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

MOHAMMED MUAYAD TAHA

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

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

FACULTY OF SCIENCE AND MATHEMATICS
SULTAN IDRIS EDUCATION UNIVERSITY
2017

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

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 Adult goats and their kids from each groups were weighed weekly and blood samples were withdrawn in every 2 weeks.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.

CONTENTS

CHAPTER 4 RESULTS

LIST OF THE TABLE

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

LIST OF FIGURES

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$\propto$	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

APPENDIX LIST

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

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).

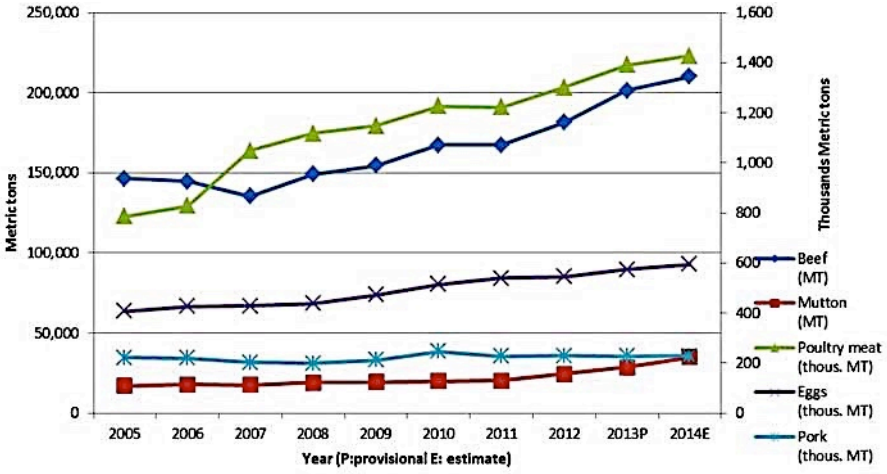

Figure 1.1 Livestock consumption in Malaysia (2005-2014) Source: DVSM (2016)

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 250kb 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