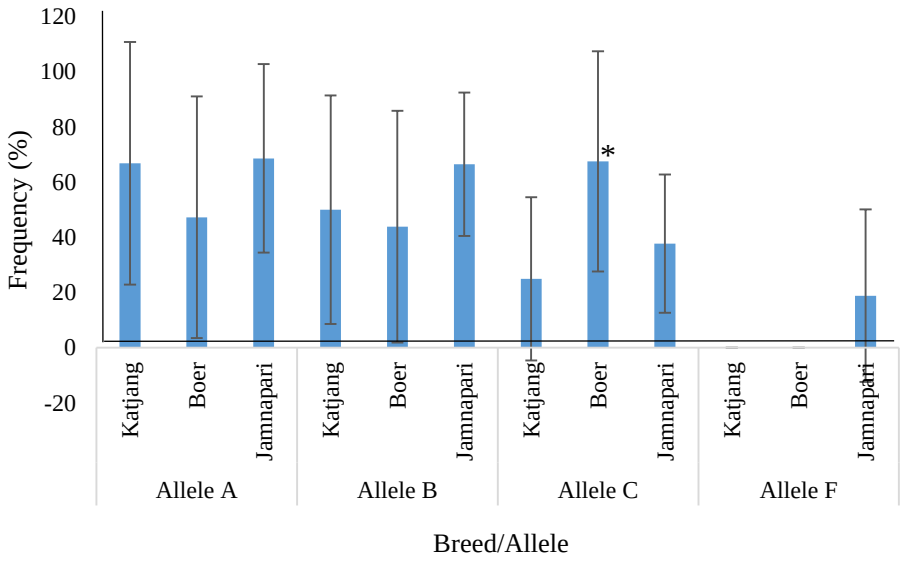


Figure 4.13 Frequency of α_{s1} - Casein alleles of adults

One-way ANOVA was conducted to confirm whether there is any significant difference among breeds of adult goats on the frequency percent of gene polymorphism. Results showed there was significant difference ($p < 0.05$) on allele C among breeds of adult goats. (Appendix M).

Moreover, a Tukey HSD post hoc comparison was done. Tukey HSD post hoc comparisons test results show that the significant difference occurs among breeds. Boer goats were significantly higher ($p < 0.05$) than other adult goats in the frequency of allele C.

4.5.2.2 Type of kids

4.5.2.2.1 Alleles detecting

Table 4.29 demonstrates the descriptive statistics of 97 samples from different breeds of kid goats that have been analyzed in this study. Six alleles were included; such as A, B, C, D, E and F. Alleles A, B, C and F were detected. In addition, results showed various results were observed among breeds regarding allele type. However, alleles A, B and C were detected in all breeds. While, allele F was detected only in Jamnapari, JK and BJ goats. Moreover, alleles D and E did not detect in all breeds (Figure 4.14).

Table 4.29 Gene polymorphism detecting of kid goat breeds

Breed	**Alleles**					
	A	**B**	**C**	**D**	**E**	**F**
Katjang (n=16)	√	√	√	X	X	X
Boer (n=16)	√	√	√	X	X	X
Jamnapari (n=16)	√	√	√	X	X	√
BK (n=16)	√	√	√	X	X	X
JK (n=16)	√	√	√	X	X	√
BJ (n=17)	√	√	√	X	X	√

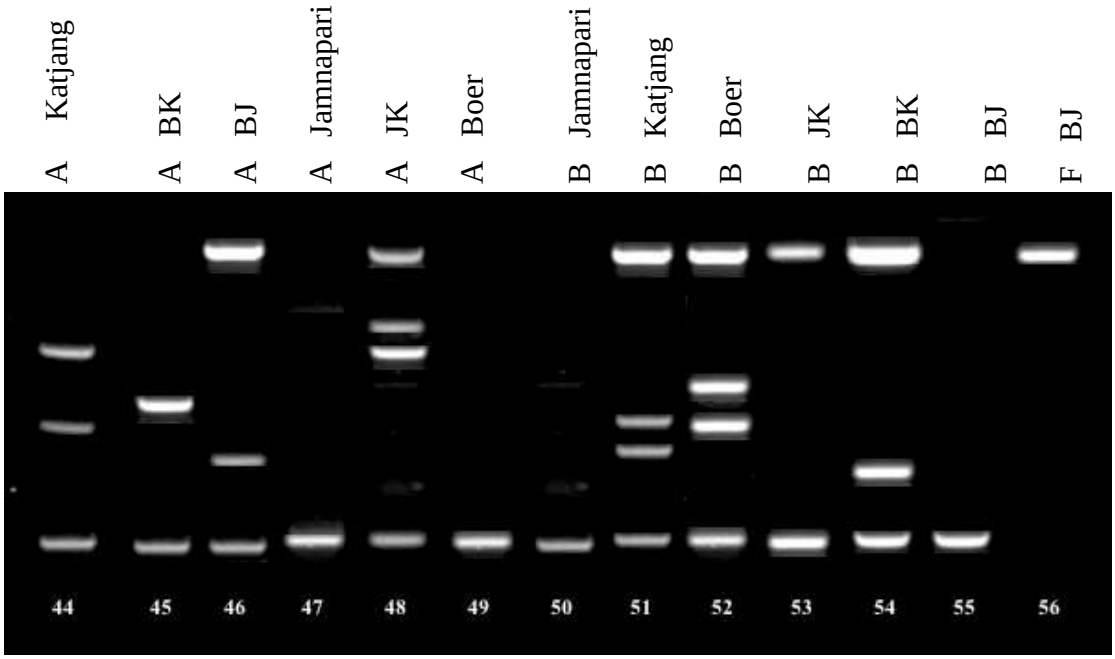


Figure 4.14 Allele detection in different breeds of kid goats

4.5.2.2.2 Molecular weight in kid goat breeds

Table 4.30 shows the descriptive statistics of molecular weight from different breeds of kid goats that have been used in this study. Alleles A and B showed the highest value of MW in JK and BJ kids, whereas, allele F showed the highest value in Jamnapari and BJ kid goats. In general, the total mean value of MW of allele C was higher compared to others. Moreover, allele F was detected only in Jamnapari, JK and BJ kid goats (Figure 4.15).

Table 4.30 Molecular weight (Kilodaltons) of kid goat breeds

Allele	Breed	Mean ±SD
Allele A	Katjang (n=16)	138.62±116.11
	Boer (n=16)	83.44±109.94
	Jamnapari (n=16)	14.35±10.18
	BK (n=16)	164.07±167.12
	JK (n=16)	193.63±152.61*
	BJ (n=17)	192.77±180.26*
Allele B	Katjang (n=16)	168.94±175.79*
	Boer (n=16)	145.05±200.55
	Jamnapari (n=16)	29.15±25.30
	BK (n=16)	73.09±105.62
	JK (n=16)	45.03±80.33
	BJ (n=17)	44.50±72.54
Allele C	Katjang (n=16)	180.43±109.07
	Boer (n=16)	130.77±105.57
	Jamnapari (n=16)	111.04±104.78
	BK (n=16)	138.78±116.47
	JK (n=16)	151.52±107.34
	BJ (n=17)	141.05±113.01
Allele F	Katjang (n=16)	0.00±0.00
	Boer (n=16)	0.00±0.00
	Jamnapari (n=16)	123.97±107.98
	BK (n=16)	0.00±0.00
	JK (n=16)	33.80±9.58
	BJ (n=17)	168.54±109.10*

* Values in the same column within allele significantly higher ($P < 0.05$)

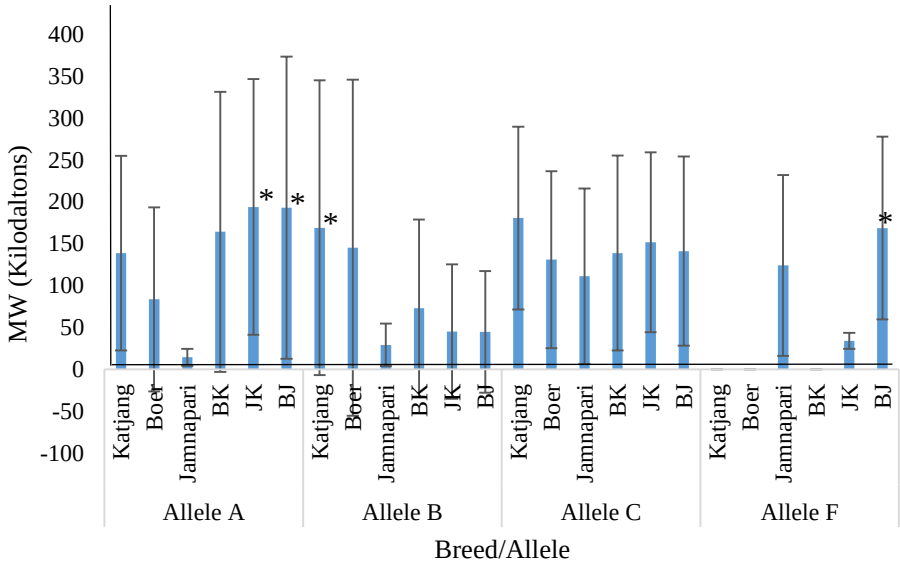


Figure 4.15 Molecular weight of α_{s1} - Casein alleles of kids

One-way ANOVA was conducted to confirm whether there is any significant difference among breeds of kid goats on the MW value. Results were showed there was a significant difference ($p < 0.05$) on the alleles A, B and F among breeds of kid goats. (Appendix M).

Moreover, a Tukey HSD post hoc comparison was done. Tukey HSD post hoc comparisons test results show that the significant difference occurs among breeds. JK and BJ crossbreed goats were significantly higher ($p < 0.05$) on the MW of allele A than other kid goats. Also, Katjang kids were significantly higher ($p < 0.05$) on the MW of allele B than other kid goats. Moreover, BJ crossbreed kids were significantly higher ($p < 0.05$) on the MW of allele F than other kid goats.

4.5.2.2.3 Frequency of αs1 - Casein alleles in kids breed

Table 4.31 shows the descriptive statistics of frequency from different breeds of kid goats that have been recorded in this study. Alleles A and B showed the highest of frequency in Jamnapari kids. Whereas, other alleles showed almost same percentage over other breeds (Figure 4.16).

Table 4.31 Frequency (%) of kid goat breeds

Allele	Breed	Frequency ±SD
Allele A	Katjang (n=16)	41.73±36.47
	Boer (n=16)	57.14±44.85
	Jamnapari (n=16)	83.33±25.20*
	BK (n=16)	57.14±43.10
	JK (n=16)	32.69±39.84
	BJ (n=17)	33.33±39.79
Allele B	Katjang (n=16)	28.56±36.03
	Boer (n=16)	34.75±38.56
	Jamnapari (n=16)	56.20±31.89*
	BK (n=16)	25.18±17.71
	JK (n=16)	24.81±16.44
	BJ (n=17)	20.00±18.83
Allele C	Katjang (n=16)	15.64±27.10
	Boer (n=16)	21.27±25.78
	Jamnapari (n=16)	31.82±27.46
	BK (n=16)	21.83±23.29
	JK (n=16)	14.74±16.09
	BJ (n=17)	19.71±18.88
Allele F	Katjang (n=16)	0.00±0.00
	Boer (n=16)	0.00±0.00
	Jamnapari (n=16)	19.89±30.64
	BK (n=16)	0.00±0.00
	JK (n=16)	17.32±26.19
	BJ (n=17)	16.60±17.47

* Values in the same column significantly higher ($P < 0.05$)

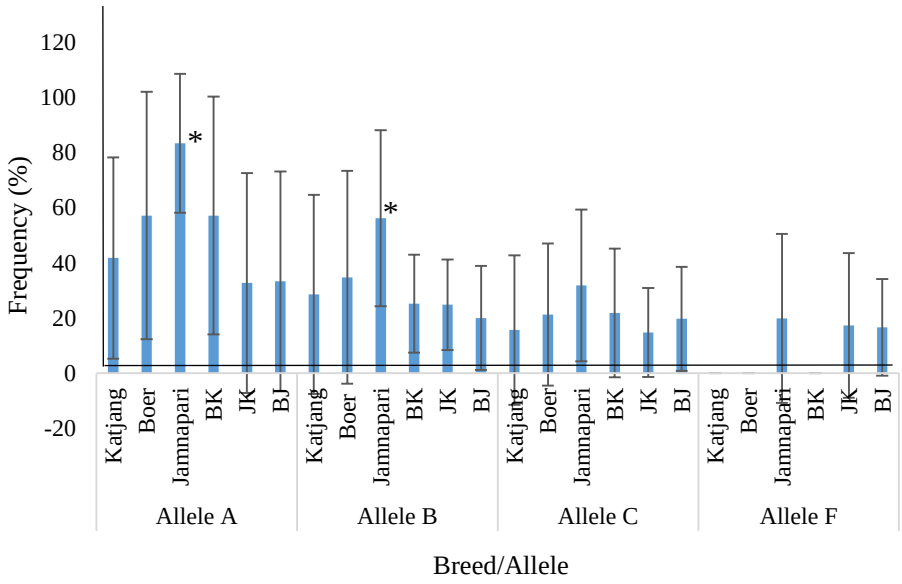


Figure 4.16 Frequency of α_{s1} - Casein alleles of kids

One-way ANOVA was conducted to confirm whether there is any significant difference among breeds of kid goats on the frequency percentage. Results showed there was a significant difference ($p < 0.05$) on the alleles A and B among breeds of kid goats. However, there was no significant difference on alleles C and F among breeds (Appendix M).

Therefore, a Tukey HSD post hoc comparison was done. Tukey HSD post hoc comparisons test results show that the significant difference occurs among breeds. Jamnapari kid goats were significantly higher ($p < 0.05$) than other kid goats on the frequency of alleles A and B.

4.6 Effect of sex on protein profiling and gene polymorphism

A total of 276 blood serum of different breeds, ages and sex were used.

4.6.1 Protein profiling of sex group

A total of 2 sex group types; such as male and female, of 3 breed types of adult goats and 6 different breed types of kid goats were used in this study.

4.6.1.1 Type of adults

4.6.1.1.1 Protein profile

Table 4.32 demonstrates the descriptive statistics of 108 samples from different genders of adult goats that have been used in this study. Molecular weight (MW) and band, were recorded. The results showed various values among genders. In addition, the mean value for MW was higher in females (109.89 Kilodaltons) than males. However, parameters were almost higher in female groups than male groups.

Table 4.32 Protein profiling parameters of different genders of adult goats

Parameter	Sex	Mean ±SD
MW (Kilodaltons)	Male (n=44)	97.24±100.46
	Female (n=64)	109.89±100.41
Band %	Male (n=44)	11.53±9.40
	Female (n=64)	10.71±10.58

To answer the research questions, t-test was conducted to confirm whether there is any significant difference between sex groups of adult goats on the protein profiling parameters. However, there was no significant difference ($p > 0.05$) on the protein profiling parameters between sex groups of adult goats (Appendix N).

4.6.1.1.2 αs1 - Casein gene

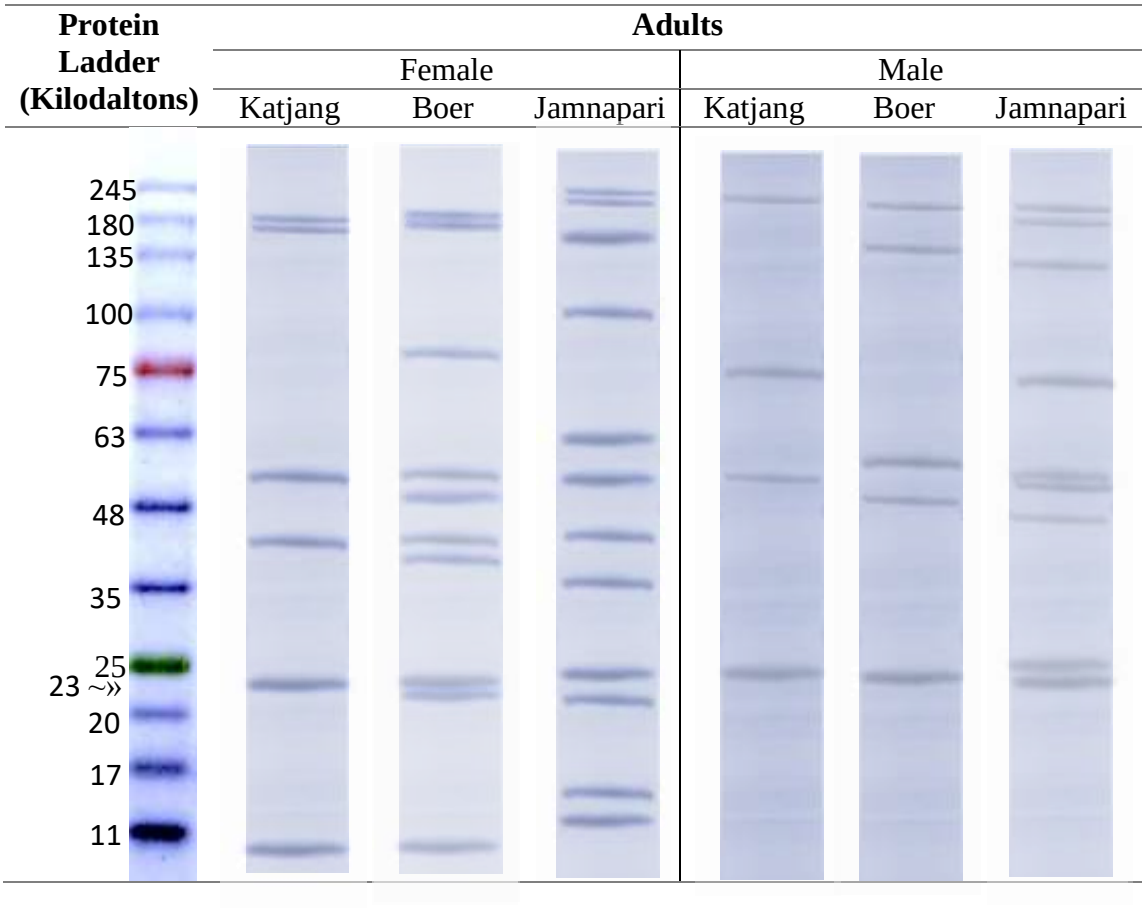
Table 4.33 demonstrates the descriptive statistics of 108 samples from different breeds of adult goats that have been used in this study. Molecular weight (MW) regarding α_{s1} - Casein were analyzed. The results showed various values between genders (Table 4.34).

Table 4.33 Descriptive statistics of α_{s1} - Casein value of adult goat breeds

Sex	Mean ±SD
Male (n=44)	23.52±.28
Female (n=64)	23.64±.31

Thus, t-test was conducted to confirm whether there is any significant difference between sex groups of adult goats on the α_{s1} - Casein. However, there was no significant difference ($p > 0.05$) between sex groups on the α_{s1} - Casein of adult goats (Appendix N).

Table 4.34 Differences of the α_{s1} - Casein of adult goats



4.6.1.2 Type of kids

4.6.1.2.1 Protein profile

Table 4.35 demonstrates the descriptive statistics of 168 samples from different genders of kid goats that have been used in this study. Molecular weight (MW) and Band were recorded. The results showed various values of MW among genders. In addition, the mean value for MW was higher in males (89.57 Kilodaltons) than female.

Table 4.35 Protein profiling parameters of kids' genders

Parameter	Sex	Mean ±SD
MW (Kilodaltons)	Male (n=71)	89.57±99.81
	Female (n=97)	73.09±85.32
Band %	Male (n=71)	10.46±11.88

Female (n=97)	9.76±11.18

T-test was conducted to confirm whether there is any significant difference between sex groups of kid goats on the protein profiling parameters. However, there was no significant difference ($p > 0.05$) on the protein profiling parameters between sex groups of kid goats (Appendix N).

4.6.1.2.2 αs1 - Casein gene

Table 4.36 demonstrates the descriptive statistics of 108 samples from different breeds of kid goats that have been used in this study. Molecular weight regarding α_{s1} - Casein were analyzed. The results showed various values between genders (Tables 4.37 and 4.38).

Table 4.36 α_{s1} - Casein of kid goat breeds

Sex	Mean ±SD
Male (n=71)	23.27±.254
Female (n=97)	23.24±.237

Thus, t-test was conducted to confirm whether there is any significant difference on the α_{s1} - Casein between sex groups of kid goats. However, there was no significant difference ($p > 0.05$) on the α_{s1} - Casein between sex groups of kid goats (Appendix N).

Table 4.37 Differences of the α_{s1} - Casein of pure kid goats

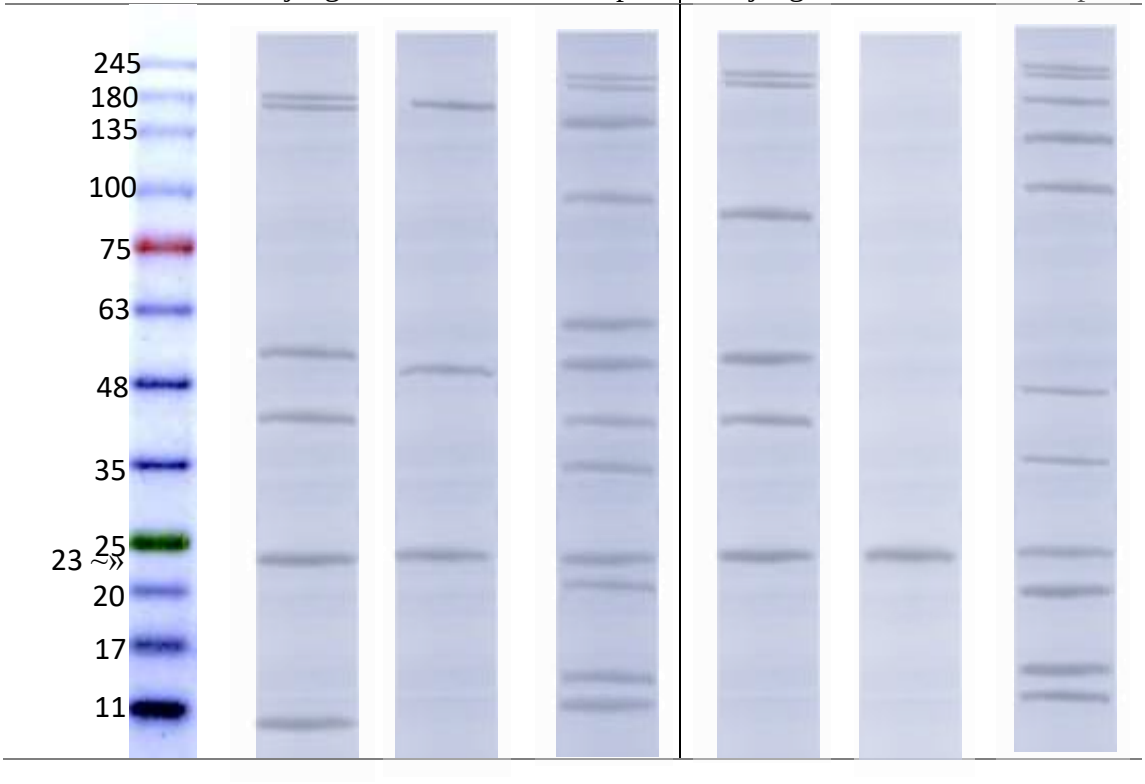
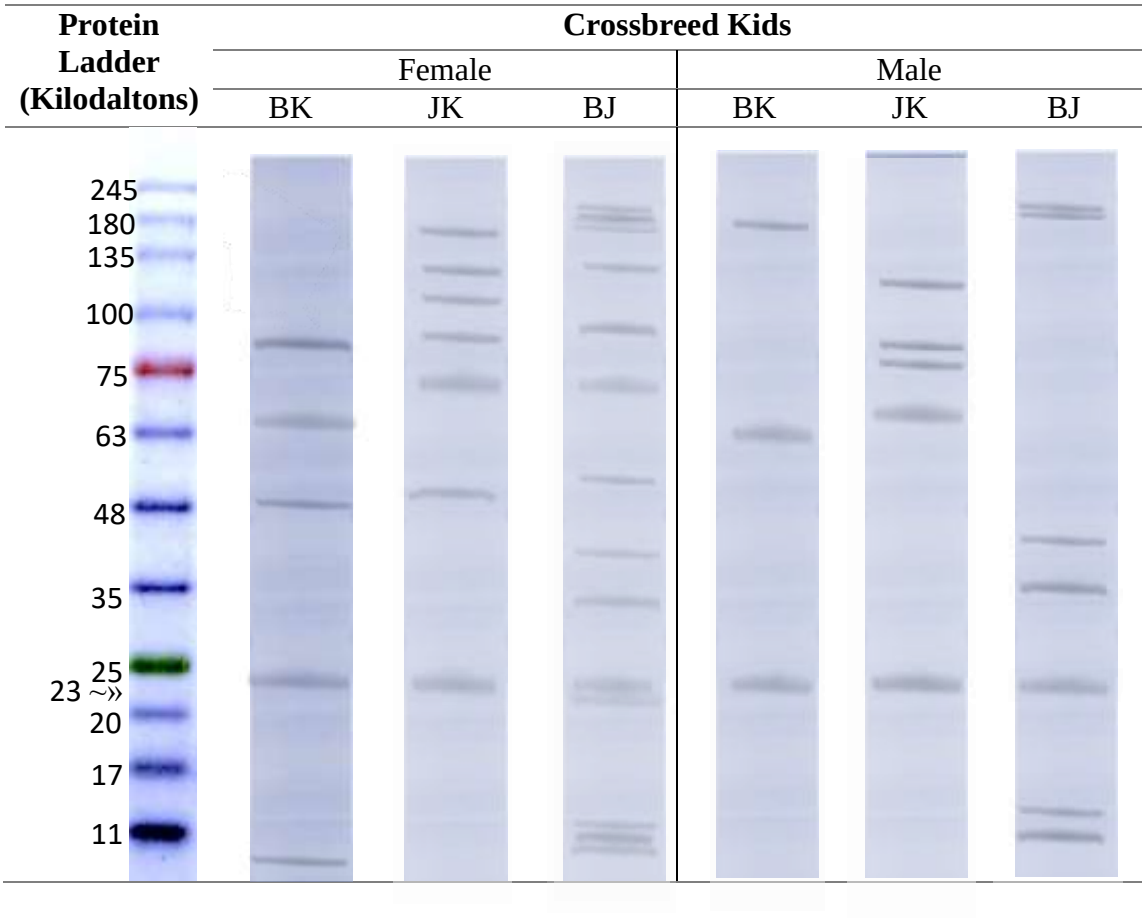
Protein Ladder (Kilodaltons)	**Pure Kids**					
	Female			Male		
	Katjang	Boer	Jamnapari	Katjang	Boer	Jamnapari
						

Table 4.38 Differences of the α_{s1} - Casein of hybrid kid goats



4.6.2 Gene polymorphism of sex group

4.6.2.1 Type of adults

4.6.2.1.1 Alleles detecting

Table 4.39 demonstrates the descriptive statistics of 36 samples from different breeds of adult goats that have been used in this study. Six alleles of α_{s1} - Casein were included; such as A, B, C, D, E and F. Alleles A, B, C and F were detected while alleles D and E did not detect in all sex groups. In addition, results were varying between sex groups regarding allele type. However, alleles A, B and C were detected in all genders. Moreover, allele F was detected in both genders of Jamnapari goats.

Table 4.39 Gene polymorphism detecting of different sex groups of adult goats

Breed	Sex	Alleles					
		A	B	C	D	E	F
Katjang	Male (n=5)	√	√	√	X	X	X
	Female (n=7)	√	√	√	X	X	X
Boer	Male (n=5)	√	√	√	X	X	X
	Female (n=7)	√	√	√	X	X	X
Jamnapari	Male (n=5)	√	√	√	X	X	√
	Female (n=7)	√	√	√	X	X	√

4.6.2.1.2 Molecular weight in adult goats

Table 4.40 shows the descriptive statistics of molecular weight of α_{s1} – Casein Alleles from different breeds of adult goats that have been used in this study. Male groups showed the highest of MW of alleles A, B and F, while the female groups showed the highest of allele C.

Table 4.40 Molecular weight (Kilodaltons) of adult goat genders

Allele	Sex	Mean ±SD
Allele A	Male (n=15)	73.74±108.25
	Female (n=21)	58.76±85.83
Allele B	Male (n=15)	72.36±99.06
	Female (n=21)	48.88±79.52
Allele C	Male (n=15)	92.94±107.82
	Female (n=21)	118.14±115.93
Allele F	Male (n=15)	128.68±107.77*
	Female (n=21)	42.93±20.04

* Values in the same column within allele significantly higher ($P < 0.05$)

T-test analysis was conducted to confirm whether there is any significant difference among sex groups of adult goats on the MW. Results showed no significant difference ($p > 0.05$) on the α_{s1} - Casein alleles A, B, C among sex groups of adult goats (Appendix O). However, male was significantly higher ($p < 0.05$) than female on the α_{s1} - Casein allele F of adult goats.

4.6.2.1.3 Frequency of αs1 - Casein alleles in adult goats

Table 4.41 shows the descriptive statistics of α_{s1} - Casein frequency from different sex groups of adult goats that have been used in this study. The minimum and maximum values of frequency showed various recorded among groups for alleles A, B, C and F.

Table 4.41 Frequency (%) of different sex groups of adult goats

Allele	Sex	Frequency ±SD
Allele A	Male (n=15)	68.46±44.00
	Female (n=21)	46.28±33.60
Allele B	Male (n=15)	69.19±41.15*
	Female (n=21)	37.49±28.14
Allele C	Male (n=15)	39.02±35.28
	Female (n=21)	41.74±36.40
Allele F	Male (n=15)	6.37±4.46
	Female (n=21)	49.99±48.60*

* Values in the same column significantly higher ($P < 0.05$)

T-test analysis was conducted to confirm whether there is any significant difference between sex groups of adult goats on the α_{s1} - Casein frequency. Results showed there was a significant difference ($p < 0.05$) on the frequency of alleles B and F between sex groups of adult goats (Appendix O). However, frequency of allele B for male groups were higher (69.19%) than female groups, whereas, frequency of allele F for female groups were higher (49.99%) than male groups.

4.6.2.2 Type of kids

4.6.2.2.1 Alleles detecting

Table 4.42 explain the descriptive statistics of 97 samples from different sex groups of kid goats that have been used in this study. Six alleles of α_{s1} - Casein were included;

such as A, B, C, D, E and F. Alleles A, B, C and F were detected while alleles D and E did not detect in all sex groups. In addition, the table show various results between sex groups regarding allele type. However, alleles A, B and C were detected in all genders. Moreover, allele F was detected in both genders of Jamnapari and BJ kid goats, while it was detected in the female group of JK crossbreed goats.

Table 4.42 Gene polymorphism detecting of different sex groups of kid goats

Breed	**Sex**	**Alleles**					
		A	**B**	**C**	**D**	**E**	**F**
Katjang	Male (n=8)	√	√	√	X	X	X
	Female (n=8)	√	√	√	X	X	X
Boer	Male (n=8)	√	√	√	X	X	X
	Female (n=8)	√	√	√	X	X	X
Jamnapari	Male (n=8)	√	√	√	X	X	√
	Female (n=8)	√	√	√	X	X	√
BK	Male (n=8)	√	√	√	X	X	X
	Female (n=8)	√	√	√	X	X	X
JK	Male (n=8)	√	√	√	X	X	X
	Female (n=8)	√	√	√	X	X	√
BJ	Male (n=8)	√	√	√	X	X	√
	Female (n=9)	√	√	√	X	X	√

4.6.2.2.2 Molecular weight in kid goats

Table 4.43 shows the descriptive statistics of molecular weight of α_{s1} - Casein from different age groups of kid goats that have been used in this study. Male group was higher of MW of alleles B and F than female group.

Table 4.43 Molecular weight (Kilodaltons) of different sex groups of kid goats

Allele	**Sex**	**Mean ±SD**
Allele A	Male (n=48)	115.85±140.00
	Female (n=49)	148.70±148.88
Allele B	Male (n=48)	108.67±165.13*
	Female (n=49)	55.67±75.21
Allele C	Male (n=48)	151.34±105.62
	Female (n=49)	135.63±111.88
Allele F	Male (n=48)	177.35±105.92*

	Female (n=49)	91.10±96.27

* Values in the same column within allele significantly higher (P < 0.05)

T-test analysis was conducted to confirm whether there is any significant difference between sex groups of kid goats on the MW. Results showed there was a significant difference (p <0.05) on the alleles A, B, C and F between sex groups of kid goats (Appendix O). However, males were significantly higher (p<0.05) on the alleles B and F than females.

4.6.2.2.3 Frequency of αs1 - Casein alleles in kid goats

Table 4.44 shows the descriptive statistics of α_{s1} - Casein frequency from different sex groups of kid goats that have been used in this study. The frequency showed various recorded between sex groups for alleles A, B, C and F.

Table 4.44 Frequency (%) of different sex groups of kid goats

Allele	Sex	Frequency ±SD
Allele A	Male (n=48)	61.36±43.26*
	Female (n=49)	39.78±36.99
Allele B	Male (n=48)	33.64±34.72
	Female (n=49)	27.17±21.48
Allele C	Male (n=48)	15.26±20.18
	Female (n=49)	26.13±26.05*
Allele F	Male (n=48)	8.14±6.55
	Female (n=49)	25.87±30.91*

* Values in the same column within allele significantly higher (P < 0.05)

T-test analysis was conducted to confirm whether there is any significant difference between sex groups of kid goats on the α_{s1} - Casein frequency. Results showed a significant difference (p <0.05) on the α_{s1} - Casein frequency of alleles A, B, C and F between sex groups of kid goats (Appendix O). However, frequency percentage of allele A for male group was higher (61.360375) than females, whereas,

frequency of allele C and F for female group was higher (26.13 and 25.87%, respectively) than male group. Moreover, there is no significant difference ($p > 0.05$) on the α_{s1} - Casein frequency of alleles B between sex groups.

In conclusion of part C, finding of protein profile study showed there is no significant difference ($p > 0.05$) among breeds with respect to the αs1 - Casein values. However, finding of DNA polymorphism showed alleles A, B and C of αs1 - Casein were detected in all breeds and sexes. While, allele F were detected in Jamnapari and its hybrid goats (JK and BJ) only.

4.7 Conclusion

Findings of recent study showed the reproductive efficiency in breeds had been improved, such as estrus synchronization and twin rate, in related to breeds. The results of physiological parameters showed the improvement of crossbreed kids; such as BJ (Boer X Jamnapari) and JK (Jamnapari X Katjang), in related to body weight and hematological value, respectively.

Also, finding of gene polymorphism showed the αs_1 – Casein gene were improved in crossbreed kids, especially allele F which was detected in kid goats of JK and BJ.

However, next chapter will discuss the results of recent study from all its sides with the comparison of other goat breeds, ages, and sexes, of different worldwide areas.

CHAPTER 5

DISCUSSION

5.1 Introduction

This study has focused on factors which may influence goat's production. The data included were reproductive efficiency, physiological parameters, protein profiling and gene polymorphism in local and crossbreed goats in Malaysia. However, the results showed various information about these factors.

5.2 Comparison of reproductive efficiency

Reproductive and survival rates are without a doubt the most essential attributes in all small ruminant creation frameworks, whatever the environment considered (Matika et al., 2003). Given the significance of conceptive rates and maternal capacity for the achievement of meat generation in small ruminants, the components that meddle with them ought to be recognized, so as to enhance life-time regenerative effectiveness and in this manner diminish meat creation costs (Wang & Dickerson, 1991). For instance, recently show that expanding the quantity of posterity per female has a considerably bigger effect than changing food productivity that paying little respect to the production system (McManus et al., 2011).

Efficient control of fertility and health is currently acknowledged as a main target to increase profitability of dairy operations, due to the economic impact of poor fertility or poor health performance (Inchaisri et al., 2010). Another target to increase profitability is obtaining better milk prices by increasing quality, especially milk solid contents. For dairy operations relying on the Holstein herd, these 2 targets often appear particularly relevant (Dezetter et al., 2017).

A number of kids born per doe kidding is an important characteristic, referring to the number of ova liberated and eventually expressed as the number of ovulation (Greyling, 2000). This was confirmed in the present study, where the higher number of kids born per doe (twin) was referred to superovulation occurred associated with the increase in the number of generated embryos after using Controlled Internal Drug Release device (CIDR) for estrus synchronization.

In the present study, a higher twin rate was observed in treated females Boer breed. Similar results were reported by Thatcher et al. (2001) and Safdarian, Kafi & Hashemi (2006) whom also used CIDR. It has been observed that under controlled conditions, Boer goat does successfully produce twins (Naude & Hofmeyr, 1981), but not to other breeds.

5.2.1 Estrus synchronization (ES)

The estrus response and conception rate did not differ ($p = 0.05$) among breeds. However, twin rate was higher in Boer goats than other breeds. Moreover, in present study a high rate of treated females exhibited heat signs within 24 hours after CIDR removal. This finding is similar to the results reported by Omontese et al. (2013) and

consistent with the findings by Leboeuf et al. (2003) and Freitas et al. (2004) whom treated goats with CIDR under temperate and tropical conditions.

In the present experiment, about 60% of the treated goats conceived which is in agreement with the findings by Motlomelo, Greyling & Schwalbach (2002) who treated Boer goats with CIDR. However, the pregnancy rate in this study was higher than those reported by Leboeuf et al. (2008) who recorded only 65% pregnancy rate and this may be due to the use of cervical insemination in their study and use vaginal insemination in the present study. Also, singleton kidding rate was not significantly affected by breeds or treatment. Our result was similar to which reported in Sudanese Nubian goats which have been synchronized with intravaginal sponges or cloprostenol (Ahmed, Makawi & Jubara, 1998). Besides, similar to Greyling (2000), who reported a lower singletons rate in Boer goat. However, this result is contrary to the findings by Nasroallah, Nemat & Ebrahim (2011), who concluded that kidding rate was not significantly affected by synchronization methods.

5.2.2 Artificial insemination (AI)

Successful fertilization depends on the time of insemination relative to ovulation, and this is related to the estrus onset (Robinson et al., 1967). Presently, it is recommended that fixed-time AI should be performed 24 hours after CIDR removal (CON group) or after estrus onset (TRE group). In present study, 73% of the females artificially inseminated after 24 hours in both groups (CON and TRE) that were in estrus became pregnant.

Diluted semen reduced fertilizing capacity in comparison with fresh semen (Hawk, 1983; Lightfoot & Salamon, 1989). However, in present study diluted semen

has been used because fresh semen is very limited. Moreover, we used to dilute the fresh semen in order to fertilize more females and it can be kept longer compared to the fresh semen.

5.2.3 Crossbreeding systems (CB)

Gradual expansion of goat meat industries is as a result of increased consumer demand (Dhanda et al., 2003). This development has stimulated researches to improve the availability and quality of goat meat (Adeyemi et al., 2015; Sabow et al., 2016). The high variation values of goat traits among different ages, sex and breed could result from variations on influences of breeds and genetics, nutrition and environmental, health and disease, breeding age and method, and management system.

The average body weights of JK (Jamnapari X Katjang) were higher than pure breed Katjang kids. However, crossbreeding (CB) between Katjang and other exotic or temperate breeds was suggested in many works, such as Hirooka et al. (1997), to increase productivity. The average body weights of BJ (Boer X Jamnapari) in the present study were agreed with those reported by Han et al. (2005) that the average of body weight of Boer crossbred kids is 4.05 kg. This value is greater than those reported by Cao et al. (2004) that the average body weight of Boer crossbreed kids is 2.49 kg. The bucks were always heavier and larger than does. These advantage records were comparable with other goat breeds reported by Blackburn et al. (1990).

5.2.4 Mortality rate

Results of overall mortality rate in present study were higher (17%) than those of Sabapara and Deshpande (2010) and Dohare et al. (2013), whom recorded overall mortality rates in goats under field conditions were 8.42% and 10.20%, respectively.

The data analysis showed that the mortality was highest in Jamnapari goats compared to other breeds. In our study, 38% of mortality rate was observed in Jamnapari goats which is higher than that reported by Singh et al. (2009) (32%). Also, our data showed that the mortality was highest (7%) at 1 day old of age and subsequently it declined. This might be due to less immunity in kids, which leads to disease and ultimately mortality. However, overall mortality of the kids on 1 day and 1 month old were (11%) lower than that reported by Singh et al. (2009) and Dohare et al. (2013), who recorded 39.29% mortality during first months of age.

Moreover, the mortality rate in this study did not affected by sex, contrary to that reported by Debele, Duguma & Hundessa (2011) and Dohare et al. (2013) whom recorded a higher mortality rate in females than males due to pneumonia which was higher in female than male.

5.3 Comparison of physiological parameters

The physiological parameters; such as body weight and hematological value, were various. However, in this part will discuss the reasons which may cause these variations to understand how to improve goat production.

5.3.1 Body weight

Numerous Boer goats were heavier than other breeds since Boer goats have great nourish change proficiency, and huge body outline that obliges more meat than

Katjang and Jamnapari goats. This concurs with Lu (2002) who reported that Boer goats are known to have prevalent attributes for goat meat generation, heavier body weight and quickly developing rate contrasted with other goat breeds. Since the market cost of the goats was reliant on the heaviness of the individual goat, Boer goats could procure more wage to ranchers than Katjang and Jamnapari goats.

The physiological attribute is a marker of general productivity in goats that incorporates the aggregate commitments of litter size at birth, mortality and kids weight (Bromley et al., 2001), and is likely the most essential determination criteria in goat breeding, given its financial effect on meat creation efficiency (Sharma et al., 2004).

The variations in year and seasons may be explained partly by differences of rainfall, temperature and environment, which in turn influences grass production and feed availability (Al-Shorepy, Alhadrami & Abdulwahab, 2002), which will affect the amount of food traits.

In present study, the average of body weights in Katjang kids were similar to those reported by López de Torre et al. (1992). Boer kids in this study were similar to the observations made by Lu (1988) and Zhang, Yang & Huazhong (2008) whom recorded the birth weight of Boer kids ranging from 3 kg to 4 kg. However, the results in the present study were higher than those recorded by Wu, Hai & Li (2001) that an average weight of 3.05 kg at birth.

The weights of the Boer goat genders were lower than those reported by Lu (2002) who watched that the adult bucks and does around 40–50 and 35–45 kg, separately, at 7 months old, which then expanded to 50–70 and 45–65 kg, individually, at yearling.

The body weights of Jamnapari goats were higher than those detailed by Hassan, Talukder & Sultana (2010) who observed that the mean body weight of Jamnapari at 12 months was 21.4 kg. The results were lower than those reported in different works by Rout et al. (2013) in which female Jamnapari goats weigh around 29.48 kg at 12 months, though male Jamnapari goats can achieve 36.28 kg of the body weight by 12 months under a decent nourishing framework.

The average of body weights of Jamnapari kids were similar to those reported by Rout et al. (2013) that the weight of Jamnapari kids at birth is 2.72 kg. The results in the present study were higher than those reported by Hassan, Talukder & Sultana (2010) who recorded that the mean body weight of Jamnapari at birth is 1.6 kg. The average of body weights of hybrid BK kids (Boer X Katjang) is agreed with many researchers (Oman et al., 1999; Oman et al., 2000; Merlos-Brito et al., 2000; Browning & Leite-Browning, 2011) that the crossbreeding (CB) of Boer goats shows an improved body conformation over the pure-bred kids.

Litter size in crossbreed goats, such as BJ, in present research is higher than the other goat breeds. For native goats in Malaysia, mean litter size was reported low. Therefore, Boer goats in Malaysia seem to be well adapted, with reproductive rates similar to those observed in other countries and higher than those reported for local goat breeds.

5.3.2 Hematological pictures

Several of the analyzed blood parameters of adult goats seemed to be affected by the age, sex and breed. One or both factors revealed a steady state or a development of the hematological system for goats.

The red blood cell (RBC) count in all types of goats in this study was lower than that reported by other researchers (Zumbo et al., 2011; Shaikat et al., 2013), and also disagreed with the findings of another study (Rice & Hall, 2007), which investigated on mountain goats. The difference might be caused by the variation in the magnitude of their position or geographical variation. The results of the red blood cells count showed that does have a higher value than bucks. The difference of red blood cells in current study may have caused by sexes which is a signal of the health status of the various sex groups among the investigated goat breed.

The current results disagreed with the findings by other researches (Addas, Midau & Babale, 2010), which reported that bucks have higher RBC count than does. A hemoglobin (Hb) of males and Boer goats were significantly higher ($P < 0.05$) than other goats. In this study, the hemoglobin count in goats was higher than those reported by other researches (Kiran et al., 2012; Shaikat et al., 2013). Probably it was due to nutritional variation, breed, and sex of goats.

The hemoglobin concentration was almost higher in males than in females. This characteristic is an advantage in terms of the oxygen carrying capacity of the blood. The results agreed with those reported by other studies (Tambuwal, Agale & Bangana, 2002; Rice & Hall, 2007; Piccione et al., 2010a). The hemodilution of the domestic animals might be of physiological significance, as it reduces the blood stream in the narrow vessels and it might enhance the blood flow through the placental slender vessels - particularly to build the dissemination of O_2 and nourishments to the fetus (Yılmaz, 2000). This speculation has been affirmed by Pere, Dourmad & Etienne (1996).

The packed cell volume (PCV) of females and Jamnapari goats were significantly higher ($P < 0.05$) than the other breeds. This result disagreed with that of Njidda, Hassan & Olatunji (2013), who claimed that bucks having higher PCV values than does is a likelihood of inherent sex differences between male and female (Addas, Midau & Babale, 2010). The findings of this study indicated that PCV varies among sex and breed of goats. High packed cell volume hematocrit values demonstrate either an expansion in the quantity of increasing RBC or decreasing in flowing plasma volume (Baneejee, 2007). Hematological qualities particularly PCV and Hb were associated with nutritious status of the animal (Bentrick, 1974). However, the essential elements of the erythrocyte are to fill in as a carrier of hemoglobin. An increase in packed cell volume might be attributed to the increase in environmental temperature (Isidahomen et al., 2010). The increased packed cell volume observed in this study might probably be a sign of healthy goats.

The mean corpuscular volume (MCV) of females and Katjang goats were significantly higher ($P < 0.05$) than other breeds. The values of MCV were no significantly differs among adults except in Katjang. However, the results determined in the present study disagreed with those of the described goats by other researchers, and the trend in the present study was higher to that reported by other researchers (Addas, Midau & Babale, 2010). In present study, mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) of males and Katjang goats were significantly higher ($P < 0.05$) than other breeds.

The mean corpuscular hemoglobin and MCHC in this study showed higher values than those recorded by Afyon (2012). The mean corpuscular hemoglobin measures the amount or the mass of Hb present in one RBC, whereas MCHC

measures the proportion of each cell taken up by Hb. The mean corpuscular hemoglobin concentration of less than 32% or MCH below 27 % indicates that the RBCs are deficient in hemoglobin concentration. The MCH has been decreased in the females, Boer and Jamnapari. The mean corpuscular hemoglobin concentration is very significant in the diagnosis of anemia. It also serves as a useful index of the capacity of bone marrow to produce RBCs (Berger, 2003).

The total white blood cell (WBC) of females and Katjang goats were significantly higher ($P < 0.05$) than other sex and breeds. Total WBC count showed significant effect of sex, which indicates that the sex has small or large effect on the health status of these goat breeds; however, the values in this study were higher than those obtained in other researches (Tambuwal, Agale & Bangana, 2002; Zumbo et al., 2011; Shaikat et al., 2013).

The results in this present study also agreed with those reported in many researches (Piccione et al., 2010a; Muayad et al., 2016), that sex factors might affect these values. Differentials leucocyte counts were explained for all pure breeds. The increased values showed in Katjang goats of present study suggested that the immune system of this goat breed was well developed. Compared with other ruminants, more lymphocytes exist in circulation than neutrophils (Afyon, 2012). The increased WBC count observed may also be attributed to the extensively managed goats, consequently influencing them to confront challenges from microbes when on an unfenced. The total white blood cells are the first line of defense of a body against invading bacteria and other harmful organisms. The WBC count measures the total number of all types of total white blood cells. Further examination of the different types and numbers of cells present can provide an information about the state of the defense system of a

body. Thus, the female of Katjang has the strongest defense system among all other goats in this study.

Moreover, polymorphs (polys) of females and Boer goats were significantly higher ($P < 0.05$) than other sex and breeds. The lymphocytes (lymphs) of males and Katjang goats were significantly higher ($P < 0.05$) than other sex and breeds. The polys values in females of Boer were significantly higher than those in males. The lymphocytes levels were comparable among the breeds and sex groups of the animals. In goats, similar to other ruminants, high levels of lymphocytes exist in circulation (Olusanya, Edewor & Health, 1976). Lymphocytes are the key elements in the production of immunity. However, sex, and breed significantly influence the lymphocyte count. In the present study, the lymphocytes percentage was higher than the findings by many researchers (Rice & Hall, 2007; Piccione et al., 2010b; Shaikat et al., 2013). It is also higher in male of Katjang compared with other sex and breeds. The reason may probably be the altitude variation and other factors.

Monocytes (monos) of females and Boer goats were significantly higher ($P < 0.05$) than other sex and breeds. The monocytes percentage of adult goats in the present study was lower than that of the findings by Piccione et al. (2010a) for Girgentana goat and by Rice and Hall (2007) for mountain goats. The reason might be caused by the prevalence of chronic infection exposure in green pastures compared with those in the mountains.

The values for eosinophils in this study were significantly higher ($P < 0.05$) in adult males of Jamnapari than in other breeds. These results were lower than those reported by Njidda, Hassan & Olatunji (2013). However, the selectins and integrin have some selectivity in the way in which they respond and on the killing molecules

secreted (Ganong, 2005). A basophils were generally not observed in all the breeds. This result is similar to that observed by Njidda, Hassan & Olatunji (2013).

The white blood cell differentials (lymphocytes and neutrophils) are equivalent among age, sex and breed groups of the animals. In goats like other ruminants, there are a greater number of lymphocytes than neutrophils (DeRitis, Coltori & Gisuti, 1972). Lymphocytes are the key components in the generation of resistance. Low counts of lymphocytes can be found in some bacterial diseases, aplastic iron deficiency, and in a few types of leukemia while high counts can be seen in viral contaminations, and in a few types of leukemia (Devendra, 1977).

In present study, the platelets count (PLT) are an important parameter because their count in the goat blood cannot be established easily and because of the change showed during the experimental period in adults. However, the platelet of males were higher than those of the other groups. These values were higher than those reported by Zumbo et al. (2011). In addition, several of the analyzed blood parameters of kid goats in present study seemed to be affected by the sex and breeds. These factors revealed a steady state or a development of the hematological system for kid goats.

The kids (particularly the hybrids) showed a substantial increase in red blood cells during the early life. This shift is not caused by an abnormal response but is called “adaptive period,” during which, in all species, the stem cells change into normal erythrocytes that, in the embryo, are principally produced by the liver and by the bone marrow in adults (Piccione et al., 2010a). As observed in a newborn calf (Mohri et al., 2007), the erythrocyte size continues to decrease after the fetal life for the first 3–4 months.

The WBC of the BJ kids were significantly higher ($P < 0.05$) than those of the pure kids of Boer and Jamnapari in some of the age. The increased values of WBC in BK hybrid kids suggested that the immune system of this goat breed was well developed. Compared with other ruminants, more Lymphocytes exist in circulation than neutrophils (Afyon, 2012). The increased values of the WBC observed may also be attributed to the extensively managed goats, thereby making them have challenges from microbes when on a free range. Thus, the hybrid BK kids have the strongest defense system among all other goats in this study.

The red blood cells of BK kids were significantly higher ($P < 0.05$) than other kids. However, the red blood cells count of hybrid kids were higher than that of the pure kids. Compared with others, BK hybrids showed increased red blood cells counts. The red blood cells of BJ kids were significantly higher ($P < 0.05$) than those of the pure kids of Boer and Jamnapari. The red blood cells count in all kids was lower than that reported by other studies (Zumbo et al., 2011; Shaikat et al., 2013).

The hemoglobin concentration in BK kids were significantly higher ($P < 0.05$) than other kids. The Hb of the BJ kids were significantly higher ($P < 0.05$) than those of the pure kids of Boer and Jamnapari. This characteristic is an advantage in terms of the oxygen carrying capacity of the blood. The results agreed with those reported by other researchers (Tambuwal, Agale & Bangana, 2002; Rice & Hall, 2007; Piccione et al., 2010b). In this study, the Hb in all kids were higher than those reported by other researchers (Kiran et al., 2012; Shaikat et al., 2013). The probable reason is the nutritional variation and breed of goats.

Packed cell volume of BK kids were significantly higher ($P < 0.05$) than those of the pure Katjang kids. The packed cell volume of the pure kids of Boer and

Jamnapari were significantly higher ($P < 0.05$) than those of the hybrid BJ kids. Moreover, the packed cell volume of BK hybrid kids showed nearly higher values than those of the all pure kids. These results were higher than those reported by Afyon (2012). The findings of this study indicated that packed cell volume varies among breed of goats. An increase in packed cell volume might be attributed to the increase in environmental temperature (Isidahomen et al., 2010). The increased packed cell volume observed in this study might probably be a sign of healthy kid goats.

The values of mean corpuscular volume in BK goats were significantly higher ($P < 0.05$) than those of pure and other hybrid goats. The mean corpuscular volume of the pure kids of Boer and Jamnapari were significantly higher ($P < 0.05$) than those of the hybrid BJ kids. The highest values of mean corpuscular volume were detected in neonatal goats because of the increase in the erythrocyte count. However, the values determined in the present study disagreed with other researchers, and the trend was higher to that reported in other studies (Addas, Midau & Babale, 2010). Increased mean corpuscular volume may also be observed in regenerative anemia caused by hemolysis and hemorrhages (Chineke, Olugun & Ikeobi, 2006). The increased mean corpuscular volume values indicate macrocytosis (Latimer, Mahaffey & Prasse, 2004).

The mean corpuscular hemoglobin of BK goats were significantly higher ($P < 0.05$) than other kids. The mean corpuscular hemoglobin concentration of JK goats were significantly higher ($P < 0.05$) than other kids. The mean corpuscular hemoglobin of BK kids were significantly higher ($P < 0.05$) than those of the pure Katjang kids, whereas the mean corpuscular hemoglobin concentration of the JK kids were significantly higher ($P < 0.05$) than other kids. mean corpuscular hemoglobin

and mean corpuscular hemoglobin concentration in this study showed higher counts than those recorded by Afyon (2012). Moreover, the hybrid kids were showed increase in these parameters compared to pure kids.

Total WBC of BK kids were significantly higher ($P < 0.05$) than those of all the other kids. However, the WBC of BK kids were significantly higher ($P < 0.05$) than those of the pure Katjang kids.

The Polymorphs and Lymphocytes were showed various results among kid groups. However, the Polymorphs and Lymphocytes of the pure kids of Jamnapari were significantly higher ($P < 0.05$) than those of the hybrid BJ kids. The Lymphocytes were comparable among the breed groups of the animals. In goats, similar to other ruminants, high levels of Lymphocytes exist in circulation (Olusanya, Edewor & Health, 1976). Lymphocytes are the key elements in the production of immunity. Low levels can be seen in some bacterial infections, aplastic anemia, and some forms of leukemia, whereas high values can be observed in viral infections and in some forms of leukemia (Ganong, 2005). On the contrary, Tariq et al. (2010) reported lymphocytes counts ranging from 43.89% to 45.86% for kid goats. An increase in the lymphocytes percentage has been reported by Samad and Rahman (1986). Depending on the stage and progress of the disease, lymphocytosis, lymphopenia, and monocytosis can be observed (Kumar et al., 1994). However, breed significantly influence lymphocytes count. In the present study, the lymphocyte percentage was higher than the findings by many researchers (Rice & Hall, 2007; Piccione et al., 2010a; Shaikat et al., 2013).

The Monocytes of BK kids were significantly higher ($P < 0.05$) than those of the pure Katjang kids. However, the Monocytes of the pure kids of Boer and

Jamnapari were higher ($P < 0.05$) than those of the hybrid BJ kids. The monocyte percentage of kid goats was lower in the present study than that reported by Piccione et al. (2010a) for Girgentana goat and by Rice & Hall (2007) for mountain goats.

The values of eosinophil (Eos) of the pure Boer kids were significantly higher ($P < 0.05$) than other kids. However, the Eos of the pure kids of Boer and Jamnapari were significantly higher ($P < 0.05$) than those of the hybrid kids in some of age. These results were lower than those reported by Njidda, Hassan & Olatunji (2013). They are especially abundant in the mucosa of the gastrointestinal tract where they defend against parasites and in the mucosa of respiratory and urinary tracts (Ganong, 2005).

A basophils (Basos) were generally not observed in all the breeds. This result is similar to that observed by Njidda, Hassan & Olatunji (2013).

The platelet count of BK goats were significantly higher ($P < 0.05$) than other kids at 5 months old. The platelet count of BK kids were significantly higher ($P < 0.05$) than those of the pure Katjang kids. However, the platelet count of the pure kids of Jamnapari were significantly higher ($P < 0.05$) than those of the hybrid BJ kids at some of age. In the present study, the platelet counts are an important parameter because their count in the goat blood cannot be established easily and because of the change showed during the experimental period in kids. However, the platelet of kids of Jamnapari and BK were higher than those of all the other breeds. These values were higher than those reported by Zumbo et al. (2011).

In the present study, an increase platelet was recorded in kids. Thrombopoietin is the reason for the increase in platelet count in kids. The hematological system in all

animals is still not completely developed, and megakaryocytes are the prevalent form of platelet, which are minimal in number but large in size (Frolich et al., 1998). We can hypothesize that the platelets in kids during the first month after birth acquire the ultimate shape and the specific physiological number. However, the levels of the antinutritional element of or the factors present in the feed also influence the hematological values (Akinmutimi, 2004).

5.4 Comparison of protein profiling and gene polymorphism

The protein profiling and gene polymorphism were explained an important things in related to the factors; such as breeds, ages, and sexes. However, in this part will discuss how these parameters were affected by the factors and which breed, age, and sex, was improved after crossbreeding system.

5.4.1 Protein profiling

Blood samples tested using SDS-PAGE, indicate one of a kind examples that consider the distinguishing proof of varieties between the distinctive species or breeds, as the primary groups relate to α_{s1}-casein protein. Most of the goats studied in this study have almost same quality of protein profiling regarding α_{s1}-casein gene. The α_{s1}-casein protein showed various molecular weight (MW) among breeds. The MW ranging between 23.00 to 23.99 Kilodaltons.

In current study, analyses of α_{s1}-casein gene provided an important contribution in order to evaluate the role and the importance factors involved in the regulation of milk protein gene expression and the transcriptional effects of polymorphisms. Knowledge of α_{s1}-casein gene polymorphisms will provide new

opportunities to select the best dairy goats for the preferred milk protein producing genotype.

However, α_{s1}-casein gene in present study was improved in Jamnapari hybrid kids (JK and BJ) compared to the pure breeds (Katjang and Boer). The high substance or ordinary of α_{s1}-casein protein in the blood samples in connected to different caseins which makes it more alluring for handling into inferred dairy items. However, the protein content influences the milk coagulation rate and also the handling yield, taste, and consistency of the determined items (Ceballos et. al., 2009; Maga et. al., 2009; Silva et. al., 2009).

However, the electrophoretic representation of α_{s1}-casein in goat blood has to a great degree unpretentious differences in the movement among groups, which have on a very basic level the same as molecular weights, impeding the exact qualification of α_{s1}-casein present in goats (Egito et. al., 2006).

5.4.2 Gene polymorphism

Goat genetic studies are still in their infancy and only a few studies investigating genetic diversity, phenotype-genotype association and signatures of selection are available (Brito et al., 2014; Nicoloso et al., 2015; Lashmar, Visser & van Marle-Köster, 2016; Mdladla et al., 2016). None of these studies assessed the genomic adaptation to specific environments nor attempted to untangle the ecological relevance of the genome-wide outlier markers. The adaptive genetic potential of indigenous goats is paramount in ecosystems where harsh and extreme production environments are worsened by climate changes as experienced in tropical developing countries.

The recognizable proof of the αs1-casein quality, genotyping was confined to the A, B and C alleles which were discovered even more as much as possible in each of the breeds. The D and E alleles were not distinguished in all types of goat. While, F allele was found in Jamnapari goats and its hybrid kids (JK and BJ). The recurrence of α_{s1}-casein C allele were observed to be higher in adult Boer compared with the adults of Katjang and Jamnapari, whereas A and B alleles were higher in Jamnapari kid goats. The nearness of high recurrence of α_{s1}-casein in the goats shows their capacity to create milk containing high α_{s1}-casein protein. However, the results were higher than those reported by Amie Marini et. al. (2011).

The allelic frequencies of the α_{s1}-casein quality was assessed by direct checking. The C allele, in adult Boer, and A and B alleles, in Jamnapari kids, were the most continuous. In general, a higher recurrence of alleles related with a little measure of α_{s1}-casein in drain F allele. As indicated by Serradilla (2002), genotypic frequencies change amongst breeds.

Although the C allele is the most continuous in adult of Boer breeds, the present study showed an expansion in the frequencies of alleles related with a high measure of α_{s1}-casein in blood (A + B), as saw in the Katjang and Jamnapari breeds.

Moreover, results of this study found significant difference ($p < 0.05$) between genders regarding B and F alleles of α_{s1}-casein protein. These results agreed with Guastella et. al. (2009) who found a difference between gender groups in α_{s1}-casein frequencies.

In respect to the variations observed for each casein alleles, there is difficulty to interpret the vast literature related to the subject and compare them with present results.

5.5 Conclusion

With a specific end goal to advance the productive capability of the goat, it is fundamental that a conceptive administration program is actualized that considers all the conceptive physiology perspectives.

With the valuable regenerative attributes of the goat, it can be viewed as the wellspring of animal protein to reduce the need in the creating nations and as a methods for aiding in the social upliftment of the rustic poor communities.

The goat however with its broadened reproducing season, additionally has incredible potential in the commercial industry and can be used even in more escalated generation frameworks for milk and meat production. It is this across the board application potential and the capacity of the goat that makes it mainstream around the world.

CHAPTER 6

GENERAL DISCUSSION AND CONCLUSION

6.1 Introduction

In general, the mix of alluring characteristics of at least two goat breeds is required to frame composite herds. Raisers expect the recently created composite populace to approach the level of execution achieved by crossbreeding at least two breeds with a much less difficult rearing structure. Likewise, following estrus synchronization and artificial insemination programs, there is an operational favorable position in light of the fact that there is no compelling reason to buy new animals, consequently improving herds and diminishing the danger of presenting sicknesses.

Singular contrasts in develop estimate must be considered in summed up animal researches of development example. Fitzhugh and Taylor (1971) characterized an idea of level of development to unreservedly analyze the same or diverse quality at the same or distinctive stages, in the same or diverse species/breeds. Level of development communicates the span of an animal at a youthful stage as extent of its develop measure. The idea well clarifies contrasts in organic effectiveness of creation autonomous of individual size distinction.

The normal body weights of Katjang goats in present study concurred with those revealed by López de Torre et al. (1992) which asserted that the weight of Katjang extents from 27 kg to 31.8 kg.

The mean weight of mature Boer goats found in this study is intermediate in the range reported for the breed worldwide, which shows an extremely large variability, with reported means body weight of 35 kg in South African villages (Lusweti, 2000), 47 kg in the Caribbean island of Guadeloupe (Gunia et al., 2011), 58 kg in Malaysia (Ariff et al., 2010) and 80–100 kg in the United States (Lu, 2001). This could, however, be a consequence of the recognized variability of the pure Boer breed, food, and environment.

However, if fed correctly, Boer goats show increased growth potential (Malan, 2000), body weight at slaughter, carcass weight, dressing percentage (Stanisz, Slósarz & Gut, 2009), muscularity (Blackburn & Gollin, 2009), and weight of primal cuts (Cameron et al, 2001).

The time of ovulation in the goat is reported to occur towards the end of the estrus period (Van der Westhuysen et al., 1985). In the Boer goat doe (mean bodyweight of 44.5±14.5 kg), the time of ovulation is recorded at 36.8 hours (86.7% of does ovulating by 38 hours) after the onset of estrus, with the mean time interval between the LH peak and ovulation was 24.7 hours (Greyling, 1988).

The duration of the estrus cycle in the mature Boer goat doe is 20.7±0.7 days with a high incidence of short (<13 days) and long (>25 days) cycles. The frequency of short and long cycles in the Boer goat doe was 16.6 and 10.2%, respectively (Greyling, 1988). Prasad and Bhattacharyya (1979) categorised the estrus cycle of the

Barbari goat breed into short, medium and long cycles, with the frequency of each category was 19.7, 68.8 and 11.5%, respectively. This variation in estrus cycle length could be related to the season of the year and stage post-partum.

The mean duration of the natural estrus period in the mature Boer goat is 37.4±8.6 hours, with a variation of 24±56 hours between individuals. No significant difference was recorded between multiparous, biparous or primiparous does (38.2 versus 34.0 versus 38.6 hours, respectively) (Greyling, 1988). Estrus cycles are found to be significantly shorter during periods of the year with moderate climatic conditions, compared to extreme cold-dry and hot-wet periods (Prasad & Bhattacharyya, 1979). Marais (1968) found the estrus period of the Angora doe to be shorter at the onset and end of the breeding season, compared to the months of peak sexual activity (autumn). The duration of the estrus period of the Boer goat appears to be variable in length, but in line with the common duration of estrus reported in goats of 36 hours, with a variation of between 22 and 60 hours (Riera, 1982).

The percentage singletons, twins, triplets and quadruplets born in the Boer goat were 24.5, 59.2, 15.3 and 1%, respectively (Campbell, 1994). Nevertheless, Boer goat does can be considered as being one of the more prolific goat breeds in the world. No significant correlation (r=0.49) was recorded between the bodyweight of the females and the ovulation rate (Greyling & Van Niekerk, 1990).

It is common experience that multiple births in goats are associated with a high mortality rate (Devendra & Burns, 1983). There seems to be however, no biological reason why mortality should be high, provided nutrition and management are adequate. It should just be pointed out that the full meat production potential of the Boer goat could only be utilised by exploiting their prolificacy. To this end,

intensive management and high nutritional levels might be economically worthwhile. Under intensive conditions, Boer goat does successfully raise twins and triplets. It is, however, necessary to pay special attention to triplets during the first few days after birth (Naude & Hofmeyr, 1981).

However, a Boer goat is popular for CB because of its large mature size and potentially high growth rates (Mahgoub, Kadim & Webb, 2012). Moreover, the birth weights of hybrid goats were nearly higher than those of the pure breeds because of their desirable genetic traits for meat production. Boer goats have successfully improved the productive performance of indigenous breeds through CB; such as BK and BJ. The most notable improvements include birth weight, growth weight, weaning weight, breeding weight, mature weight, kidding rate, and carcass quality (Brown et al., 1997; Cameron et al., 2001).

Desirable effects of crossbreeding are heterosis and the utilization of differences between breeds to optimize genetic merit of different traits under various environmental conditions (Mohammed, Khalil & Al-Saef, 2013; Mestawet et al., 2014). However, within breed, genetic improvement of these traits is possible (Taylor, Taylor & Decker, 2016); for example, reproductive and health genetic merit of Holstein cows has slightly increased in the past 10 years (Berry, Wall & Pryce, 2014). Nevertheless, given the superiority of milk quality, reproduction, and health traits of several other dairy breeds, dairy crossbreeding might be an alternative option to pure breeding to improve these traits faster (Dezetter et al., 2017).

Despite its potential advantages, dairy crossbreeding is still scarcely implemented in most countries. Countries with a dominancy of purebreds have recently been the subject of research dairy crossbreeding (Buckley, Lopez-Villalobos & Heins, 2014). Very few studies have compared productivity of crossbred goats with pure goats.

The α_{s1}-casein genotype data could be used a choice plan for milk protein content, where this quality largy affects exhibitions. However, ruminant milk creation is impacted by inborn (e.g., genotype, lactation organize) or outward (e.g., sustaining) components. Impacts connected to breed or genotype (Ferlay et al., 2010) must be accomplished over the long haul. Coincidentally, goats have a polymorphism at the α_{s1}-casein locus, which brings about checked differences in milk protein qualities and focus (Grosclaude et al., 1994; Manfredi & Adnoy, 2012). Moreover, different between genotypes in milk protein are reliable with past outcomes (Grosclaude et al., 1994; Manfredi, 2003; Chilliard, Rouel & Leroux, 2006).

Consequently, we can state that the milk from Jamnapari goats has higher measures of casein when contrasted with the milk from other goats; this can likewise be seen by looking at the power of the groups identified with the caseins in the electrophoretic profiles. Moreover, these discoveries bolster the capability of versatile limit appeared by goats (Lopez-Exposito & Recio, 2006), which might be a persuasive develop the likeness between the casein profiles from the diverse goat breeds utilized as a part of this research.

The high frequency of the strong genotypes can be related with the generation of milk with high fat and protein content and with ideal mechanical properties.

Indeed, clear and noteworthy differences were seen in the cheddar yield with +7.4% amongst AA and EE alleles, and +14.8% amongst allele AA and allele FF alleles (Grosclaude & Martin, 1997). Also, casein focus is more prominent when strong alleles are available (Martin et al., 2002). Maga et al. (2009) in a review on the α_{s1}-casein content in American dairy goats, utilizing sodium dodecyl sulfate–polyacrylamide gel electrophoresis and two-dimensional gels, demonstrated that milk from FF and EE alleles creatures had 35 and 25% less caseins, separately, than animals homozygous for the strong alleles. The presence of A or B allele in heterozygote condition with either the F or E allele lessened the deficiency in casein by just 5–7% difference and AA homozygote condition.

A conceivable bother of strong and intermediate genotypes has been found in connection with cheese enhance. Cheeses made with milk from these genotypes have less run of the mill goat flavour than those from weak genotypes because of various unsaturated fat profiles (Delacroix-Buchet et al., 1996). In addition, polymorphism at α_{s1}-casein locus affected milk unsaturated fat creation, the FF genotype has been related with low rates of unsaturated fats altogether (C12:0, C14:0, C6-C14) or mostly (C18 : 0, odd and stretched chain unsaturated fat) all over again orchestrated in the mammary tissues, and with high milk Δ^9 desaturated fatty acids (cis-9 C14 : 1, cis-9 C16 : 1, cis-9 C17 : 1 and cis-9 C18 : 1) (Valenti et al., 2010).

Although the purpose of the herd is milk production, it may be considered under small selection intensity. Regardless of the selection intensity, the distribution of allelic frequencies related to the α_{s1}-casein locus in dairy goat populations, according to Jordana et al. (1996), may have been influenced by the reduced effective population size and also by the founder effect on dispersion of small populations,

determinant effects on distribution of allelic frequencies. Therefore, the analyses of these frequencies in herds worldwide would contribute with the understanding of this dynamics.

6.2 Conclusion

The productivity of any breeding female is determined by the number of progeny delivered in a given period of time. The interval from parturition to a subsequent pregnancy is a factor of major economic importance and any factor that could place limitations on this period could hamper the goal of optimal reproductive efficiency. Considered in the light of the health-consciousness and rural nutritional needs that prevail, the Boer goat yields lean meat of a high quality, particularly at a young age, while also having an abundance of milk.

A knowledge on the body physiological reference values in goats provides a useful information in recognizing the adaptation mechanisms starting from their first day of life. However, based on findings, we concluded that age, sex and breed, showed remarkable influence on the reproductive efficiency, weight values, hematological pictures, protein profiling and gene polymorphism of goat breeds studied in Malaysia. The values obtained are comparable to values recorded elsewhere. A fluctuation exists in all the physiological parameters of all the age, sex and breeds of the animals.

The results presented in this study of hematological parameters contribute to the knowledge of adaptation process in breeds. A knowledge on the hematological values for the adults and kids of this species provides a useful information for the

body condition and immunology system prior and subsequent of crossbreeding systems of goats.

Blood of Katjang, Boer and Jamnapari goats in Malaysia have α_{s1}-casein in their casein composition and do not differ much from each other, with respect to casein alleles. These breeds have the potential to be interesting casein protein sources. The blood from Jamnapari goats and its hybrids (JK and BJ) have higher amounts of casein composition when compared to other goats. However, further studies are necessary to subsidize their use more efficiently.

Moreover, the results of this research demonstrated that by using crossbreeding among various breeds, a vigorous genotype was reared, for example, BJ (Boer X Jamnapari), which could be created and replicated under broad conditions with no confinement. Based on these findings, the results provided useful information for the adaptation that occur after crossbreeding. Moreover, finding showed the Boer and Jamnapari crossbreeds (BJ) might help to improve herd production by producing twins, large body and milk with a high quality.

Further selection for improved Malaysian goat quality should be performed in BJ. However, further studies on Malaysian goats are required.

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APPENDIX A

Reproductive Efficiency

Table 1 ANOVA analysis of the reproductive efficiency of different breeds

ANOVA						
		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Estrus	Between Groups	.10	2	.05	.19	**.825**
	Within Groups	14.75	57	.26		
	Total	14.85	59			
Pregnancy	Between Groups	.03	2	.02	.08	**.922**
	Within Groups	11.70	57	.21		
	Total	11.73	59			
Singleton	Between Groups	1.03	2	.52	2.17	**.123**
	Within Groups	13.55	57	.24		
	Total	14.58	59			
Twin	Between Groups	.93	2	.47	4.43	**.016**
	Within Groups	6.00	57	.11		
	Total	6.93	59			

Table 2 T-test analysis of differences of the reproductive efficiency values

		Levene's Test for Equality of Variances		**t-test for Equality of Means**		
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**
Estrus	Equal variances assumed	16.31	.000	-16.16	58	**.000**
	Equal variances not assumed			-16.16	29.00	**.000**
Pregnancy	Equal variances assumed	.00	1.000	.00	58	**1.000**
	Equal variances not assumed			.00	58.00	**1.000**
Singleton	Equal variances assumed	3.63	.062	1.31	58	**.197**
	Equal variances not assumed			1.31	57.80	**.197**
Twin	Equal variances assumed	31.61	.000	-2.34	58	**.023**
	Equal variances not assumed			-2.34	39.12	**.024**

Table 3 ANOVA analysis of the mortality rate of different breeds

ANOVA					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	1.67	5	.34	2.56	**.031**
Within Groups	15.02	115	.13		
Total	16.69	120			

Table 4 T-test analysis of the mortality rates between sex groups

		Levene's Test for Equality of Variances		**t-test for Equality of Means**		
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**
Mortality	Equal variances assumed	9.37	.003	-1.52	119	**.132**
	Equal variances not assumed			-1.48	98.55	**.143**

APPENDIX B

Body Weight of Breeds

Table 1 ANOVA of the age perceptions of body weights of different breeds of adults

ANOVA						
Weight		**Sum of Squares**	**df**	**Mean Square**	**F**	Sig.
1.5 year	Between Groups	11165.53	2	5582.76	4595.29	.000
	Within Groups	372.97	107	1.22		
	Total	11538.5	109			
2 years	Between Groups	17753.40	2	8876.70	7649.05	.000
	Within Groups	336.54	90	1.16		
	Total	18089.95	92			
2.5	Between Groups	20607.26	2	10303.63	3712.83	.000
years	Within Groups	743.74	168	2.78		
	Total	21351.00	170			
3 years	Between Groups	22436.78	2	11218.39	4460.14	.000
	Within Groups	477.9	90	2.52		
	Total	22914.68	92			

Table 2 ANOVA analysis of body weights of different age perceptions of kid goats

ANOVA						
Weight		**Sum of Squares**	**df**	**Mean Square**	**F**	Sig.
first day	Between Groups	73.60	5	14.72	16.67	.000
	Within Groups	93.56	106	.88		
	Total	167.17	111			
1 month	Between Groups	85.83	5	17.16	16.48	.000
	Within Groups	105.15	86	1.04		
	Total	190.98	91			
2 months	Between Groups	112.20	5	22.44	15.17	.000
	Within Groups	149.38	77	1.47		
	Total	261.58	82			
3 months	Between Groups	249.01	5	49.80	18.72	.000
	Within Groups	265.99	64	2.66		
	Total	515.01	69			
5 months	Between Groups	636.55	5	127.31	16.46	.000
	Within Groups	749.99	54	7.73		
	Total	1386.55	59			

APPENDIX C

Red Blood Cells of Age

Table 1 ANOVA analysis on differences of Red blood cells of the age of adult goats

ANOVA						
Age/ years		Sum of Squares	df	Mean Square	F	**Sig.**
1.5	Between Groups	8.22	2	4.11	14.01	**.000**
	Within Groups	24.65	84	.29		
	Total	32.88	86			
2	Between Groups	6.84	2	3.42	11.62	**.000**
	Within Groups	23.85	81	.29		
	Total	30.69	83			
2.5	Between Groups	7.58	2	3.79	13.06	**.000**
	Within Groups	23.49	81	.29		
	Total	31.07	83			
3	Between Groups	8.03	2	4.01	13.73	**.000**
	Within Groups	23.67	81	.29		
	Total	31.71	83			

Table 2 ANOVA analysis on differences of hemoglobin of the age of adult goats

ANOVA						
Age/ years		Sum of Squares	df	Mean Square	F	**Sig.**
1.5	Between Groups	14.41	2	7.20	7.34	**.001**
	Within Groups	82.40	84	.98		
	Total	96.81	86			
2	Between Groups	12.65	2	6.32	6.49	**.002**
	Within Groups	78.89	81	.97		
	Total	91.55	83			
2.5	Between Groups	16.07	2	8.03	8.00	**.001**
	Within Groups	81.37	81	1.00		
	Total	97.45	83			
3	Between Groups	11.75	2	5.87	6.30	**.003**
	Within Groups	75.49	81	.93		
	Total	87.24	83			

Table 3 ANOVA analysis on differences of packed cell volume of the age of adults

ANOVA						
Age/ years		Sum of Squares	df	Mean Square	F	**Sig.**
1.5	Between Groups	2275.46	2	1137.73	23.70	**.000**
	Within Groups	4032.25	84	48.00		
	Total	6307.72	86			
2	Between Groups	2031.23	2	1015.61	21.11	**.000**
	Within Groups	3896.70	81	48.10		
	Total	5927.93	83			
2.5	Between Groups	2338.86	2	1169.43	25.27	**.000**
	Within Groups	3748.52	81	46.27		
	Total	6087.39	83			
3	Between Groups	2144.69	2	1072.34	22.41	**.000**
	Within Groups	3874.62	81	47.83		

Total	6019.32	83			

Table 4 ANOVA analysis of mean corpuscular volume of the age of adults

ANOVA						
Age/ years		Sum of Squares	df	Mean Square	F	**Sig.**
1.5	Between Groups	2777.95	2	1388.97	10.41	**.000**
	Within Groups	11198.27	84	133.31		
	Total	13976.23	86			
2	Between Groups	2139.31	2	1069.65	7.55	**.001**
	Within Groups	11467.50	81	141.57		
	Total	13606.81	83			
2.5	Between Groups	2437.31	2	1218.65	8.37	**.000**
	Within Groups	11781.39	81	145.44		
	Total	14218.70	83			
3	Between Groups	2768.66	2	1384.33	10.13	**.000**
	Within Groups	11066.89	81	136.62		
	Total	13835.56	83			

Table 5 ANOVA analysis of mean corpuscular hemoglobin of the age of adults

ANOVA						
Age/ years		Sum of Squares	df	Mean Square	F	**Sig.**
1.5	Between Groups	990.52	2	495.26	18.30	**.000**
	Within Groups	2272.70	84	27.05		
	Total	3263.23	86			
2	Between Groups	937.64	2	468.82	17.49	**.000**
	Within Groups	2170.80	81	26.80		
	Total	3108.45	83			
2.5	Between Groups	1035.47	2	517.73	19.52	**.000**
	Within Groups	2147.77	81	26.51		
	Total	3183.24	83			
3	Between Groups	862.79	2	431.39	16.44	**.000**
	Within Groups	2124.91	81	26.23		
	Total	2987.70	83			

Table 6 ANOVA analysis on differences of mean corpuscular hemoglobin concentration of the age of adult goats

ANOVA						
Age/ years		Sum of Squares	df	Mean Square	F	**Sig.**
1.5	Between Groups	1937.65	2	968.82	27.73	**.000**
	Within Groups	2934.62	84	34.93		
	Total	4872.27	86			
2	Between Groups	1760.88	2	880.44	24.55	**.000**
	Within Groups	2904.82	81	35.86		
	Total	4665.70	83			
2.5	Between Groups	2016.12	2	1008.06	27.19	**.000**
	Within Groups	3002.37	81	37.06		
	Total	5018.50	83			
3	Between Groups	1914.68	2	957.34	25.79	**.000**
	Within Groups	3006.37	81	37.11		
	Total	4921.06	83			

Table 7 ANOVA analysis on differences of red blood cells distribution width of the age of adult goats

ANOVA						
Age/ years		Sum of Squares	df	Mean Square	F	**Sig.**
1.5	Between Groups	25.98	2	12.99	1.42	**.246**
	Within Groups	765.85	84	9.11		
	Total	791.84	86			
2	Between Groups	16.95	2	8.47	.88	**.417**
	Within Groups	776.62	81	9.58		
	Total	793.58	83			
2.5	Between Groups	10.82	2	5.41	.60	**.551**
	Within Groups	729.94	81	9.01		
	Total	740.76	83			
3	Between Groups	19.95	2	9.97	1.05	**.354**
	Within Groups	768.97	81	9.49		
	Total	788.93	83			

APPENDIX D

White Blood Cells of Age

Table 1 ANOVA analysis on differences of white blood cells of the age of adult goats

ANOVA						
Age/years		Sum of Squares	df	Mean Square	F	**Sig.**
1.5	Between Groups	641687586.20	2	320843793.103	96.233	**.000**
	Within Groups	280057241.37	84	3334014.778		
	Total	921744827.58	86			
2	Between Groups	648943095.23	2	324471547.619	91.836	**.000**
	Within Groups	286186785.71	81	3533170.194		
	Total	935129880.95	83			
2.5	Between Groups	622895000.00	2	311447500.000	88.920	**.000**
	Within Groups	283708214.28	81	3502570.547		
	Total	906603214.28	83			
3	Between Groups	621068809.52	2	310534404.762	90.202	**.000**
	Within Groups	278855357.14	81	3442658.730		
	Total	899924166.66	83			

Table 2 ANOVA analysis on differences of polymorphs of the age of adult goats

ANOVA						
Age/years		Sum of Squares	df	Mean Square	F	**Sig.**
1.5	Between Groups	16218.316	2	8109.158	76.056	**.000**
	Within Groups	8956.123	84	106.621		
	Total	25174.440	86			
2	Between Groups	15249.387	2	7624.693	70.923	**.000**
	Within Groups	8708.043	81	107.507		
	Total	23957.430	83			
2.5	Between Groups	15765.215	2	7882.608	70.418	**.000**
	Within Groups	9067.143	81	111.940		
	Total	24832.358	83			
3	Between Groups	16120.630	2	8060.315	76.420	**.000**
	Within Groups	8543.393	81	105.474		
	Total	24664.022	83			

Table 3 ANOVA analysis on differences of lymphocytes of the age of adult goats

ANOVA						
Age/years		Sum of Squares	df	Mean Square	F	**Sig.**
1.5	Between Groups	14194.144	2	7097.072	91.988	**.000**
	Within Groups	6480.776	84	77.152		
	Total	20674.920	86			
2	Between Groups	13337.935	2	6668.967	85.339	**.000**
	Within Groups	6329.875	81	78.147		
	Total	19667.810	83			
2.5	Between Groups	14247.077	2	7123.539	92.769	**.000**
	Within Groups	6219.813	81	76.788		
	Total	20466.890	83			
3	Between Groups	14270.857	2	7135.429	96.266	**.000**
	Within Groups	6003.893	81	74.122		
	Total	20274.750	83			

Table 4 ANOVA analysis on differences of monocytes of the age of adult goats

ANOVA						
Age/years		Sum of Squares	df	Mean Square	F	**Sig.**
1.5	Between Groups	89.379	2	44.690	21.953	**.000**
	Within Groups	171.000	84	2.036		
	Total	260.379	86			
2	Between Groups	80.452	2	40.226	20.351	**.000**
	Within Groups	160.107	81	1.977		
	Total	240.560	83			
2.5	Between Groups	81.435	2	40.717	21.869	**.000**
	Within Groups	150.813	81	1.862		
	Total	232.247	83			
3	Between Groups	82.667	2	41.333	20.744	**.000**
	Within Groups	161.393	81	1.993		
	Total	244.060	83			

Table 5 ANOVA analysis on differences of eosinophils of the age of adult goats

ANOVA						
Age/years		Sum of Squares	df	Mean Square	F	**Sig.**
1.5	Between Groups	106.075	2	53.037	23.463	**.000**
	Within Groups	189.879	84	2.260		
	Total	295.954	86			
2	Between Groups	105.167	2	52.583	22.895	**.000**
	Within Groups	186.036	81	2.297		
	Total	291.202	83			
2.5	Between Groups	100.518	2	50.259	22.494	**.000**
	Within Groups	180.982	81	2.234		
	Total	281.500	83			
3	Between Groups	114.756	2	57.378	26.312	**.000**
	Within Groups	176.634	81	2.181		
	Total	291.390	83			

Table 6 ANOVA analysis on differences of platelet count of the age of adult goats

ANOVA						
Age/years		Sum of Squares	df	Mean Square	F	**Sig.**
1.5	Between Groups	71695103448.276	2	35847551724.138	2.156	**.122**
	Within Groups	1396858551724.138	84	16629268472.906		
	Total	1468553655172.414	86			
2	Between Groups	64968666666.667	2	32484333333.333	1.945	**.150**
	Within Groups	1352603571428.571	81	16698809523.810		
	Total	1417572238095.238	83			
2.5	Between Groups	80157595238.095	2	40078797619.048	2.421	**.095**
	Within Groups	1340908357142.857	81	16554424162.257		
	Total	1421065952380.952	83			
3	Between Groups	54797642857.143	2	27398821428.571	1.663	**.196**
	Within Groups	1334526107142.857	81	16475630952.381		
	Total	1389323750000.000	83			

APPENDIX E

Red Blood Cells of Ages of Kids

Table 1 ANOVA analysis on differences of Red blood cells of the age of kid goats

ANOVA						
Age		Sum of Squares	df	Mean Square	F	**Sig.**
1 day	Between Groups	25.250	5	5.050	8.158	**.000**
	Within Groups	11.142	18	.619		
	Total	36.392	23			
1	Between Groups	39.215	5	7.843	23.501	**.000**
month	Within Groups	10.012	30	.334		
	Total	49.227	35			
3	Between Groups	20.425	5	4.085	17.280	**.000**
months	Within Groups	5.201	22	.236		
	Total	25.626	27			
5	Between Groups	27.954	5	5.591	15.298	**.000**
months	Within Groups	10.233	28	.365		
	Total	38.186	33			

Table 2 ANOVA analysis on differences of hemoglobin of the age of kid goats

ANOVA						
Age		Sum of Squares	df	Mean Square	F	**Sig.**
1 day	Between Groups	18.854	5	3.771	3.535	**.021**
	Within Groups	19.201	18	1.067		
	Total	38.055	23			
1 month	Between Groups	31.710	5	6.342	5.523	**.001**
	Within Groups	34.447	30	1.148		
	Total	66.158	35			
3 months	Between Groups	23.491	5	4.698	5.838	**.001**
	Within Groups	17.704	22	.805		
	Total	41.195	27			
5 months	Between Groups	32.942	5	6.588	7.614	**.000**
	Within Groups	24.229	28	.865		
	Total	57.171	33			

Table 3 ANOVA analysis on differences of packed cell volume of the age of kid goats

ANOVA						
Age		Sum of Squares	df	Mean Square	F	**Sig.**
1 day	Between Groups	1628.325	5	325.665	1.392	**.274**
	Within Groups	4210.300	18	233.906		
	Total	5838.625	23			
1	Between Groups	2650.397	5	530.079	2.642	**.043**
month	Within Groups	6018.575	30	200.619		
	Total	8668.972	35			
3	Between Groups	3887.250	5	777.450	4.634	**.005**
months	Within Groups	3690.750	22	167.761		
	Total	7578.000	27			
5	Between Groups	3300.016	5	660.003	4.075	**.007**
months	Within Groups	4535.425	28	161.979		

Total	7835.441	33			

Table 4 ANOVA analysis of mean corpuscular volume of the age of kid goats

ANOVA						
Age		Sum of Squares	df	Mean Square	F	**Sig.**
1 day	Between Groups	1183.583	5	236.717	.762	**.589**
	Within Groups	5592.917	18	310.718		
	Total	6776.500	23			
1	Between Groups	5055.464	5	1011.093	2.791	**.035**
month	Within Groups	10868.842	30	362.295		
	Total	15924.306	35			
3	Between Groups	1348.679	5	269.736	.953	**.467**
months	Within Groups	6228.000	22	283.091		
	Total	7576.679	27			
5	Between Groups	1164.043	5	232.809	.737	**.602**
months	Within Groups	8842.575	28	315.806		
	Total	10006.618	33			

Table 5 ANOVA analysis on differences of mean corpuscular hemoglobin of the age of kid goats

ANOVA						
Age		Sum of Squares	df	Mean Square	F	**Sig.**
1 day	Between Groups	708.435	5	141.687	11.797	**.000**
	Within Groups	216.179	18	12.010		
	Total	924.615	23			
1	Between Groups	722.617	5	144.523	4.653	**.003**
month	Within Groups	931.883	30	31.063		
	Total	1654.500	35			
3	Between Groups	623.818	5	124.764	9.813	**.000**
months	Within Groups	279.708	22	12.714		
	Total	903.527	27			
5	Between Groups	884.937	5	176.987	8.934	**.000**
months	Within Groups	554.688	28	19.810		
	Total	1439.625	33			

Table 6 ANOVA analysis on differences of mean corpuscular hemoglobin concentration of the age of kid goats

ANOVA						
Age		Sum of Squares	df	Mean Square	F	**Sig.**
1 day	Between Groups	861.685	5	172.337	5.068	**.004**
	Within Groups	612.054	18	34.003		
	Total	1473.740	23			
1	Between Groups	593.397	5	118.679	2.511	**.052**
month	Within Groups	1417.679	30	47.256		
	Total	2011.076	35			
3	Between Groups	748.631	5	149.726	3.528	**.017**
months	Within Groups	933.583	22	42.436		
	Total	1682.214	27			
5	Between Groups	882.731	5	176.546	4.299	**.005**
months	Within Groups	1149.769	28	41.063		
	Total	2032.500	33			

Table 7 ANOVA analysis on differences of red blood cells distribution width of the age of kid goats

ANOVA						
Age		Sum of Squares	df	Mean Square	F	**Sig.**
1 day	Between Groups	96.204	5	19.241	2.825	**.047**
	Within Groups	122.601	18	6.811		
	Total	218.805	23			
1 month	Between Groups	107.818	5	21.564	2.727	**.038**
	Within Groups	237.237	30	7.908		
	Total	345.055	35			
3 months	Between Groups	251.600	5	50.320	4.601	**.005**
	Within Groups	240.609	22	10.937		
	Total	492.209	27			
5 months	Between Groups	170.760	5	34.152	5.505	**.001**
	Within Groups	173.704	28	6.204		
	Total	344.464	33			

APPENDIX F

White Blood Cells of Ages of Kids

Table 1 ANOVA analysis on differences of white blood cells of the age of kid goats

ANOVA						
Age		Sum of Squares	df	Mean Square	F	**Sig.**
1 day	Between Groups	233860083.333	5	46772016.667	10.638	**.000**
	Within Groups	79139500.000	18	4396638.889		
	Total	312999583.333	23			
1	Between Groups	205022722.222	5	41004544.444	10.755	**.000**
month	Within Groups	114380333.333	30	3812677.778		
	Total	319403055.556	35			
3	Between Groups	203592738.095	5	40718547.619	9.393	**.000**
months	Within Groups	95368333.333	22	4334924.242		
	Total	298961071.429	27			
5	Between Groups	299358176.471	5	59871635.294	17.841	**.000**
months	Within Groups	93963000.000	28	3355821.429		
	Total	393321176.471	33			

Table 2 ANOVA analysis on differences of polymorphs of the age of kid goats

ANOVA						
Age		Sum of Squares	df	Mean Square	F	**Sig.**
1 day	Between Groups	1252.865	5	250.573	8.342	**.000**
	Within Groups	540.644	18	30.036		
	Total	1793.510	23			
1	Between Groups	2802.702	5	560.540	7.742	**.000**
month	Within Groups	2172.018	30	72.401		
	Total	4974.720	35			
3	Between Groups	2080.171	5	416.034	8.314	**.000**
months	Within Groups	1100.933	22	50.042		
	Total	3181.104	27			
5	Between Groups	3892.279	5	778.456	15.128	**.000**
months	Within Groups	1440.790	28	51.457		
	Total	5333.069	33			

Table 3 ANOVA analysis on differences of lymphocytes of the age of kid goats

ANOVA						
Age		Sum of Squares	df	Mean Square	F	**Sig.**
1 day	Between Groups	2536.033	5	507.207	10.618	**.000**
	Within Groups	859.800	18	47.767		
	Total	3395.833	23			
1	Between Groups	2096.526	5	419.305	4.897	**.002**
month	Within Groups	2568.883	30	85.629		
	Total	4665.410	35			
3	Between Groups	2365.420	5	473.084	8.325	**.000**
months	Within Groups	1250.250	22	56.830		
	Total	3615.670	27			
5	Between Groups	4667.129	5	933.426	31.514	**.000**
months	Within Groups	829.342	28	29.619		
	Total	5496.471	33			

Table 4 ANOVA analysis on differences of monocytes of the age of kid goats

ANOVA						
Age		Sum of Squares	df	Mean Square	F	**Sig.**
1 day	Between Groups	41.052	5	8.210	9.201	**.000**
	Within Groups	16.063	18	.892		
	Total	57.115	23			
1	Between Groups	29.347	5	5.869	4.680	**.003**
month	Within Groups	37.625	30	1.254		
	Total	66.972	35			
3	Between Groups	27.568	5	5.514	4.112	**.009**
months	Within Groups	29.500	22	1.341		
	Total	57.068	27			
5	Between Groups	36.245	5	7.249	6.380	**.000**
months	Within Groups	31.814	28	1.136		
	Total	68.059	33			

Table 5 ANOVA analysis on differences of eosinophils of the age of kid goats

ANOVA						
Age		Sum of Squares	df	Mean Square	F	**Sig.**
1 day	Between Groups	19.258	5	3.852	10.961	**.000**
	Within Groups	6.325	18	.351		
	Total	25.583	23			
1	Between Groups	14.056	5	2.811	3.667	**.010**
month	Within Groups	23.000	30	.767		
	Total	37.056	35			
3	Between Groups	24.047	5	4.809	13.383	**.000**
months	Within Groups	7.906	22	.359		
	Total	31.953	27			
5	Between Groups	15.269	5	3.054	6.907	**.000**
months	Within Groups	12.380	28	.442		
	Total	27.649	33			

Table 6 ANOVA analysis on differences of platelet count of the age of kid goats

ANOVA						
Age		Sum of Squares	df	Mean Square	F	**Sig.**
1 day	Between Groups	1076673299999.999	5	215334660000.000	3.363	**.026**
	Within Groups	1152701200000.000	18	64038955555.556		
	Total	2229374500000.000	23			
1	Between Groups	503424120555.556	5	100684824111.111	1.472	**.228**
month	Within Groups	2052102701666.667	30	68403423388.889		
	Total	2555526822222.222	35			
3	Between Groups	2070252924285.714	5	414050584857.143	8.707	**.000**
months	Within Groups	1046218520000.000	22	47555387272.727		
	Total	3116471444285.714	27			
5	Between Groups	2198190017254.902	5	439638003450.980	7.380	**.000**
months	Within Groups	1668093593333.333	28	59574771190.476		
	Total	3866283610588.235	33			

APPENDIX G

Body Weight of Sex Groups

Table 1 T-test analysis of sex groups perceptions of different age of adult goats

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	**Sig. (2-tailed)**
1.5	Equal variances assumed	.032	.858	1.480	308	**.140**
year	Equal variances not assumed			1.483	166.087	**.140**
2	Equal variances assumed	1.740	.188	.048	291	**.961**
years	Equal variances not assumed			.051	171.723	**.959**
2.5	Equal variances assumed	.024	.876	.951	269	**.343**
years	Equal variances not assumed			.955	126.975	**.341**
3	Equal variances assumed	5.822	.017	.024	191	**.981**
years	Equal variances not assumed			.022	34.311	**.983**

Table 2 T-test analysis of sex groups perceptions of different age of kid goats

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Weight		F	Sig.	t	df	**Sig. (2-tailed)**
first	Equal variances assumed	.746	.390	2.246	110	**.027**
day	Equal variances not assumed			2.241	108.115	**.027**
1	Equal variances assumed	.038	.845	1.778	105	**.078**
month	Equal variances not assumed			1.777	104.682	**.078**
2	Equal variances assumed	.072	.789	1.370	105	**.174**
months	Equal variances not assumed			1.370	104.959	**.174**
3	Equal variances assumed	.110	.740	1.173	104	**.243**
months	Equal variances not assumed			1.173	103.927	**.243**
5	Equal variances assumed	.130	.720	1.303	101	**.196**
months	Equal variances not assumed			1.303	100.550	**.196**

APPENDIX H

Red Blood Cells of Sex Groups of Adults

Table 1 T-test analysis on differences of Red blood cells of different sex groups of adults

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age		F	Sig.	t	df	**Sig. (2-tailed)**
1.5	Equal variances assumed	8.019	.006	-5.650	85	**.000**
	Equal variances not assumed			-5.585	73.289	**.000**
2	Equal variances assumed	5.409	.022	-5.773	82	**.000**
	Equal variances not assumed			-5.693	71.568	**.000**
2.5	Equal variances assumed	5.617	.020	-6.042	82	**.000**
	Equal variances not assumed			-6.002	74.167	**.000**
3	Equal variances assumed	7.212	.009	-5.827	82	**.000**
	Equal variances not assumed			-5.692	67.665	**.000**

Table 2 T-test analysis on differences of hemoglobin of different sex groups of adults

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age		F	Sig.	t	df	**Sig. (2-tailed)**
1.5	Equal variances assumed	40.561	.000	6.645	85	**.000**
	Equal variances not assumed			6.476	52.468	**.000**
2	Equal variances assumed	38.604	.000	6.315	82	**.000**
	Equal variances not assumed			6.095	49.672	**.000**
2.5	Equal variances assumed	43.289	.000	6.618	82	**.000**
	Equal variances not assumed			6.502	51.313	**.000**
3	Equal variances assumed	40.628	.000	6.501	82	**.000**
	Equal variances not assumed			6.168	48.375	**.000**

Table 3 T-test analysis on differences of packed cell volume of different sex groups of adults

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age		F	Sig.	t	df	**Sig. (2-tailed)**
1.5	Equal variances assumed	.021	.885	-8.243	85	**.000**
	Equal variances not assumed			-8.223	83.396	**.000**
2	Equal variances assumed	.010	.922	-7.889	82	**.000**
	Equal variances not assumed			-7.867	80.071	**.000**
2.5	Equal variances assumed	.052	.820	-8.248	82	**.000**
	Equal variances not assumed			-8.242	81.510	**.000**
3	Equal variances assumed	.008	.929	-8.290	82	**.000**
	Equal variances not assumed			-8.267	79.322	**.000**

Table 4 T-test analysis of mean corpuscular volume of sex groups of adults

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age		F	Sig.	t	df	**Sig. (2-tailed)**
1.5	Equal variances assumed	16.121	.000	-4.850	85	**.000**
	Equal variances not assumed			-4.939	70.248	**.000**
2	Equal variances assumed	14.706	.000	-4.650	82	**.000**
	Equal variances not assumed			-4.766	69.254	**.000**
2.5	Equal variances assumed	15.054	.000	-4.997	82	**.000**
	Equal variances not assumed			-5.058	67.700	**.000**
3	Equal variances assumed	13.585	.000	-4.657	82	**.000**
	Equal variances not assumed			-4.825	72.453	**.000**

Table 5 T-test analysis of mean corpuscular hemoglobin of sex groups of adults

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age		F	Sig.	t	df	**Sig. (2-tailed)**
1.5	Equal variances assumed	11.750	.001	6.867	85	**.000**
	Equal variances not assumed			6.769	69.273	**.000**
2	Equal variances assumed	12.107	.001	6.384	82	**.000**
	Equal variances not assumed			6.257	65.296	**.000**
2.5	Equal variances assumed	11.343	.001	6.612	82	**.000**
	Equal variances not assumed			6.547	67.968	**.000**
3	Equal variances assumed	9.319	.003	6.991	82	**.000**
	Equal variances not assumed			6.805	65.211	**.000**

Table 6 T-test of different sex groups of adults

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age		F	Sig.	t	df	**Sig. (2-tailed)**
1.5	Equal variances assumed	4.761	.032	8.164	85	**.000**
	Equal variances not assumed			8.229	82.941	**.000**
2	Equal variances assumed	3.536	.064	7.800	82	**.000**
	Equal variances not assumed			7.879	80.925	**.000**
2.5	Equal variances assumed	5.843	.018	8.492	82	**.000**
	Equal variances not assumed			8.541	78.990	**.000**
3	Equal variances assumed	4.018	.048	8.246	82	**.000**
	Equal variances not assumed			8.372	81.636	**.000**

Table 7 T-test analysis of red blood cells distribution width of sex groups of adults

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age		F	Sig.	t	df	**Sig. (2-tailed)**
1.5	Equal variances assumed	.788	.377	2.041	85	**.044**
	Equal variances not assumed			2.026	79.061	**.046**
2	Equal variances assumed	1.179	.281	1.982	82	**.051**
	Equal variances not assumed			1.960	74.513	**.054**
2.5	Equal variances assumed	.357	.552	2.332	82	**.022**
	Equal variances not assumed			2.324	79.545	**.023**
3	Equal variances assumed	1.335	.251	2.119	82	**.037**

Equal variances not assumed	2.083	71.887	**.041**

APPENDIX I

White Blood Cells of Sex Groups of Adults

Table 1 T-test analysis on differences of white blood cells of different sex groups of adults

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age/year		F	Sig.	t	df	**Sig. (2-tailed)**
1.5	Equal variances assumed	.105	.747	-3.308	85	**.001**
	Equal variances not assumed			-3.318	84.988	**.001**
2	Equal variances assumed	.030	.863	-3.579	82	**.001**
	Equal variances not assumed			-3.588	81.854	**.001**
2.5	Equal variances assumed	.051	.822	-3.194	82	**.002**
	Equal variances not assumed			-3.199	81.953	**.002**
3	Equal variances assumed	.074	.787	-3.294	82	**.001**
	Equal variances not assumed			-3.312	81.598	**.001**

Table 2 T-test analysis on differences of polymorphs of different sex groups of adults

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age/year		F	Sig.	t	df	**Sig. (2-tailed)**
1.5	Equal variances assumed	23.005	.000	-5.339	85	**.000**
	Equal variances not assumed			-5.419	75.113	**.000**
2	Equal variances assumed	28.957	.000	-5.163	82	**.000**
	Equal variances not assumed			-5.282	71.318	**.000**
2.5	Equal variances assumed	18.792	.000	-5.565	82	**.000**
	Equal variances not assumed			-5.620	72.366	**.000**
3	Equal variances assumed	22.132	.000	-5.272	82	**.000**
	Equal variances not assumed			-5.439	75.272	**.000**

Table 3 T-test analysis of lymphocytes of different sex groups of adults

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age/year		F	Sig.	t	df	**Sig. (2-tailed)**
1.5	Equal variances assumed	9.427	.003	4.556	85	**.000**
	Equal variances not assumed			4.597	81.945	**.000**
2	Equal variances assumed	10.768	.002	4.404	82	**.000**
	Equal variances not assumed			4.464	79.256	**.000**
2.5	Equal variances assumed	6.608	.012	4.456	82	**.000**
	Equal variances not assumed			4.480	79.527	**.000**
3	Equal variances assumed	6.868	.010	4.198	82	**.000**
	Equal variances not assumed			4.265	81.514	**.000**

Table 4 T-test analysis on differences of monocytes of different sex groups of adults

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age/year		F	Sig.	t	df	**Sig. (2-tailed)**
1.5	Equal variances assumed	26.042	.000	-4.432	85	**.000**
	Equal variances not assumed			-4.326	54.616	**.000**
2	Equal variances assumed	20.181	.000	-4.555	82	**.000**
	Equal variances not assumed			-4.409	52.327	**.000**
2.5	Equal variances assumed	21.050	.000	-4.486	82	**.000**
	Equal variances not assumed			-4.416	55.392	**.000**
3	Equal variances assumed	26.491	.000	-4.470	82	**.000**
	Equal variances not assumed			-4.252	50.001	**.000**

Table 5 T-test analysis on differences of eosinophils of different sex groups of adults

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age/year		F	Sig.	t	df	**Sig. (2-tailed)**
1.5	Equal variances assumed	39.669	.000	4.708	85	**.000**
	Equal variances not assumed			4.855	50.004	**.000**
2	Equal variances assumed	38.516	.000	4.766	82	**.000**
	Equal variances not assumed			4.974	48.795	**.000**
2.5	Equal variances assumed	36.338	.000	4.385	82	**.000**
	Equal variances not assumed			4.478	47.952	**.000**
3	Equal variances assumed	36.130	.000	4.473	82	**.000**
	Equal variances not assumed			4.765	50.677	**.000**

Table 6 T-test analysis of platelet count of different sex groups of adults

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age/year		F	Sig.	t	df	**Sig. (2-tailed)**
1.5	Equal variances assumed	35.928	.000	5.165	85	**.000**
	Equal variances not assumed			5.074	64.133	**.000**
2	Equal variances assumed	33.424	.000	5.074	82	**.000**
	Equal variances not assumed			4.950	60.292	**.000**
2.5	Equal variances assumed	38.211	.000	4.943	82	**.000**
	Equal variances not assumed			4.882	62.533	**.000**
3	Equal variances assumed	37.005	.000	4.875	82	**.000**
	Equal variances not assumed			4.695	57.942	**.000**

APPENDIX J

Red Blood Cells of Sex Groups of Kids

Table 1 T-test analysis of Red blood cells of different sex groups of kids

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age		F	Sig.	t	df	**Sig. (2-tailed)**
1 day	Equal variances assumed	.991	.327	.704	34	**.486**
	Equal variances not assumed			.736	21.348	**.470**
1 month	Equal variances assumed	.902	.349	1.254	35	**.218**
	Equal variances not assumed			1.284	16.916	**.216**
3 month	Equal variances assumed	2.113	.156	-.668	30	**.509**
	Equal variances not assumed			-.844	10.562	**.417**
5 month	Equal variances assumed	.048	.828	-.310	66	**.758**
	Equal variances not assumed			-.307	51.581	**.760**

Table 2 T-test analysis of hemoglobin of different sex groups of kids

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age		F	Sig.	t	df	**Sig. (2-tailed)**
1 day	Equal variances assumed	.053	.819	.758	34	**.454**
	Equal variances not assumed			.746	18.551	**.465**
1 month	Equal variances assumed	6.546	.015	1.357	35	**.183**
	Equal variances not assumed			1.847	32.665	**.074**
3 month	Equal variances assumed	2.042	.163	.536	30	**.596**
	Equal variances not assumed			.433	6.233	**.680**
5 month	Equal variances assumed	1.974	.165	-.548	66	**.586**
	Equal variances not assumed			-.574	60.803	**.568**

Table 3 T-test analysis of packed cell volume of different sex groups of kids

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age		F	Sig.	t	df	**Sig. (2-tailed)**
1 day	Equal variances assumed	.395	.534	.298	34	**.768**
	Equal variances not assumed			.281	16.896	**.782**
1 month	Equal variances assumed	3.624	.065	.273	35	**.786**
	Equal variances not assumed			.308	20.884	**.761**
3 month	Equal variances assumed	.002	.968	.441	30	**.663**
	Equal variances not assumed			.403	6.869	**.699**
5 month	Equal variances assumed	1.119	.294	.046	66	**.964**
	Equal variances not assumed			.047	59.061	**.962**

Table 4 T-test analysis of mean corpuscular volume of different sex groups of kids

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age		F	Sig.	t	df	**Sig. (2-tailed)**
1 day	Equal variances assumed	1.960	.171	.486	34	**.630**
	Equal variances not assumed			.420	14.283	**.681**
1 month	Equal variances assumed	3.338	.076	-.557	35	**.581**
	Equal variances not assumed			-.837	34.543	**.409**
3 month	Equal variances assumed	2.172	.151	-.559	30	**.581**
	Equal variances not assumed			-1.029	28.635	**.312**
5 month	Equal variances assumed	2.245	.139	-.782	66	**.437**
	Equal variances not assumed			-.841	64.100	**.403**

Table 5 T-test analysis of mean corpuscular hemoglobin of sex groups of kids

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age		F	Sig.	t	df	**Sig. (2-tailed)**
1 day	Equal variances assumed	.307	.583	.514	34	**.610**
	Equal variances not assumed			.493	17.448	**.628**
1 month	Equal variances assumed	1.939	.173	-.236	35	**.815**
	Equal variances not assumed			-.290	25.931	**.774**
3 month	Equal variances assumed	1.004	.324	.225	30	**.823**
	Equal variances not assumed			.250	8.546	**.808**
5 month	Equal variances assumed	1.841	.179	-.844	66	**.402**
	Equal variances not assumed			-.894	62.270	**.375**

Table 6 T-test analysis on differences of mean corpuscular hemoglobin concentration of different sex groups of kids

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age		F	Sig.	t	df	**Sig. (2-tailed)**
1 day	Equal variances assumed	.010	.921	-.159	34	**.875**
	Equal variances not assumed			-.153	17.552	**.880**
1 month	Equal variances assumed	1.072	.308	-1.365	35	**.181**
	Equal variances not assumed			-1.190	12.878	**.256**
3 month	Equal variances assumed	.940	.340	-.272	30	**.788**
	Equal variances not assumed			-.301	8.521	**.771**
5 month	Equal variances assumed	.344	.559	-.244	66	**.808**
	Equal variances not assumed			-.238	49.029	**.813**

Table 7 T-test analysis of red blood cells distribution width of different sex groups of kids

		Levene's Test for Equality of Variances		**t-test for Equality of Means**		
Age		F	Sig.	t	df	**Sig. (2-tailed)**
1 day	Equal variances assumed	.003	.955	-.248	34	**.805**
	Equal variances not assumed			-.244	18.531	**.810**
1 month	Equal variances assumed	.640	.429	.548	35	**.587**
	Equal variances not assumed			.599	19.421	**.556**
3 month	Equal variances assumed	.245	.624	.964	30	**.343**
	Equal variances not assumed			1.089	8.748	**.305**
5 month	Equal variances assumed	2.192	.144	.729	66	**.469**
	Equal variances not assumed			.774	62.717	**.442**

APPENDIX K

White Blood Cells of Sex Groups of Kids

Table 1 T-test analysis of white blood cells of different sex groups of kids

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age		F	Sig.	t	df	**Sig. (2-tailed)**
1 day	Equal variances assumed	.254	.617	.737	34	**.466**
	Equal variances not assumed			.771	21.384	**.449**
1 month	Equal variances assumed	2.785	.104	2.332	35	**.026**
	Equal variances not assumed			2.946	27.728	**.006**
3 month	Equal variances assumed	.015	.904	-.078	30	**.938**
	Equal variances not assumed			-.079	7.564	**.939**
5 month	Equal variances assumed	.278	.600	-.423	66	**.673**
	Equal variances not assumed			-.419	51.227	**.677**

Table 2 T-test analysis on differences of polymorphs of different sex groups of kids

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age		F	Sig.	t	df	**Sig. (2-tailed)**
1 day	Equal variances assumed	.043	.836	.752	34	**.457**
	Equal variances not assumed			.756	19.402	**.459**
1 month	Equal variances assumed	3.186	.083	.907	35	**.371**
	Equal variances not assumed			1.041	21.796	**.309**
3 month	Equal variances assumed	.723	.402	-.021	30	**.983**
	Equal variances not assumed			-.021	7.403	**.984**
5 month	Equal variances assumed	1.312	.256	.955	66	**.343**
	Equal variances not assumed			.983	57.992	**.330**

Table 3 T-test analysis on differences of lymphocytes of different sex groups of kids

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age		F	Sig.	t	df	**Sig. (2-tailed)**
1 day	Equal variances assumed	.081	.777	.165	34	**.870**
	Equal variances not assumed			.162	18.515	**.873**
1 month	Equal variances assumed	3.855	.058	.217	35	**.830**
	Equal variances not assumed			.282	29.784	**.780**
3 month	Equal variances assumed	2.677	.112	.511	30	**.613**
	Equal variances not assumed			.616	9.701	**.552**
5 month	Equal variances assumed	.466	.497	-.416	66	**.678**
	Equal variances not assumed			-.430	58.391	**.669**

Table 4 T-test analysis on differences of monocytes of different sex groups of kids

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age		F	Sig.	t	df	**Sig. (2-tailed)**
1 day	Equal variances assumed	.156	.696	-.038	34	**.970**
	Equal variances not assumed			-.036	16.859	**.972**
1 month	Equal variances assumed	4.022	.053	.495	35	**.624**
	Equal variances not assumed			.637	29.089	**.529**
3 month	Equal variances assumed	1.939	.174	.031	30	**.975**
	Equal variances not assumed			.044	13.157	**.966**
5 month	Equal variances assumed	.954	.332	.842	66	**.403**
	Equal variances not assumed			.818	48.126	**.417**

Table 5 T-test analysis on differences of eosinophils of different sex groups of kids

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age		F	Sig.	t	df	**Sig. (2-tailed)**
1 day	Equal variances assumed	.211	.649	-.256	34	**.800**
	Equal variances not assumed			-.257	19.333	**.800**
1 month	Equal variances assumed	2.278	.140	.180	35	**.858**
	Equal variances not assumed			.161	13.282	**.875**
3 month	Equal variances assumed	2.423	.130	.145	30	**.886**
	Equal variances not assumed			.122	6.400	**.907**
5 month	Equal variances assumed	.088	.767	.847	66	**.400**
	Equal variances not assumed			.854	54.717	**.397**

Table 6 T-test analysis on differences of platelet count of different sex groups of kids

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Age		F	Sig.	t	df	**Sig. (2-tailed)**
1 day	Equal variances assumed	.100	.754	.205	34	**.839**
	Equal variances not assumed			.206	19.490	**.839**
1 month	Equal variances assumed	1.162	.289	.052	35	**.959**
	Equal variances not assumed			.063	24.351	**.950**
3 month	Equal variances assumed	.003	.960	1.360	30	**.184**
	Equal variances not assumed			1.318	7.252	**.228**
5 month	Equal variances assumed	2.778	.100	-1.230	66	**.223**
	Equal variances not assumed			-1.303	62.347	**.197**

APPENDIX L

Protein Profiling of Breeds

Table 1 ANOVA of the protein profiling of different breeds of adult goats

ANOVA						
		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
MW (Kilodaltons)	Between Groups	4904.935	2	2452.468	.241	**.786**
	Within Groups	1068618.992	105	10177.324		
	Total	1073523.927	107			
Band %	Between Groups	317.756	2	158.878	1.609	**.205**
	Within Groups	10366.499	105	98.729		
	Total	10684.255	107			

Table 2 ANOVA analysis on differences of the αs1 - Casein of adult goat breeds

ANOVA					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	.113	2	.056	.656	**.533**
Within Groups	1.289	15	.086		
Total	1.401	17			

Table 3 ANOVA analysis of the protein profiling of different breeds of kid goats

ANOVA						
		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
MW (Kilodaltons)	Between Groups	8226.622	5	1645.324	.185	**.968**
	Within Groups	1446893.863	163	8876.649		
	Total	1455120.486	168			
Band %	Between Groups	263.067	5	52.613	.390	**.855**
	Within Groups	22008.736	163	135.023		
	Total	22271.803	168			

Table 4 ANOVA of the αs1 - Casein of different breeds of kid goats

ANOVA					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	.183	5	.037	.589	**.708**
Within Groups	2.914	47	.062		
Total	3.097	52			

APPENDIX M

Gene Polymorphism of Breeds

Table 1 ANOVA analysis on differences of gene polymorphism of adult goat breeds

ANOVA						
MW (Kilodaltons)		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Allele A	Between Groups	34864.694	2	17432.347	1.899	**.168**
	Within Groups	266178.115	29	9178.556		
	Total	301042.810	31			
Allele B	Between Groups	13705.823	2	6852.911	.869	**.431**
	Within Groups	212826.007	27	7882.445		
	Total	226531.830	29			
Allele C	Between Groups	32140.091	2	16070.046	1.334	**.277**
	Within Groups	409626.465	34	12047.837		
	Total	441766.556	36			

Table 2 ANOVA analysis on differences of the frequency of adult goat breeds

ANOVA						
		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Allele A	Between Groups	3252.422	2	1626.211	.963	**.393**
	Within Groups	48946.691	29	1687.817		
	Total	52199.113	31			
Allele B	Between Groups	2784.321	2	1392.161	.974	**.391**
	Within Groups	38609.419	27	1429.978		
	Total	41393.740	29			
Allele C	Between Groups	11232.558	2	5616.279	5.670	**.007**
	Within Groups	33677.154	34	990.505		
	Total	44909.711	36			

Table 3 ANOVA analysis on differences of the MW of kid goat breeds

ANOVA						
		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
MW (Kilodaltons) Allele A	Between Groups	311643.278	5	62328.656	3.423	**.008**
	Within Groups	1383712.119	76	18206.738		
	Total	1695355.396	81			
MW (Kilodaltons) Allele B	Between Groups	274598.273	5	54919.655	3.511	**.006**
	Within Groups	1439260.527	92	15644.136		
	Total	1713858.800	97			
MW (Kilodaltons) Allele C	Between Groups	50226.980	5	10045.396	.845	**.521**
	Within Groups	1093466.030	92	11885.500		
	Total	1143693.010	97			
MW (Kilodaltons) Allele F	Between Groups	79854.712	2	39927.356	3.888	**.029**
	Within Groups	400524.288	39	10269.854		
	Total	480379.000	41			

Table 4 ANOVA analysis on differences of the frequency of kid goat breeds

ANOVA						
		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Allele A	Between Groups	23371.097	5	4674.219	3.081	**.014**
	Within Groups	115284.339	76	1516.899		
	Total	138655.436	81			
Allele B	Between Groups	12770.724	5	2554.145	3.333	**.008**
	Within Groups	70502.986	92	766.337		
	Total	83273.709	97			
Allele C	Between Groups	3341.262	5	668.252	1.184	**.323**
	Within Groups	51936.811	92	564.531		
	Total	55278.073	97			
Allele F	Between Groups	102.628	2	51.314	.077	**.926**
	Within Groups	25842.105	39	662.618		
	Total	25944.733	41			

APPENDIX N

Protein Profiling of Sex Groups

Table 1 T-test analysis on differences of the protein profiling parameters of different genders of adult goats

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**
MW (Kilodaltons)	Equal variances assumed	.074	.786	-.654	106	**.515**
	Equal variances not assumed			-.654	105.402	**.515**
Band %	Equal variances assumed	.490	.485	.427	106	**.671**
	Equal variances not assumed			.429	105.795	**.669**

Table 2 T-test analysis on differences of the αs1 - Casein of adult goat genders

	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	t	df	**Sig. (2-tailed)**
Equal variances assumed	.000	.984	-.839	16	**.414**
Equal variances not assumed			-.821	12.013	**.428**

Table 3 T-test analysis of the protein profiling parameters of genders of kid goats

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**
MW (Kilodaltons)	Equal variances assumed	7.311	.008	1.152	167	**.251**
	Equal variances not assumed			1.155	164.617	**.250**
Band %	Equal variances assumed	1.044	.308	.396	167	**.693**
	Equal variances not assumed			.396	166.890	**.693**

Table 4 T-test analysis on differences of the αs1 - Casein of kid goat genders

	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	t	df	**Sig. (2-tailed)**
Equal variances assumed	.166	.686	.434	51	**.666**
Equal variances not assumed			.432	49.320	**.668**

APPENDIX O

Gene Polymorphism of Sex Groups

Table 1 T-test analysis on differences of the MW of adult goat genders

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	**Sig. (2-tailed)**
A	Equal variances assumed	2.935	.097	.417	30	**.680**
	Equal variances not assumed			.436	29.242	**.666**
B	Equal variances assumed	1.960	.172	.720	28	**.477**
	Equal variances not assumed			.709	24.925	**.485**
C	Equal variances assumed	1.145	.292	-.684	35	**.498**
	Equal variances not assumed			-.680	33.106	**.501**
F	Equal variances assumed	21.055	.001	1.544	12	**.149**
	Equal variances not assumed			2.414	10.390	**.036**

Table 2 T-test analysis on differences of the frequency% of adult goat genders

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	**Sig. (2-tailed)**
A	Equal variances assumed	2.744	.108	1.535	30	**.135**
	Equal variances not assumed			1.615	29.554	**.117**
B	Equal variances assumed	3.087	.090	2.489	28	**.019**
	Equal variances not assumed			2.428	22.542	**.024**
C	Equal variances assumed	.021	.884	-.230	35	**.819**
	Equal variances not assumed			-.230	33.672	**.820**
F	Equal variances assumed	767.536	.000	-2.997	12	**.011**
	Equal variances not assumed			-1.792	3.020	**.170**

Table 3 T-test analysis on differences of the MW of different sex groups of kid goats

		Levene's Test for Equality of Variances		t-test for Equality of Means		
Alleles		F	Sig.	t	df	**Sig. (2-tailed)**
A	Equal variances assumed	.697	.406	-1.028	80	**.307**
	Equal variances not assumed			-1.030	79.988	**.306**
B	Equal variances assumed	17.724	.000	2.000	96	**.048**
	Equal variances not assumed			2.083	73.162	**.041**
C	Equal variances assumed	4.089	.046	.714	96	**.477**
	Equal variances not assumed			.715	95.974	**.476**
F	Equal variances assumed	1.450	.236	2.753	40	**.009**
	Equal variances not assumed			2.715	34.735	**.010**

Table 4 T-test analysis of the α_{s1} - Casein frequency% of sex groups of kid goats

		Levene's Test for Equality of Variances		**t-test for Equality of Means**		
Alleles		F	Sig.	t	df	**Sig. (2-tailed)**
A	Equal variances assumed	8.584	.004	2.430	80	**.017**
	Equal variances not assumed			2.421	76.805	**.018**
B	Equal variances assumed	17.214	.000	1.092	96	**.278**
	Equal variances not assumed			1.123	86.349	**.265**
C	Equal variances assumed	7.162	.009	-2.302	96	**.024**
	Equal variances not assumed			-2.314	91.962	**.023**
F	Equal variances assumed	38.558	.000	-2.387	40	**.022**
	Equal variances not assumed			-2.730	25.714	**.011**

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