STUDY ON EARLY MILK COMPOSITION AND ITS EFFECT ON PREWEANING GROWTH PERFORMANCE IN BOER GOAT CROSSES

MOHD. NUR KAUTHAR BIN HJ. MOHD. YASIN

DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF BACHELOR OF AGRICULTURE SCIENCE WITH HONOURS

LIVESTOCK PRODUCTION PROGRAMME
SCHOOL OF SUSTAINABLE AGRICULTURE
UNIVERSITI MALAYSIA SABAH
2010

UNIVERSITI MALAYSIA SABAH

BORANG PENGESAHAN STATUS TESIS

JUDUL: STUDY ON EARLY MILK COMPOSITION AND ITS EFFECT ON PREWEANING GROWTH PERFORMANCE IN BOER GOAT CROSSES

IJAZAH: IJAZAH SARJANA MUDA SAINS PERTANIAN DENGAN KEPUJIAN (PENGELUARAN TERNAKAN)

SAYA: MOHD NUR KAUTHAR BIN HJ MOHD YASIN (HURUF BESAR) SESI PENGAJIAN: 2006 - 2010

Mengaku membenarkan tesis * (LPSM/~~Sarjana/Doktor Falsafah~~) ini disimpan di Perpustakaan Universiti Malaysia Sabah dengan syarat-syarat kegunaan seperti berikut:-

1. Tesis adalah hakmilik Universiti Malaysia Sabah.
2. Perpustakaan Universiti Malaysia Sabah dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (/)

☐	SULIT	(Mengandungi maklumta yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di AKTA RAHSIA RASMI 1972)
☐	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana Penyelidikan dijalankan)
☑	TIDAK TERHAD	

(TANDATANGAN PENULIS)

Alamat Tetap: 40, JALAN GELAMA, TAMAN SURIA, 81100 JOHOR BAHRU, JOHOR

Tarikh: 26/04/2010

Disahkan Oleh:

26/4/10

(TANDATANGAN PENYELIA)

DR. KIRON D. K. AMIN
Pengajian Pengurusan Akademik
Sekolah Pengajian Lepasan

(NAMA PENYELIA dan cop)

JAMIUN MICHEAL
PUSTAKAWAN
PERPUSTAKAAN
UNIVERSITI MALAYSIA SABAH

Tarikh:

Catatan: - * Potong yang tidak berkenaan.

** Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak yang berkuasa/organisasi berkenaan dengan menyatakan sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT atau TERHAD.

Tesis dimaksudkan sebagai tesis bagi Ijazah Doktor Falsafah dan Sarjana Secara penyelidikan atau disertasi bagi pengajian secara kerja kursus dan Laporan Projek Sarjana Muda (LPSM)

DECLARATION

I hereby declare that this dissertation is based on my original work except for citations and quotations which have been duly acknowledged. I also declare that no part of this dissertation has been previously or concurrently submitted for a degree at this or any other university.

Mohd. Nur Kauthar bin Hj. Mohd.Yasin
HP2006 – 1871
13rd APRIL 2010

VERIFIED BY

1. Dr. Kiron Deep Singh Kanwal
   SUPERVISOR

DR. KIRON D.S KANWAL
Pensyarah / Penasihat Akademik
Sekolah Pertanian Lestari
Universiti Malaysia Sabah

2. Dr. Abd. Rashid Baba
   CO-SUPERVISOR

3. En. Assis Kamu
   EXAMINER 1

ASSIS KAMU
Lecture / Academic Advisor
School Of Sustainable Agriculture
Universiti Malaysia Sabah

4. En. Mohammad Amizi Ayob
   EXAMINER 2

MOHAMAD AMIZI BIN AYOB
Senior Lecturer / Academic Advisor
School Sustainable Agriculture
Universiti Malaysia Sabah

5. Prof. Dr. Ridzwan Abd. Rahman
   DEAN of SSA

PROF. DR. RIDZWAN ABDUL RAHMAN
Dekan
Sekolah Pertanian Lestari
Universiti Malaysia Sabah

ACKNOWLEDGEMENT

My sincere and profound acknowledgement goes to my supervisor, Dr. Kiron Deep Singh Kanwal for his guidance and support during the course of this project. I like to thank Dr. Abd. Rashid Baba for standing in as co-supervisor, mentorship and constructive criticisms while my main advisor was on leave. Special thanks to Dr. Mohd. Shahrom Salisi and Dr. Punimin Abdullah for their assistance in provided me with to collected goat's milk samples and verification to use Ekomilk Total machine at JPV (Department of Veterinary Service). Many thanks to all my course mate of Livestock Production and Mrs. Nik Siti Mariani for their co-operation and technical assistance towards the success of this effort. My warmest regards goes to the staff of the Sabah Rural Development Corporation, namely, Mr. Crispin, Mr. Jaslin, Mr. Razali, Siti, Kartini and Rina for shared experience and proper animal handling to me. Thanks to Mrs. Farah and their staff for transferring laboratory skills to me. Thank also to my all beloved family, especially my parents Hj. Mohd. Yasin and Hjh. Nurani for their love and support. I would also like to thank Farah 'Amirah for her willingness to assisted me in statistic and completed this study. My foremost appreciation goes to our Lord, Allah SWT, the giver of wisdom and the creator of knowledge and mankind.

ABSTRACT

The objective of this study was to evaluate the early milk composition values for Boer goat crosses and to identify relationship between composition of milk values with preweaning ADG (Average Daily Gain) and weaning weight in single and twin type of birth. A total of 30 samples of milk were collected by hand milking. Milk composition was analyzed using a special milk analyzer, 'Ekomilk Total' which is a robust, reliable, automated multi-parameter milk analyzer and providing rapid test result. All milk composition parameters such as fat, SNF, density, protein and lactose decreased through days except percentage of fat which increased. Result showed that respective parameters except percentage of fat differed significantly ($P < 0.05$) over three days. The milk composition for three days post partum was negatively correlated with preweaning ADG and weaning weight for single kidding. For twin kidding, the correlation between SNF, density, protein and lactose values with preweaning ADG and weaning weight was significantly positive ($P < 0.05$). Conversely, the correlations between percentage of fat with preweaning ADG and weaning weight in twin kidding were significantly negative.

KAJIAN TENTANG KOMPOSISI AWAL SUSU DAN KESANNYA KE ATAS PRESTASI TUMBESARAN SEBELUM CERAI SUSU BAGI KAMBING KACUKAN BOER

ABSTRAK

Objektif kajian ini adalah untuk menilai komposisi awal susu kambing Boer kacukan dan untuk mengenal pasti hubungan antara komposisi susu dengan purata kenaikan berat anak sebelum cerai susu (sapih) dan berat sapih anak bagi satu dan dua jenis kelahiran anak. 30 sampel susu telah dikumpulkan dengan kaedah pemerahan menggunakan tangan. Analisis komposisi susu dengan menggunakan mesin Ekomilk Total yang kuat, dipercayai, automatik multi-parameter dan memberikan keputusan yang cepat. Semua nilai komposisi susu seperti lemak, pepejal bukan lemak, kepadatan, protin dan laktosa menurun terhadap tiga hari kecuali peratus bagi lemak yang meningkat. Keputusan kajian menunjukkan nilai yang nyata ($P < 0.05$) bagi kesan tiga hari selepas kelahiran terhadap semua nilai komposisi susu kecuali peratusan lemak. Komposisi susu untuk tiga hari selepas kelahiran tidak menunjukkan nilai yang nyata dan berkorelasi negatif dengan purata berat sebelum sapih dan berat sapih bagi satu kelahiran anak. Untuk kelahiran kembar, korelasi antara pepejal bukan lemak, kepadatan, protin dan laktosa dengan purata berat badan sebelum sapih dan berat sapih anak adalah positif ($P < 0.05$). Korelasi antara peratusan lemak dengan purata berat sebelum sapih dan berat sapih anak untuk kelahiran kembar adalah tidak nyata dan negatif.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF FORMULA

LIST OF SYMBOLS, UNITS AND ABBREVIATIONS

ADG	Average Daily Gain
ANOVA	Analysis of variance
DVS	Department of Veterinary Service
F	F value
FPT	Failure Passive Transfer
g/cm^3	Gram per Cubic Centimetre
Ig	*Immunoglobulin*
MARDI	Malaysian Agriculture Research and Development Institute
P	Significant level
PKE	Palm Kernel Effluent
PUFA	Polyunsaturated Fatty Acid
r	Pearson Correlation
RDC	Rural Development Corporation
SNF	Solid Non Fat

CHAPTER 1

INTRODUCTION

1.1 Background

Goats are a valuable and important livestock species used for meat production around the world. Goats are the oldest domesticated animal and its meat is widely consumed and the goat continues to be valued as a meat producing livestock species (Jeffrey, 2005).

Boer goat or more popularly termed as *Kambing Boer* in Malaysia is tipped to become a backbone in the goat farming activity and plays an important role in driving the agriculture sector, which seems to be ailing lately. It is expected to undergo a growth of more than 6% per year between 2006 until 2010 and with the support from the Ministry of Agriculture, the government and the associated financial and development bodies; the future seems bright for Boer farming. The National Goat Production Goat targets to have about 1.99 million number of goats in 2015 in Malaysia (Utusan Malaysia, 2008).

1.2 Justification

Colostrum and milk composition quality is very important for the initial growth and survival of the kids. The study is to evaluate early milk composition value such as fat, protein, solid non fat (SNF), density and lactose. Also to identify the relationship between composition constituent of colostrum and milk with preweaning ADG (Average Daily Gain) and weaning weight in crossbred Boer goat.

1.3 Objectives

This project aim is 1) to evaluate the content of early milk composition quality in crossbred Boer goat. 2) To identify the relationship of milk compositional values with preweaning ADG (Average Daily Gain) and weaning weight in single and twin type of birth.

1.4 Boer Goat Milk

Milk production in Boer goats is generally considered ample for rearing multiple kids. Little difference in growth rate at weaning was reported between single and multiple births. Lactation length is shorter for meat breeds compared to the dairy breeds. And milk solids are generally higher in meat breeds. Milk production during the first 12 week of lactation ranged from 1.8 to 2.5 kg/day in Boer goats. Milk fat (6.4 to 9.4 %), protein (3.9 to 4.5 %), and lactose (4.6 to 4.9 %) contents were also reported. It led to the conclusion that milk fat content in Boer goats was twice of that observed in dairy goats. Nevertheless, in a more recent study, milk yield ranged from 1.91 to 2.32 kg/d, fat from 3.4 to 4.6 %, protein from 3.7 to 4.7 %, lactose from 5.2 to 5.4 % during the first 8 weeks of lactation (Christopher, 2002).

According to Christopher (2002), it seems that the milk fat content is higher in Boer goats. But it should not be surprising given the fact that no real peak was observed in milk yield during the course of study. In general, milk yield peaks at 6 to 8 weeks postpartum in lactating dairy goats.

1.5 Birth Weight, Weaning Weight and ADG

Birth weight of Boer kids typically range between three and four kg with male kids weighing approximately 0.5 kg heavier than the females. Weaning weights range between 20 and 25 kg depending upon weaning times and methods. Average daily gain (ADG) measure is important to determine weaning weight (Jeffrey, 2005).

CHAPTER 2

LITERATURE REVIEW

2.1 Background of Boer Goat

Boer goat (*Capra hircus)* is considered to be one of the most desirable goat breeds for meat production. It has gained worldwide recognition for brilliant body conformation, fast growing rate and good carcass quality. Its popularity as a meat goat breed soared during the last decade due to its availability in Australia, New Zealand and later in North America and other parts of the world. Boer goats are widely used in cross breeding programs for the improvement of productive performance of many indigenous breeds. It has a strong impact on the goat meat industry globally (Christopher, 2002).

Although the exact origin of Boer goats is not clear, it is believed to be the result of a genetic pooling of African indigenous goats, Indians goats, Angora goats, and with some influence of European dairy goats. It resembles Nubian goats but have a much larger frame size. Several researchers agree that the indigenous populations were probably from the Namaqua Hottentots and from southward migrating Bantu tribes. The present day Boer goats appeared in the early 1900's when Eastern Cape ranchers started the selection of a meat type goat. The name is derived from the Dutch word "Boer" meaning farmer (Christopher, 2002).

There are five types of Boer goats recognized in South Africa according to South African Boer Goat Breeders' Association. The ordinary Boer goats are animals with good body conformation, short hair and a variety of colour patterns. The long hair Boer goats have heavy coats and coarse meats. The polled Boer goats are hornless with a less desirable confirmation. The indigenous Boer goats have long legs, variable

and poor conformation and a variety of colour patterns. The improved Boer goats are the primary line which breeders have been selected for (Christopher, 2002).

According to Angela (2007), a mature male can weigh between 118 to 172 kg and the female between 95 to 136 kg. They are capable of obtaining average daily gain over 0.40 kg under feedlot conditions. Boer does can also produce three sets of kids every two years with weaning rates over 160%.

Prolificacy is another major distinction of Boer goats. Average litter size is close to two. About 50% of the does produce twins and 10 to 15% produce triplets. In certain instances about to 60% of does produced twins (Christopher, 2002). Estrus synchronization, artificial insemination and embryo transfer have been demonstrated successfully in Boer goats. Boer goats were found to produce higher quality embryos with longer induced estrous period in recipients and higher number of ovulations in donors. It has been demonstrated that under nutrition (4% crude protein) reduced scrotal circumference, testicular volume, sperm concentration and increased sperm abnormality in Boer goats. In addition to prolificacy these technologies can and will speed up enhancement through breeding (Christopher, 2002).

2.2 Colostrum

2.2.1 Definition of Colostrum

Colostrum is the first mammary secretion produced after birth in the mammalian species, and early ingestion of colostrum by the newborn is critical for its survival. Through colostrum, immunoglobulin (Ig) and other important factors in disease protection, as well as hormones, growth factors and essential nutrients are transferred. Failure of passive transfer (FPT) of colostral Ig is associated with increased morbidity and mortality from neonatal diseases and is well documented for the neonates of farm animals. The management of livestock can influence the levels of Ig and is better in kids suckling the colostrum from their dams. Sometimes, this is not possible because the newborn is orphaned or the amount of colostrum is insufficient (Fernandez *et al.*, 2006).

Figure 2.1 Kids suckling colostrum from their mother teats

2.2.2 Secretion of Colostrum

Colostrum and milk components are secreted (Figure 2.1) by different mechanisms. Secretion is regulated by both local and systemic factors. Local factors include intramammary pressure and an autocrine feedback inhibitor of lactation. Milk is secreted between milking and accumulates in alveolar and cisternal compartments. During milking the cisternal fraction is first removed. Removal of the alveolar fraction requires milk ejection by oxytocin at about one minute after tactile udder stimulation has started, resulting in transfer of milk to the cistern for removal. Because milk ejection is a continuous process throughout milking, it can be hypothesized that there are also continuous changes in milk composition during the course of milking (Ontsouka *et al.*, 2002).

2.2.3 Importance of Colostrum

Kids are born without antibodies circulating in their blood and rely on antibodies in colostrum, or first milk, for protection against disease during the first few weeks of life.

The antibodies are concentrated in the doe's udder prior to kidding, are sucked by the kid and then passed through the intestinal wall into the kid's circulation. This transfer, or absorption, is made possible by special cells in the intestinal lining that permit antibodies to pass through for the first 18 hours of life. After that time, the cells are eliminated and no further antibodies can enter the blood stream. It is critical then, that kids suckle soon after birth, preferably within two and four hours. Colostrum is also high in nutrient value, especially vitamin A, B-vitamins, proteins, and minerals. The protein content of colostrum is about 20% as compared to 3.5% for the normal milk (Barnet and Frederick, 2003).

Overfeeding colostrums or other milk to kids can cause loose bowels and possibly scours. The extra colostrum can be placed in the refrigerator and later fed at body temperature. The kid must be handled gently and not forced to drink. After a few hours, the hungry kid will drink readily. The kid may be changed to goat's milk, cow's milk, or powdered milk after about one day on colostrum. Provide about two to three pints of milk each day in three to four feedings the first two to three days and twice per day thereafter (Barnet and Frederick, 2003).

2.2.4 Growth Factors

Growth factors are useful components of milk, both for developing offspring and as potential for nutraceuticals; however, growth factor activity in milk differs among mammals. Goat milk is another source of physiologically active amounts of growth factors. Colostrum from most mammals is rich in growth factors and other bioactive molecules, but the levels of these components decrease rapidly during the first three days of lactation (Wu *et al.*, 2005).

Growth factors in milk have been implicated in the development of the neonatal gastrointestinal tract. Growth factor activity in goat milk, as detected by cell culture assay, occurs at a much higher level than that in cow milk. Hence, goat milk may be a feasible nutraceuticals for gastrointestinal disorders. The ability of goat milks to reduce heat-induced gastrointestinal hyper permeability. These findings support the description in an ancient Chinese medical text of goat milk as a tonic for the digestive system. Preliminary tests of goat milk samples showed high variation in growth factor

activity. To develop a growth factor nutraceuticals product, it is necessary to collect milk with a consistently high growth factor activity (Wu *et al.*, 2005).

2.3 Goat Milk

Goat milk has a high market value. Weaning of kids in a reasonably short period of time is important for the conservation of goat milk. However, the farmer has an ethical duty to meet the nutrient requirements of the kids. Therefore, kids should be reared in such a way to obtain maximum performance at a low cost. The milk feeding of kids starts with the consumption of colostrum postpartum (Ugur *et al.*, 2007).

When selecting a milk goat, teat size and placement are important. If you will be hand milking your goat selects one with teat size that fits your hand, not too small or too large. If you are machine milking the goat the teat should fit into the inflation. The teat should be placed on the outer edge of the half pointing downward or even slightly inward. The medial suspensory ligament should be strong, providing a halving of the udder. The orifice size is important. If it is too small it will take a long time to milk out and if it is too large your doe may leak milk. Upon milking the doe out her udder should be soft and collapse down. If doe has a hard udder after being milked out it may have scar tissue in her udder or have some other health issues. If the doe has just kidded she may have some udder edema which should be gone within one to two weeks. If this swelling persists there are some other problems (Clara, 2004).

2.4 Goat Milk Composition

The composition of goat's milk varies both within and between breeds. Various values have been reported for each of the nutrients. This has without a doubt resulted from analyzing milk from a single breed, a single herd, or the analytical techniques used. Goat's milk contains more fat and ash than cow's milk, but has less lactose. Generally, the composition of goat's milk can be expected to fall within a specified range for each milk component. Fat, the most variable component, will usually fall between 3.0 to 6.0% in herd samples. However, values outside this range are not uncommon for individual samples. The ranges that can be expected for total solids, protein, lactose, and ash are 12-16, 3-4, 3.8-4.8 and 0.70-0.95, respectively (Barnet and Frederick, 2003).

2.4.1 Protein

Proteins are the most valuable components of milk in terms of their importance in human nutrition and their influence on the properties of dairy products containing them. This, together with the availability of rapid instrumental methods of measurement, has led to increased use of protein as a quality parameter in payment of farmers. Proteins are large molecular weight complex organic compounds which contain carbon, hydrogen, oxygen and nitrogen, sulphur, phosphorus and other elements may also be present. These links are together via peptide bonds to form long chains (Harding, 1999).

The protein in goat's milk can be divided into casein and whey protein. Casein accounts for about 83% of the total protein and is the primary protein fraction in cheese products. Casein will coagulate under certain conditions and can be removed from the milk. Rennet, acid, and a combination of pepsin and acid will all coagulate casein in milk. Each method closely resembles a natural process of casein coagulation. Rennet coagulation is the process that is used in cheese making. The addition of acid increases the acidity of milk until the casein coagulates in the similar manner as sour milk and the human digestive process is stimulated by the acid-pepsin coagulation of casein (Barnet and Frederick, 2003).

Whey is the clear liquid that remains after casein is removed from the milk. Proteins that remain in the whey are the whey proteins. Both casein and whey proteins are general categories of proteins. Each contains many individual proteins. Many of these proteins are similar to cow proteins and cause identical allergic reactions. However, there are specific proteins in goat's milk and these are immunologically distinct from proteins in cow's milk (Barnet and Frederick, 2003).

2.4.2 Fat

According to Haenlein (2002), scientifically, fats are called lipids, which include mostly the large group of different triglycerides besides cholesterol and other minor lipids. Triglycerides are very interesting nutritionally, because of their wide range of different physical and chemical properties. They can be solid or soft or liquid at room temperature depending on what their component fatty acids are. They can also be

influenced greatly by feeds, which make up the daily ration of the milk-producing cow, goat or human.

Fat in milk occurs as small fat droplets of different diameters. Between different goat and cow species as well as between goats and cows, considerable differences exist in the frequency distribution of small and large droplets of milk fat, which provides different degrees of a kind of naturally homogenized milk fat in some milk, mostly for genetic reasons. The greater amount of small fat droplets in milk of many goat breeds compared to many cow breeds has been long a point of emphasis, when goat and cow milk have been discussed for human nutrition and digestibility. Actually, even more important is the chemical composition within the fat droplets (Haenlein, 2002).

The lipids or fats of milk cumulatively are referred to as butterfat. Biologically, due to the high percentage of carbon in fats, they are stored nutrients with the highest energy or calorific value of all food constituents. The basic structure involves etherification of fatty acids onto a glycerol molecule. Saturated fatty acids have no double bonds, monounsaturated one and polyunsaturated two or more double bonds. In oils from fish or plants, fatty acids tend to be polyunsaturated (PUFA) whereas animal fats tend to be saturated. However, the fatty acids of butterfat differ in chain length and in levels of monounsaturated and this variation can affect both the nutritional value of fat and the quality and characteristics of products made from it (Harding, 1999).

2.4.3 Lactose

Lactose, with the exception of water is, at about 4.6%, the principal component of milk yet it is the less important of the solids both nutritionally and commercially. Lactose (milk sugar) is the major carbohydrate in the milk of most mammals. Consequently, mammalian milk is the major course of the lactose, one of the most common natural disaccharides. Lactose consists of two molecules, D-glucose and D-galactose and is digested or breakdown into these constituents part by the enzyme lactase (Harding, 1999).

2.4.4 Solid Non Fat

SNF (Solid Non Fat) by definition are the total solids other than butterfat. The reference SNF therefore is obtained by taking the reference oven-drying total solids and subtracting the reference (solvent extraction) butterfat (Harding, 1999).

2.5 Kid Weight Growth

Another important trait to consider when analyzing a kid's growing potential is his/her ability to gain weight from birth to weaning. One point to consider is that daily weight gain averages have a substantial amount of variability due to differences in litter sizes and type of rearing. Boer goats had higher daily gain with an average of 0.23 kg/day kept under intensive conditions with free access to a high quality feed ration (Jeffrey, 2005).

Base on Christopher (2002), the average daily gain was 0.062, 0.139, 0.182, and 0.194 kg for birth - 10 kg, 10 – 23 kg, 23 - 32 kg and 32 – 41 kg body weight. Average daily gains were 0.240, 0.238, and 0.218 kg/day for single, twin and triplets Boer kids raised in Namibia, respectively. The corresponding rates in Germany were 0.257, 0.193, and 0.182 kg/day. Post weaning growth can be in excess of 0.25 kg/day for Boer goats under extreme favourable conditions. This is substantially higher than dairy goats during birth to weaning, 0.13-0.15 kg/day, and during 4 to 8 months of age, 0.115 kg/day.

Faster growing rate implies that Boer goats can potentially reach marketing weight earlier. However, it must also consider desirable carcass quality to capture maximum market return. Another important implication of faster growing rate is that Boer goats can reach breeding weight earlier. Continuous improvement in genetic selection, feeding method, and management system may contribute to even a faster growing rate in Boer goats as well as their crosses in the future (Christopher, 2002).

CHAPTER 3

MATERIALS AND METHODS

3.1 Study Site

Production performance data was randomly collected on selected crossbred Boer female goats at RDC Cross Boer Goat Breeding Project farm in Kampung Kabang, Papar (Figure 3.1). This project is collaboration between RDC and MARDI.

Figure 3.1 RDC Cross Boer Goat Breeding Project farm

REFERENCES

Angela, M. J. 2007. Selecting and Evaluating Goats for Meat Production. Extension Animal Science Specialist Florida A&M University College of Engineering Sciences. *Florida A&M University College of Engineering Sciences, Technology, and Agriculture*

Barnet, H. and Frederick S. 2003. Dairy Goat Production Guide. Dairy Science Undergraduate Student, Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville. *Animal Science Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida*

Calderon, I., De Peters, E. J., Smith, N. E and Franke, A. A. 1984. Composition of Goat's Milk: Changes within Milking and Effects of a High Concentrate Diet. *Journal of Dairy Science* **67**

Chen, J. C., Chang, C. J., Peh, H. S. and Chen, S. Y. 1998. Total Protein and y-Globulin Contents of Mammary Secretion during Early Post-Partum Period of Nubian Goats in the Taiwan Area. *Small Ruminant Research* **31** (1998) 67-73

Christopher, D. L. 2002. *Boer Goat Production: Progress and Perspective*, http://www.uhh.hawaii.edu/uhh/vcaa/documents/BoerGoatProductionProgressaandPerspective2002.pdf. Access on 6 May 2009. Verified on 2 Mac 2010

Clara, H. 2004. The Milk Goat. *My 4-H Goat Project Record Book.* http://www.adga.org/milk-goat.pdf. Access on 19 Mac 2010. Verified on 2 Mac 2010

Fernandez, A., Ramos, J. J., Loste, A., Ferrer, L. M., Figueras, L., Verde, M. T. and Marca, M. C. 2006. Influence of Colostrum Treated by Heat on Immunity Function in Goat Kids. *Comparative Immunology, Microbiology & Infectious Diseases* **29** (2006): 353–364

Goonewardene, L. A., Okinea, E., Patrick, N. and Scheer, H. D. 1998. The Relationship between Multiple Births and Milk Yields in Non-Suckled Intensively Managed Dairy Goats. *Small Ruminant Research* **32** (1999) 181-185

Greyling, J. P. C., Mmbengwa, V. M., Schwalbach, L. M. J., and Muller, T. 2002. Comparative Milk Production potential of Indigenous and Boer Goats under Two Feeding Systems in South Africa. *Small Ruminant Research* **55** (2004) 97-105

Hadjipanayiotou, M. 1994. Composition of Ewe, Goat and Cow Milk and of Colostrum of Ewes and Goats. *Small Ruminant Research* **18** (1995) 255-262

Haenlein, G. F. W. 2002. *Lipids and Proteins in Milk, Particularly Goat Milk.* http://ag.udel.edu/extension/information/goatmgt/gm-08.htm. Access on 22 September 2009

Harding, F. 1999. Milk Quality. Compositional Quality. *Chapman and Hall Food Science Book, Aspen Publishers, Inc. Gaithersburg, Maryland, Aspan, First Edition*: 76-85

Jeffrey, A. R. 2005. *Estimation of Reproductive, Production, and Progeny Growth Differences among F1 Boer-Spanish and Spanish Females.* Master of Science Thesis, Texas A&M University

Mmbengwa, V. M., Schwalbach, L. M., Greyling, J. P. C. and Fair, M. D. Milk Production Potential of South African Boer and Nguni Goats. *South African Journal of Animal Science* 2000, **30** (Supplement 1)

Nickerson, S. C. 1999. Milk Quality. Milk Production: Factors Affecting Milk Composition. *Chapman and Hall Food Science Book, Aspen Publishers, Inc. Gaithersburg, Maryland, Aspan, First Edition*: 22-23

Ontsouka, C. E., Bruckmaier, R. M. and Blum, J. W. 2002. Fractionized Milk Composition During Removal of Colostrum and Mature Milk. *Journal of Dairy Science* **86**:2005-2011

Rudovsky, A., Locher, L., Zeyner, A., Sobiraj, A. and Wittek, T. 2007. Measurement of immunoglobulin concentration in Goat Colostrum. *Small Ruminant Research* **74** (2008) 265-269

Tsenkova, R., Atanassova, S., Toyoda, K., Ozaki, Y., Itoh, K. and Fearn, T.1999. Near-Infrared Spectroscopy for Dairy Management: Measurement of Unhomogenized Milk Composition. *Journal Dairy Science* **82**:2334-2351

Ugur, F., Atasoslu, C., Tolu, C., Diken, F. and Pala, A. 2007. Effects of Different Weaning Programs on Growth of Saanen Kids. *Animal Science Journal* (2007) 78, 281–285

Utusan Malaysia. 2008. Boer Farming in Malaysia. *Utusan Malaysia,* 03 April 2008

Wu, F. Y., Tsao, P. H., Wang, D. C., Lin, S., Wu, J. S. and Cheng, Y. K. 2005. Factors Affecting Growth Factor Activity in Goat Milk. *Journal of Dairy Science* **89**:1951-1955