NUTRIENT CONTENT COMPARISON OF MILK FROM SAANEN GOAT BETWEEN SANDAKAN FARM AND DESA DAIRY FARM

LEE JIAN XIANG

PERPUSTAKAAN
UNIVERSITI MALAYSIA SABAH

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

LIVESTOCK PRODUCTION PROGRAM
FACULTY OF SUSTAINABLE AGRICULTURE
UNIVERSITI MALAYSIA SABAH
2017

UMS
UNIVERSITI MALAYSIA SABAH

UNIVERSITI MALAYSIA SABAH

BORANG PENGESAHAN TESIS

JUDUL : ~~Kesan~~ NUTRIENT CONTENT COMPARISON OF MILK FROM SAANEN GOAT BETWEEN ~~Sandakan~~ SANDAKAN FARM AND DESA DAIRY FARM

IJAZAH : Degree of Bachelor of Agricultural Science with Honour - ~~Ke~~ Livestock Production Program

SAYA : LEE JIAN XIANG SESI PENGAJIAN : 2013-2017
(HURUF BESAR)

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

1. Tesis adalah hak milik 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 maklumat 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: 14, Jalan Nakamur 29,
Taman Damai Jaya, 81300
Skudai, Johor

TARIKH: 11.1.2017

Disahkan oleh:
NURULAIN BINTI ISMAIL
PUSTAKAWAN KANAN
UNIVERSITI MALAYSIA SABAH

(TANDATANGAN PUSTAKAWAN)

NURUL'AZAH MOHD YAAKUB
PENSYARAH
FAKULTI PERTANIAN LESTARI
UNIVERSITI MALAYSIA SABAH

TARIKH: 12.1.2017

Catatan:
*Potong yang tidak berkenaan.
*Jika tesis ini SULIT dan TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT dan TERHAD.
*Tesis dimaksudkan sebagai tesis bagi Ijazah Doktor Falsafah dan Sarjana Secara Penyelidikan atau disertai bagi pengajian secara kerja kursus dan Laporan Projek Sarjana Muda (LPSM).

PERPUSTAKAAN UNIVERSITI MALAYSIA SABAH

UMS
UNIVERSITI MALAYSIA SABAH

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.

LEE JIAN XIANG
BR13110077
29th November 2016

UMS
UNIVERSITI MALAYSIA SABAH

VERIFIED BY

1. Miss Nurul'azah Mohd Yaakub
SUPERVISOR

Signature and stamp

NURUL'AZAH MOHD YAAKUB
PENSYARAH
FAKULTI PERTANIAN LESTARI
UNIVERSITI MALAYSIA SABAH

UMS
UNIVERSITI MALAYSIA SABAH

ACKNOWLEDGEMENT

This project was made possible through the support, guidance and assistance of many individuals and institutions to whom I am greatly indebted. My most sincere gratitude to my Supervisor, Miss Nurul'azah Mohd Yaakub for her guidance and mentorship throughout my candidature which permitted the completion of this work. Without her constant willingness to assistance, I could have not been able to overcome various problems that arose during the conduct of my project.

Special thanks to the coordinators, Miss Shahida Mohd Sharif and Miss Izyan Ayuni binti Mohamad Selamat for helping me to solve the problems that I meet when conducting my project. Besides that, I would also like to say thank you to all the lecturers who have taught me throughout my study in Faculty of Sustainable Agriculture, University Malaysia Sabah, as enriched me with various knowledge and writing techniques.

I would like to take this opportunity to express my sincere appreciation to all the lab assistants for their continuous assistance and kind help in providing me with all the apparatus and materials required throughout my project.

I also would like to express my deep sense of gratitude to Mr. Chua Tao Phiaw, Mr. Ha Sing Yong, Miss Ooi Phaik Sim, Miss Farhatu Syifa Binti Mohammad Fuad, Miss Nur Afini Bt. Ahmad Akhir, Miss Chong Pui Khee, and Miss Teo Wei Ting and all my friends for their kind assistance and supports in completing my project.

My deepest gratitude and appreciation to my beloved family members, my father, Mr. Lee Ah Tee and my mother, Mrs. Lee Sem Tai, for their continuous blessings and support. Thank you for being the most exemplary role models since I took the first step to school.

Above all, to the Great Almighty, the author of knowledge and wisdom, my deepest gratitude for all the blessings which enables me to complete my project smoothly.

UMS
UNIVERSITI MALAYSIA SABAH

ABSTRACT

An experiment was conducted at the Faculty of Sustainable Agriculture' s Final Year Project laboratories in University Malaysia Sabah, Sandakan, Sabah to determine the selected nutritional content and proximate analysis of the Saanen goat's milk. The objective is to determine the selected nutritional content (lactose and calcium) and proximate analysis of the fresh goat milk from Saanen goat the reared in the Sandakan's farm and in the Desa Dairy Farm, Ranau. Independent-samples t-test was used and done under the statistical program SPSS, version 22. Fresh milk samples from Saanen goat in Desa Dairy Farm that brought from Desa Fresh Mart in Mile 4, Sandakan was used to compare with the Saanen goat from Az-Zahra Farm that reared in Sandakan in Mile 10 (control). Parameters were included total solids/dry matter, moisture, ash, fat, protein, carbohydrates, lactose, and calcium and each of them were made in three replicates for each farm. From the result, although carbohydrates and lactose content in the Saanen goat milk from Desa Dairy Farm were higher than Az-Zahra Farm, they were no significant difference between them. However, the others nutrients (total solids/dry matter, moisture, ash, fat, protein, and calcium) had showed significant difference between the farms ($p<0.05$). Thus, the alternate hypothesis (H_A) was accepted and the Desa Dairy Farm have the higher nutritional value for most of the nutrients except the ash content for its goat milk. Since the data analysed in this research were very limited, further in-depth research on the factors affecting the milk composition are recommended. For example, the different stage of lactation or the feeding management of the Saanen goat. Besides that, dairy goat farms with the easier access to their management system for the goats are also recommended for comparison.

UMS
UNIVERSITI MALAYSIA SABAH

PERBANDINGAN KANDUNGAN NUTRIENT SUSU DARI KAMBING SAANEN ANTARA FARM SANDAKAN DAN DESA DAIRY FARM

ABSTRAK

Eksperimen dijalankan dalam makmal Projek Tahun Akhir di Fakulti Pertanian Lestari, Universiti Malaysia Sabah, Sandakan, Sabah untuk menentukan beberapa kandungan nutrient (laktosa dan kalsium) susu kambing Saanen dan analisis proksimat. Objektif kajian ini adalah untuk menentukan kandungan nutrient yang dipilih (kalsium dan laktosa) dan analisis proksimat dari kambing Saanen yang diternak di Sandakan dan di Desa Dairy Farm, Ranau. Ujian-T sample bebas telah digunakan dan dilakukan di bawah program statistik SPSS, versi 22. Sampel susu segar dari kambing Saanen di Desa Dairy Farm yang dibawa dari Desa Fresh Mart di Batu 4, Sandakan telah digunakan untuk membandingkan dengan kambing Saanen dari Az-Zahra Farm yang dipelihara di Sandakan di Batu 10 (kawalan). Parameter termasuk jumlah pepejal/berat kering, kelembapan, abu, lemak, protein, karbohidrat, laktosa, dan kalsium dan setiap parameter dibuat dalam tiga ulangan replikasi untuk setiap ladang. Berdasarkan keputusan, walaupun kandungan karbohidrat dan laktosa dalam susu kambing Saanen dari Desa Dairy Farm adalah lebih tinggi daripada Az-Zahra Farm, tiada perbezaan yang signifikan di antara kedua-dua ladang. Walau bagaimanpun, nutrien yang lain (jumlah pepejal / bahan kering, kelembapan, abu, lemak, protein dan kalsium) telah menunjukkan perbezaan yang signifikan di antara ladang-ladang ($p<0.05$). Oleh itu, hipotesis alternatif (H_A) telah diterima dan Desa Dairy Farm mempunyai nilai pemakanan yang lebih tinggi bagi kebanyakan nutrient kecuali kandungan abu untuk susu kambing. Sejak data analisis dalam kajian ini adalah sangat terhad, penyelidikan yang mendalam berkenaan faktor-faktor yang akan mempengaruhi kandungan susu adalah disyorkan. Sebagai contoh, perbezaan dalam peringkat laktasi atau pengurusan pemakanan kambing Saanen. Selain itu, ladang tenusu kambing yang lebih mudah untuk pengaksesan sistem pengurusan kambing mereka adalah disyorkan untuk perbandingan.

UMS
UNIVERSITI MALAYSIA SABAH

TABLE OF CONTENTS

UMS
UNIVERSITI MALAYSIA SABAH

UMS
UNIVERSITI MALAYSIA SABAH

LIST OF TABLES

UMS
UNIVERSITI MALAYSIA SABAH

LIST OF FIGURES

UMS
UNIVERSITI MALAYSIA SABAH

LIST OF SYMBOLS, UNITS AND ABBREVIATIONS

<	Less than
>	More than
≥	More than or equal to
AGS	American Goat Society
AOAC	Association of Official Analytical Chemists
Ca	Calcium
CI	Confidence Interval
Cl	Chloride
Cu	Copper
DM	Dry Matter
DP	Degree of polymerisation
DVS	Department of Veterinary Service
FAO	Food and Agriculture Organization
Fe	Iron
FSA	Faculty of Sustainable Agriculture
FSSAI	Food Safety and Standards Authority of India
I	Iodine
IDF	International Dairy Federation
IDFA	International Dairy Foods Association
K	Potassium
Mg	Magnesium
Na	Sodium
°C	Degree Celcius
P	Phosphate
PKE	Palm Kernel Extract
S.D	Standard deviation
S.N.F.	Solid-not-fat
SACN	Scientific Advisory Committee on Nutrition
Se	Selenium
T.S.	Total solid
UHT	Ultra-high temperature processing
UMS	University Malaysia Sabah
WHO	World Health Organization
Zn	Zinc

UMS
UNIVERSITI MALAYSIA SABAH

CHAPTER 1

INTRODUCTION

1.1 Background Study

Saanen goat is one of the dairy breed goat that originated from Saanen Valley, Switzerland (Greenwood, 1997; Belanger and Bredesen, 2010). It is the largest breed among others dairy breed goat and they are well-known because of their calm, eager-to-please temperament (Amundson, 2013).

In Malaysia, Saannen is the most common dairy goat breed that was imported since 1950's (Shanmugavelu and Nizamuddin, 2014). In 2009, Sarawak had imported a total of 115 dairy goats by the Agriculture Department, which comprising of various breed that include Saanen goats to meet the request of the local dairy goat producers. Saanen and other dairy goat breeds, such as Alpine, Anglo Nubian and Toggenburg are also kept at the Department of Veterinary Service (DVS) Infoternak Farm in Sungai Siput, Perak (DVS, 2013)..

Milk is the product that secreted by the mammalian animals during lactation period, which particularly free from colostrum and can be consider as one of the food that well-known around the world (Ghatak and Bandyopadhyay, 2007). Generally, the major constituents of milk is water, where milk contain about 87% of water roughly (IDFA, 2009). Apart from water, the rest of the constituents are termed as total solid (T.S.) and total solid after removing the fat which refer as solids-not-fat (S.N.F.). Milk containing a lot of essential nutrients require for proper development and maintenance of the human body, such as proteins (include casein and other essential amino acids), carbohydrates (mainly lactose), vitamins (basically riboflavin, thiamine, vitamins A, B_{12} and D), and minerals (calcium, phosphorus, sodium, potassium and other trace minerals) (Caprita *et al.*, 2014). These nutritive components make milk become valued by a lot of

PERPUSTAKAAN UNIVERSITI MALAYSIA SABAH

UMS
UNIVERSITI MALAYSIA SABAH

CHAPTER 1

INTRODUCTION

1.1 Background Study

Saanen goat is one of the dairy breed goat that originated from Saanen Valley, Switzerland (Greenwood, 1997; Belanger and Bredesen, 2010). It is the largest breed among others dairy breed goat and they are well-known because of their calm, eager-to-please temperament (Amundson, 2013).

In Malaysia, Saannen is the most common dairy goat breed that was imported since 1950's (Shanmugavelu and Nizamuddin, 2014). In 2009, Sarawak had imported a total of 115 dairy goats by the Agriculture Department, which comprising of various breed that include Saanen goats to meet the request of the local dairy goat producers. Saanen and other dairy goat breeds, such as Alpine, Anglo Nubian and Toggenburg are also kept at the Department of Veterinary Service (DVS) Infoternak Farm in Sungai Siput, Perak (DVS, 2013)..

Milk is the product that secreted by the mammalian animals during lactation period, which particularly free from colostrum and can be consider as one of the food that well-known around the world (Ghatak and Bandyopadhyay, 2007). Generally, the major constituents of milk is water, where milk contain about 87% of water roughly (IDFA, 2009). Apart from water, the rest of the constituents are termed as total solid (T.S.) and total solid after removing the fat which refer as solids-not-fat (S.N.F.). Milk containing a lot of essential nutrients require for proper development and maintenance of the human body, such as proteins (include casein and other essential amino acids), carbohydrates (mainly lactose), vitamins (basically riboflavin, thiamine, vitamins A, B_{12} and D), and minerals (calcium, phosphorus, sodium, potassium and other trace minerals) (Caprita *et al.*, 2014). These nutritive components make milk become valued by a lot of

PERPUSTAKAAN UNIVERSITI MALAYSIA SABAH

UMS UNIVERSITI MALAYSIA SABAH

people around the world. Ayub *et al.* (2007) described milk as the best and cheapest source of nutrition and an article of daily diet, which can be accept and used by all the age groups easily. To fulfil the market demand, a lot of milk products had also been produce, such as yogurt, cheese, ice-cream, milk powder, etc.

International Dairy Federation (IDF) reported the demand of milk was increase from year to year. The average global per capita milk consumption in 2005 is 101.4 kg, which was then increase gradually to 107.9 kg in 2011 and estimated to have 109.1 kg in 2012 with the estimated population of 7.1 billion people in 2012. The world milk production is mainly derived from cow, buffaloes, goat, sheep and camel. In between these milk producers, cow contributes about 83% of the total world milk production, and followed by buffaloes, goat, sheep and camel with 13%, 2.4%, 1.3% and 0.4% respectively (IDF, 2013). Although the world milk production of goat is much lower compare to cow, but its production is still increasing gradually. In other words, it means the goat milk consumption and demand is rising continuously.

In Malaysia, the indigenous goat breed is kambing Katjang goat (Horts, 1989). Katjang goat is primarily reared for meat and is known for its prolificacy and ability to breed all the year around. However, it's slow growth rate and low effective reproductive ability has result in the necessary for the import of breeding and slaughter goats from other countries. Although the population of goat in Malaysia has improved throughout the year (DVS, 2013), the production of the meat and milk still cannot cover the demand. The self-sufficient level of mutton (goat and sheep) and milk (goat and cow) in 2011 is only 11.3% and 5.0 % respectively (Shanmugavelu and Nizamuddin, 2014). For meat goat, the most popular imported goat breeds are Australian Feral Goat and Boer. For dairy goat, there is no local goat breed specifically reared for milk production.

1.2 Justification

Ghatak and Bandyopadhyay (2007) stated that, all the milk is not a uniform natural fluid, which will differ considerably in composition and also yield. There are a lot of factors which can cause the variation in the chemical composition of milk, such as species, breed, individuality of animal, stage of lactation, age, feeding, environment, udder health, milking interval and analytical procedure (Looper *et al.*, 2001; Haenlein, 2002; Park and Haenlein, 2006; Park *et al.*, 2007; Ghatak and Bandyopadhyay, 2007; Park *et al.*, 2013).

UMS
UNIVERSITI MALAYSIA SABAH

Regarding to the animal species, the composition and structure of milk fat in goat and cow is one of the most significant differences between them. With its smaller fat globules than cow, goat milk is called as the naturally homogenized milk. The protein content between cow and goat milk is fairly similar (Ghatak and Bandyopadhyay, 2007; Belanger and Bredesen, 2010). In term of minerals, the calcium, potassium, and magnesium content in goat milk is higher than in cow milk. Besides that, the study of Yangilar (2013) shows the lactose content of cow is slightly higher than goat. For ewe milk, it high solids content as compared to goat and cow has made it much suitable for processing into cheese and yogurt (Haenlein, 2002).

For stage of lactation, the highest composition of protein and fat in milk is in the colostrum. The fat content in milk will decrease slowly during the first or second months of lactation where, it will then gradually rise up and peak at 250 days as milk production begins to decrease (Heinrichs *et al.*, 2005). The solid-not-fat, total protein, ash, calcium, phosphorus and chloride will decline during first week of lactation, then remain constant or rising slightly up to six months and then increases rapidly to the end of lactation period.

With increasing age or parity of Holstein breed cattle, the milk protein content has typically reduce from 0.1 to 0.15 units over a period of five or more lactations (Looper *et al.*, 2001). Belanger and Bredesen (2010) proposed that, the wide variation of milk constituents in the result can also be caused by the different methods of analysis of a chemical component. For example, total solid in milk can be determined either using gravimetric or using formula, while for formula, this could become a limiting factor to produce accurate result.

In this study, after receiving the Saanen goat's fresh milk from Az-Zahra Farm in Sandakan and Desa Dairy Farm in Ranau, both were analysed for the nutritional content, which include total solids/dry matter, moisture, ash, fat, protein, carbohydrates, lactose, and calcium in the Final Year Project's laboratories in the Faculty of Sustainable Agriculture (FSA). Since there is limited studies to compare the nutritional content of Saanen goat's milk in Sandakan farm with Saanen goat's milk in other distinct in Sabah, a comparative study was made by comparing the selected nutritional content and proximate analysis of fresh goat milk from Saanen goat that reared in the Az-Zahra Farm,

UMS
UNIVERSITI MALAYSIA SABAH

Sandakan and in the Desa Dairy Farm, Ranau, which will provide useful proximate analysis and nutritional status that can be used for future research.

1.3 Objective

This study is to determine the selected nutritional content (lactose and calcium) and proximate analysis of the fresh goat milk from Saanen goat the reared in the Sandakan's farm and in the Desa Dairy Farm, Ranau.

1.4 Hypothesis

H_o: There is no significant difference in the selected nutritional content (lactose and calcium) and proximate analysis of fresh goat milk from Saanen goat that reared in the Sandakan and in the Desa Dairy Farm, Ranau.

H_A: There is significant difference in the selected nutritional content (lactose and calcium) and proximate analysis of fresh goat milk from Saanen goat that reared in the Sandakan and in the Desa Dairy Farm, Ranau.

UMS
UNIVERSITI MALAYSIA SABAH

CHAPTER 2

LITERATURE REVIEW

2.1 Goat

Goat is considered to be the first domesticated ruminant (Bylund, 2015). They are originated from Asia and are now spread almost all over the world. Goat is one of the most versatile domestic ruminant which can adapt to various types of environment, such as arid and humid, tropical and cold, and desert and mountain condition (Silanikove, 2000).

In developing countries, goats as the small ruminant animal have its significant contribution, especially to the poor in the rural areas. It has been appropriately termed as "The Poor Man's Cow" (Iqbal *et al.* 2008; Pegler, 2008; Aziz, 2010; Bhattarai, 2012). The goat breeds can mainly classify according to their main purpose, which is meat, dairy or fibre (Belanger and Bredesen, 2010). Pollott and Wilson (2009) stated that small-scale farmer keep small ruminants for both subsistence and economic reasons and at the same time, they basically improve household livelihoods.

2.1.1 Dairy Goat

Dairy goat are those breeds of goat which reared mainly for their milk production. Compare to dairy cattle, rearing goats as dairy animals will has some benefits, which is more obvious to those resource-poor small farmers (Devendra, 2012). Their smaller size compare to other larger animals (cattle and buffalo) result in less space requirement and lower risk to damage and compact soils. Besides that, they are cheaper to buy and maintain, thus it is suitable for those farmer who does not have a lot of capital. Dairy goat can optimally use the extent resources in low-input systems and marginal environments compare to cattle. They have faster generation turnover and therefore can

UMS
UNIVERSITI MALAYSIA SABAH

provide milk earlier than cattle. Besides that, goat milk is also a major source of nutrients for those nomadic societies and farmers in rural areas even though the production per individual animal is small (Iqbal *et al.*, 2008).

Park and Haenlein (2006) reported that the levels of milk production from surveys in 46 countries around the world are given for 89 goat breeds. Among these breeds, four breeds had recognised as the high-yielding breeds, which are Alpine, Saanen, Toggenburg, and Nubian.

Different from cow milk and human milk, goat milk has better digestibility, alkalinity, buffering capacity and certain therapeutic values in medicine and human nutrition (Park *et al.*, 2007). The average milk yields and lactation length of dairy goats and their origin have been reported, which shows that the goat breeds that came from the Switzerland (Alpine, Appenzell, Saanen, and Toggenburg) have higher milk yield compare to others (Table 2.1).

Table 2.1: Average milk yields and lactation lengths of dairy goats

Country	Breed	Lactation length (Days)	Yield (kg)
Cyprus	Damascus	210-300	460-560
France	Poitevine	230	440-600
Greece	Native	210-250	120-200
India	Barbari	150-230	110-200
	Beetal	182-210	190-210
	Jamnapari	170-270	200-230
Israel	Mamber	150-210	180-240
Italy	Garganica	190-210	180-250
	Girgentana	190-210	300-400
	Ionica	190-210	220-440
	Maltese	190-210	290-600
Norway	Nordic	250-300	600-700
Portugal	Serrana	210-270	300-400
Spain	Blanca Andaluza	198	400-450
	Blanca Celtiberica	200	400-450
	Canaria	210-300	600-700
	Guadarrama	210	440-660
	Malaguena	240-270	500-700
	Murciana-Granadina	210-304	500-730
Switzerland	Alpine, Chamoisee	265-290	600-820
	Appenzell	260-295	480-860
	Saanen	265-300	520-970
	Toggenburg	265-305	510-965

UMS
UNIVERSITI MALAYSIA SABAH

Table 2.1: Average milk yields and lactation lengths of dairy goats (continued)

Country	Breed	Lactation length (Days)	Yield (kg)
Turkey	Kilis	260-280	250-330
U.S.A.	La Mancha	270-305	720-800
	Nubian	270-305	690-780
	Oberhasli	270-305	540-730

Source: Park and Haenlein, 2006.

Malaysia has started utilising the imported breeds since 1950. Those breeds include Saanen, Alpine and Jamnapari. Shanmugavelu and Nizamuddin (2014), reported the population of dairy goats at present has only about 8,195 heads in Peninsular Malaysia. The majority of the dairy goats are reared in the southern state of Johor, which probably due to easier assess by the Singapore market.

a. Saanen Goat

In goat world, Saanen goat knowns as the Holsteins and on average, they produce the most milk of any of the dairy breeds. Saanen goat can produce almost 1,135 kg in 305 days and its all-time milk record is 2,980 kg (Belanger and Bredesen, 2010). The American Goat Society (AGS) stated that Saanen hair is white to creamy white, where white is more preferable. Basically, Saanens will possess pointed and erect ear, and lightly structured head. The hair may be short and fine, although a fringe over the spine and thighs is often present. Greenwood (1997) stated that, Saanens does should weigh at least 64 kg, while the average height measured at the withers is about 81 cm and 94 cm for does and bucks respectively.

2.2 Az-Zahra Farm

Az-Zahra Farm is one of the Sandakan dairy goat farm which is located at Kampung Sebait Padas Street, Mile 10, Sandakan. It situated on latitude 5^0 58'N and longitude 118º02'E. Sandakan has a tropical wet climate with the average annual temperature of 27°C (ClimaTemps.com, n.d.). The average annual rainfall is 3,101.1 mm. The owner of the farm is Mrs. Raiha Binti Ab. Rahman. This farm started its business as a dairy goat farm on 2014, before that, it was focus on meat goat. There are rearing about 100 of Saanen goats and also some other breeds such as Alpine and Toggenburg. The goats are fed with palm leaves and also the supplement feed which were formulated by

UMS
UNIVERSITI MALAYSIA SABAH

themselves. The goat milks produced by the farm were not undergo homogenisation and pasteurisation process and not added any preservative. The storage temperature for the milk there are 4°C or below and is was recommended to consume the milk before two weeks (Nur Afini, 2016).

2.3 Desa Dairy Farm

Desa Dairy Farm is one of the subsidiaries of Desa Group of Companies and is located about 100km north of Kota Kinabalu, at the Mesilau Plateau, Kundasang, Ranau. Mesilau's climate is classified as warm and temperate with the average annual temperature of 16.7°C (Climate-Data.org, n.d.). The average annual rainfall is 2,097 mm. The farm is established in 1978 under the support from the Ministry of Financial and is owned by Chief Minister of Sabah. The primary livestock that reared in the farm is the Holstein-Friesian cattle (imported from New Zealand). The temperate like climate make the place suitable for rearing these kinds of livestock. Desa Dairy Farm is famous not only because of their environment, but also their milk and milk products. Other than fresh milk, it also produce chocolate-flavoured milk, coffee-flavoured milk and various flavours of yogurt (Desa Group Of Companies, 2016).

2.4 Chemical Composition of Milk

Milk carries all the nutrients that necessary for the survival and initial growth of mammalian neonates (Husveth, 2011). Mehta (2015) stated that milk is a heterogeneous mixture which can be define as a complex chemical substances in which fat is emulsified as globules, major milk protein (casein), and some mineral contents in the colloidal state and lactose together with some minerals and soluble whey proteins in the form of true solution. Those components that present in milk will exist in different phases (Table 2.2).

Table 2.2: Major constituents that exist in milk

Compartment	Major Constituents
Aqueous phase	Lactose, oligosaccharides, amino acids, urea, glucosamine, solution ash, Ca, Mg, PO_4, Na, K, Cl_2, CO_2, whey proteins (α-lactalbumin and β-lactoglobulin), lactoferrin, immunoglobulin, losozyme, serum albumin, B-vitamins, ascorbic acid.
Colloidal dispersion	Caseins (α-, β- and κ-), Ca, PO_4.
Emulsion	Fat globules, triacylglycerols, fat soluble vitamins, cholesterol esters.

UMS
UNIVERSITI MALAYSIA SABAH

Table 2.2: Major constituents that exist in milk (continued)

Compartment	Major Constituent
Fat globule membrane	Milk fat globule membrane protein, phospholipids, enzymes, trace minerals.
Cells	Macrophages, neutrophils, lymphocytes, epithelial cells, leukocytes.

Source: Huitema, 2012.

Huitema (2012) and Bylund (2015) stated although those components that present in the milk are basically the same, there still has a wide variation in the balance of components in milk from various species. The main characteristics of the milk composition have been compared with those of milk produced by other mammals (Table 2.3). Determination of the chemical composition of food is important to reveal the nutritive value of the food. All of these nutrient constituents will have their difference analytical procedures.

Table 2.3: Gross milk composition (g/100g) in different species of mammals

Nutrient	Goat	Buffalo	Sheep	Dairy Cattle	Human
Water	86.7	82.2	82.0	87.3	87.1
Lactose	4.4	4.9	4.8	4.6	6.8
Fat	4.5	7.8	7.6	4.4	4.6
Casein	2.6	3.2	3.9	2.8	0.4
Whey Protein	0.6	0.6	0.7	0.6	0.7
Ash	0.8	0.8	0.9	0.7	0.2

Source: Bylund, 2015.

2.4.1 Carbohydrates

Carbohydrates are one of the major source of energy in the diet, which include a range of compounds that contain carbon, hydrogen and oxygen (SACN, 2015). Food and Agriculture Organization/World Health Organization Expert Consultation in 1997 recommended the primary classification of carbohydrates is based on its chemistry, such as the character of individual monomers (e.g. monosaccharides), degree of polymerisation (DP) and type of linkage (α or β) (FAO/WHO, 1998). This divides carbohydrates into three main groups, which are mono- and di-saccharides (DP 1-2), oligosaccharides (DP 3-9) and polysaccharides (DP ≥10) (Table 2.4).

UMS
UNIVERSITI MALAYSIA SABAH

Table 2.4: Chemical classification of carbohydrates

Class	Sub-group	Components
Sugars (DP 1-2)	Monosaccharides	Glucose, fructose, galactose
	Disaccharides	Sucrose, lactose, maltose
Polyols (DP 1-2)*		Erythritol, xylitol, mannitol, sorbitol
		Lactitol, isomalt, maltitol
Oligosaccharides (DP 3-9)	Malto-oligosaccharides	Maltodextrins
	Non-digestible oligosaccharides	Raffinose, stachyose, fructo-oligosaccharides, vebascose
Polysaccharides (DP >9)	Starch	Amylose, amylopectin, modified starches
	Non-starch polysaccharides	Cellulose, hemicellulose, pectins, hydrocolloids (gums)

* There are also less common oligo- polysaccharide forms.
Source: SACN, 2015

In the chemical composition of milk, the main component of carbohydrates in milk is lactose, while other carbohydrates such as glucose, galactose, hexosamine, sialic acid and oligosaccharides are still present in the milk but in trace amount (Ghatak and Bandyopadhyay, 2007).

a. Lactose

Lactose, also termed as milk sugar, is the major part of carbohydrate in the milk of most species (Hurley, 2010). Generally, lactose is found only in the mammary glands and milk (Husveth, 2011; Bylund, 2015). It is less sweet compare to other disaccharides such as sucrose, or monosaccharides (fructose or glucose). There has only about one-sixth the sweetness of cane sugar (sucrose). It is a disaccharides that composed of two monosaccharides, which are D-glucose and D-galactose (Ghatak and Bandyopadhyay, 2007; Husveth, 2011; Bylund, 2015) that joined in a β-1,4-glycosidic linkage (Hurley, 2010) as shown in Figure 2.1. Although it has the same chemical formula as sucrose ($C_{12}H_{22}O_{11}$), it shows different molecular constitution. In chemical term, lactose is termed as 4-O-β-D-galactopyranosy-D-glucopyranose.

There are two forms of lactose, which either α-form (α-glucose with β-galactose) or β-form (β-glucose with β-galactose). This is caused by a process called mutarotation,

UMS
UNIVERSITI MALAYSIA SABAH

where through the open-chain aldehyde form, the C_1 atom of glucose can easily transform from α- to the β-form and vice versa. These two isomeric forms are differ in their specific rotation to the polarised light. Huppertz and Kelly (2009) reported there have specific rotation of +89.4° and +35.0° for α-lactose and β-lactose, respectively at 20°C of water. All these forms of lactose will reach an optical rotation of +55.7° when equilibrium at 20°C with 37.3% of α-lactose and 62.7% β-lactose. The ratio of α- to β- will increase with the temperature but is independent of pH (Ghatak and Bandyopadhyay, 2007).

These is a compound which is the epimer of lactose that will exist in the heated milk (Heppell, 2002; Silveira *et al.*, 2015) and termed as lactulose (4-O-β-D-galactopyranosy-D-fructose) (Figure 2.2). Lactulose represent about 10% of the total lactose found in heated milk. The quantity of lactulose is directly proportional to the intensity of the heat treatment applied (Silveira, 2002; Bylund, 2015) and this can also be used as the indicators of the quality of milk processing (Marales *et. al.*, 2000) to differentiate between pasteurized, ultra-high temperature processing (UHT) and sterilized milks. Ghatak and Bandyopadhyay (2007) claimed lactulose can help in promoting the growth of bifidobacterium and which are beneficial in the diet of human infants. This compound has been applied to treat those people with constipation, especially in elderly.

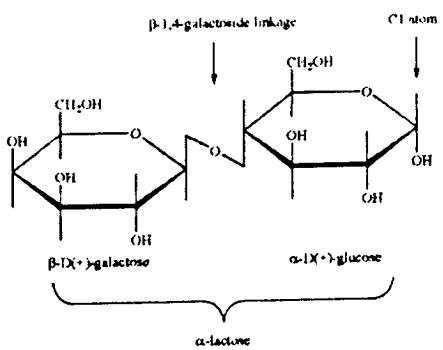

Figure 2.1: Molecular structure of α-lactose

Source: Holles, 2007

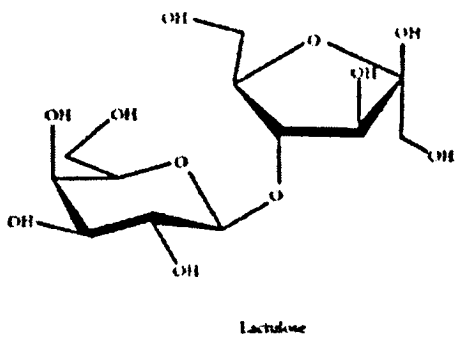

Figure 2.2: Basic structure of lactulose

Source: Silveira *et al.*, 2015

One of the most important reactions that result from the interactions of protein (amino acid) and lactose (sugar) in milk and its products is the Maillard reaction/Browning reaction. In general, this reaction require the addition of heat (Huppertz and Kelly, 2009). The reactive carbonyl of the sugar interacts with the

UMS
UNIVERSITI MALAYSIA SABAH

REFERENCES

American Goat Society. Breed Standards. http://www.americangoatsociety.com/education/breed_standards.php. Accessed on 10th March 2016. Verified on 26th November 2016.

Amundson, C. 2013. A Goat is Just a Goat-Right? In: *How to Raise Goats: Everything You Need to Know, Updated & Revised.* USA: MBI Publishing Company. Pp. 12-37

Association of Official Analytical Chemists. 2006. Official Method of Analysis of AOAC International. 18th Edition. Association of Official Analytical Chemists. Washington, D.C.

Auldist, M. J. and Hubble, I. B. 1998. Effects of mastitis on raw milk and dairy products. *The Australian Journal of Dairy Technology.* **53**: 28-36.

Auldist, M. J., Coats, S., Rogers, G. L., and McDowell, G. H. 1995. Changes in the composition of milk from healthy and mastitis dairy cows during the lactation cyce. *The Australian Journal of Dairy Technology.* **35**: 427-436.

Ayub, M., Ahmad, Q., Abbas, M., Qazi, I. M. and Khattak, I. A. 2007. Composition and Adulteration Analysis of Milk Samples. *Saehad J. Agric.* **23**(4): 1127-1130.

Aziz, M.A. 2010. Present status of the world goat populations and their productivity. http://lohmann-information.de/content/l_i_45_artikel17.pdf. Accessed on 13th March 2016. Verified on 26th November 2016.

Belanger, J and Bredesen, S. T. 2010. *Storey's Guide to Raising Dairy Goats, 4th Edition: Breeds, Care, Dairying, Marketing.* North Adams: Storey Publishing.

Bhattarai, R.R. 2012. Importance of Goat Milk. *J. Food Sci. & Technol.* Nepal. **7**: 107-111.

Bouattour, M. A., Casals, R., Albanell, E., Such, X., and Caja, G. 2008. Feeding soybean oil to dairy goats increases conjugated linoleic aicd in milk. *J. Dairy Sci.* **91**: 2399-2407.

Boyazoglu, J. and Morand-Fehr, P. 2001. Mediterranean dairy sheep and goat products and their quality. A critical review. *Small Rumin. Res.* **40**: 1-11.

Bruckmaier, R. M., Ontsouka, C. E., and Blum, J. W. 2004. Fractionised milk composition in dairy cows with subclinical mastitis. *Veterinary medicine-Czech.* **8:** 283-290

Bylund, G. 2015. *Dairy Processing Handbook.* Sweden: Tetra Pak.

Caprita, R., Caprita, A. and Cretescu, I. 2014. Determination of Lactose Concentration in Milk Serum by Refractometry and Polarimetry. *Animal Sci. and Biotech.* **47**(1): 158-161.

Climate-Data.org. n.d. Climate: Mesilau. http://en.climate-data.org/location/479835/. Accessed on 15th November 2016. Verified on 26th November 2016.

ClimaTemps.com. n.d. Sandakan, Borneo Climate and Temperature. http://www.borneo.climatemps.com/ Accessed on 15th November 2016. Verified on 26th November 2016.

Cooke, T. 2010. Benefits of Goat Milk vs. Cow Milk. https://www.mtcapra.com/benefits-of-goat-milk-vs-cow-milk/. Accessed on 19th March 2016. Verified on 26th November 2016.

Das, R., Sailo, L., and Verma, N., Bharti, P., Saikia, J., Imtiwati, and Kumar, R. 2016. Impact of heat stress on health and performance of dairy animals: A review. *Veterinary World.* **9**(3):260-268. Doi: 10.14202/vetworld.2016.260-268.

Dayoff, M.O. 1979. Kappa casein-goat. In: *Atlas of protein sequence and structure.* Washington, D.C.: Nat. Biomed. Res. Found. **5**(3): 301.

UMS
UNIVERSITI MALAYSIA SABAH

Desa Group Of Companies. 2016. Desa Group of Companies-Our Dairy Farm. http://desaplus.com/index.php?p=1_14. Accessed on 10th March 2016. Verified on 26th November 2016.

Devendra, C. 2012. Dairy Goats in Asia: Multifunctional Relevance and Contribution to Food and Nutrition Security. In: *Proceedings of the First Asia Dairy Goat Conference.* 9th – 12th April 2012. Corus Hotel Kuala Lumpur, Malaysia. 1-6.

Department of Veterinary Services. 2013. Malaysian Livestock Breeding Policy 2013. DVS.

Food and Agriculture Organisation/World Health Organisation. 1998. Carbohydrates in human nutrition. Report of a joint FAO/WHO expert consultation. FAO Food and Nutrition Paper. No. 66. Rome: FAO.

Food Safety and Standards Authority of India. 2015. Determination of Fat in Milk. In: *Manual of Methods of Analysis of Food: Milk and Milk Products.* India: Ministry of Health and Family Welfare. Pp. 36-42.

Gemechu, T., Beyene F. and Eshetu, M. 2015. Physical and chemical quality of raw cow's milk produced and marketed in Shashemene Town, Southern Ethiopia. *J. Food and Agricultural Science.* **5**(2): 7-13.

Ghatak, P.K. and Bandyopadhyay, A.K. 2007. *Practical Dairy Chemistry.* New Delhi: Kalyani Publishers.

Greenwood, P. 1997. Goat Breeds: Saanen. http://www.dpi.nsw.gov.au/agriculture/livestock/goats/breeds/saanen. Accessed on 10th March 2016. Verified on 26th November 2016.

Greppi, G.F., Roncada, P. and Fortin, R. 2008. Protein Components of Goat's Milk. In: Cannas, A. and Pulina, G. (Eds.). *Dairy Goats Feeding and Nutrition.* London: CABI. Pp. 71-94.

Group, E. 2015. Is goat milk better than cow milk? Here's a list of health benefits. http://www.globalhealingcenter.com/natural-health/goat-milk-benefits/. Accessed on 19th March 2016. Verified on 26th November 2016.

Gruner, L., Chabert, Y. (Eds.), 2000. *Proceedings of the Seventh International Conference on Goats, vol. 2.* 31st December 2000 Institute de l'Elevage, Tours, France. P. 1049.

Haenlein, G.F.W. 2002. Nutirtional Value Of Dairy Products Of Ewe And Goat Milk. http://goatconnection.com/articles/publish/article_74.shtml. Accessed on 13th March 2016. Verified on 26th November 2016.

Haenlein, G.F.W. 2004. Goat milk in human nutrition. *Small Rumin. Res.* **51**: 155-163.

Haenlein, G.F.W. and Caccese, R. 1984. Goat milk versus cow milk. In: Haenlein, G.F.W. and Ace, D.L. (Eds.). *Extension Goat Handbook.* Washington: USDA. pp. 1.

Harding, F. 1995. *Milk Quality.* UK: Blackie Academic & Professional.

Heinrichs, J., Jones, C. and Bailey, K. 2005. Milk Components: Understanding the Cause and Importance of Milk Fat and Protein Variation in Your Dairy Herd. Department of Dairy and Animal Science. The Pennsylvania State University.

Heppell, N.J. 2002. Continuous flow heat processing. In: Henry, C.J.K. and Chapman, C (Eds.). *The Nutrition Handbook for Food Processors.* Abington: Woodhead Publishing Limited. Pp. 462-473.

Holles, J. 2007. Catalytic Wet Oxidation of Lactose. http://www.google.com/patents/US20070197825. Accessed on 3rd April 2016.

Horst, P. 1989. The creation of a dual purpose goat in Malaysia as a model case for collaborative research and development. In: Wilson, R.T. and Melaku, A (Eds.). *African Small Ruminant Research and Development.* Ethiopia: African Small Ruminant Research Network.

Huitema, N.A. 2012. *How Genetic and Nutritional Factors affect New Zealand Goat Milk Composition.* Master of Science Dissertation. The University of Waikato.

UMS
UNIVERSITI MALAYSIA SABAH

Huppertz, T. and Kelly, A.L. 2009. Properties and Constituents of Cow's Milk. In: Tamime, A.Y. *Milk Processing and Quality Management.* UK: John Wiley & Sons. Pp. 23-47.

Hurley, W.L. 2010. Milk Composition and Synthesis Resource Library: Milk Composition-Lactose. http://ansci.illinois.edu/static/ansc438/Milkcompsynth/milkcomp_lactose.html. Accessed on 1st April 2016. Verified on 26th November 2016.

Husveth, F. 2011. Composition of milk. In: *Physiological and Reproduction Aspect OF ANIMAL PRODUCTION.* Hungary: University of Debrecen, University of West Hungary, University of Pannonia. Pp. 99-101.

IBM Corp. 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.

International Dairy Federation. 2013. *Bulletin of the International Dairy Federation 470/2013: The World Dairy Situation 2013.* Belgium: IDF.

International Dairy Foods Association. 2009. Definitions of Fluid Milk and Milk Products. IDFA.

Iqbal, A., Khan, B.B., Tariq, M. and Mirza M.A. 2008. Goat- A Potential Dairy Animal: Present and Future Prospects. *Pak. J. Agri. Sci.* **45**(2): 227-230.

Jacobsen, D.H. and Wallis, G.C., 1939. Factors Affecting the Composition of Milk. *Agricultural Experiment Station Bulletins.* Paper 331.

Jenness, R. 1980. Composition and characteristics of goat milk: Review 1968-1979. *J. Dairy Sci.* **63**:1605.

Kuchtik, J., Sustova, K., Urban, T., and Zapletal, D. 2008. Effect of the stage of lactation on milk composition, its properties and the quality of rennet curdling in East Friesian ewes. *Czech J. Anim. Sci.* **53**(2):55-63.

Lehrer, J.K. 2014. Lactose intolerance. https://www.nlm.nih.gov/medlineplus/ency/article/000276.htm. Accessed on 4th April 2016. Verified on 26th November 2016.

Linn, J. G. 1988. Factors Affecting the Composition of Milk from Dairy Cows. In: *Designing Foods: Animal Product Options in the Marketplace.* Washington (DC): National Academic Press.

Lock, A. L. and Amburgh, M. E. V. 2012. Feeding for Milk Components. *WCDS Advanced in Dairy Technology.* **24**:265-277.

Looper, M. 2012. Factors Affecting Milk Composition of Lactating Cows. https://www.uaex.edu/publications/pdf/FSA-4014.pdf. Accessed on 23rd November 2016. Verified on 26th November 2016.

Looper, M.L., Stokes, S.R., Waldner, D.N. and Jordan, E.R. 2001. Managing Milk Composition: Normal Sources of Variation. New Mexico State University Library.

Marshall, M.R. 2010. Ash Analysis. In: Nielsen, S (Eds.). *Food Analysis.* USA: Springer US.

McClees, H. 2014. Casein: The Disturbing Connection Between This Dairy Protein and Your Health. http://www.onegreenplanet.org/natural-health/casein-dairy-protein-and-your-health/. Accessed on 13th March 2016. Verified on 26th November 2016.

Merrill, A.L. and Watt, B.K. 1973. Carbohydrate. In: *Energy Value of Foods – Basis and Derivation.* USA: USDA. pp. 2-3.

Morales, F.J., Romero, C. and Perez, S.J. 2000. Characterization of industrial processed milk by analysis of heat-induced change. *International J. Food Science & Technology.* 35(2). Pp. 193-200.

UMS
UNIVERSITI MALAYSIA SABAH

Nicoleta, S., Gabriela, R. and Silvius, S. 2009. Assessment of Casein Content in Model Systems during Heat Treatment. In: *International Symposium Euro- aliment 2009.* 9-10 October 2009. Galati, Romania. Pp. 9-15.

Nur Afini Bt. A. A. Student of Faculty of Sustainable Agriculture, University Malaysia Sabah. 17th November 2016. Personal communication.

Otaru, S. M., Adamu, A. M., Ehoche, O., and Makun, H. J. 2011. Effects of varying the level of palm oil on feed intake, milk yield and composition and postpartum weight changes of Red Sokoto goats. *Small Ruminant Research.* **96**: 25-35.

Panda, H. 2011. Comparative Aspects of Milk Proteins. In: *Handbook on Milk and Milk Proteins.* India: Asia Pacific Business Press Inc. pp.63-78.

Park, Y.W. 1994. Hypo-allergenic and therapeutic significance of goat milk. *Small Rumin. Res.* **14**: 151-161.

Park, Y.W. 2010. 12 Improving goat milk. In: Griffiths, M.W. (Eds.). *Improving the safety quality of milk. Volume 2: Improving quality in milk products.* UK: Woodhead Publishing Limited. pp. 304-346.

Park, Y.W. and Haenlein, G.F.W. 2006. Goat Milk. In: *Handbook of Milk of Non-Bovine Mammals.* USA: Blackwell Publishing. Pp. 11-136.

Park, Y.W., Albenzio, M., Sevi, A. and Haenlein, G.F.W. 2013. Milk Quality Standards and Controls. In: Park, Y.W. and Haenlein (Eds.). *Milk and Dairy Products in Human Nutrition: Production, Composition and Health.* UK: John Wiley & Sons.

Park, Y.W., Juarez, M., Ramos, M. and Haenlein, G.F.W. 2007. Physico-chemical characteristics of goat and sheep milk. *Small Ruminat Research.* **68**: 88-113.

Parkash, S. and Jenness, R. 1968. The composition and characteristics of goat's milk: A review. *Dairy Sci. Abstr.* **30**:67.

Pavic, V., Antunac, N., Mioc, B., Ivankovic, A., and Havranek, J.L. 2002. Influence of stage of lactation on the chemical composition and physical properties of sheep milk. *Czech J. Anim. Sci.* **47**(2):80-84.

Pegler, H.S.H. 2008. *GOATS & their Profitable Management.* India: BIOTECH BOOKS.

Pollott, G. and Wilson, R.T. 2009. FAO *Diversification booklet number 9: Sheep and goats for diverse products and profits.* Rome: FAO.

Pyorala, S. 2003. Indicators of inflammation in the diagnosis of mastitis. *Veterinary Research.* **34**(5): 565-578.

Qeshlagh, F.M.A., Yonjalli, R.V., Ghorbani, A., and Archachlouei, B.F. 2016. Milk Composition and Mineral Concentration Affected by Elevation and Grazing Season in the Rangelands of North Sabalan Mountain, Iran. J. Adv. Agri. Tech. **3**(1):20-25.

Ranka, A. 2014. Chemistry Investigatory Project: 2014-2015. https://www.scribd.com/doc/251092460/Amount-of-Casein-in-Milk-Chemistry-project-cbse-class-12. Accessed on 16th April 2016. Verified on 26th November 2016.

Richardson, H.G. 1985. *Standard Methods for the Examination of Dairy Products. 6th edition.* Washington D.C.: American Public Health Association. Pp. 133-150.

Scientific Advisory Committee on Nutrition. 2015. Classification, biochemistry, absorption, metabolism and definitions of carbohydrates. In: *Carbohydrates and Health.* London: The Stationery Office. Pp. 10-22.

Shanmugavelu, S. and Quaza Nizamuddin, H.N. 2014. Country Report - Malaysia. In: *Country Reports 2013/2014 of the Asian-Australian Dairy Goat Network.* Malaysia: Universiti Putra Malaysia. Pp. 57-65.

Silanikove, N. 2000. The physiological basis of adaptation in goats to harsh environments. *Small Ruminant Research.* **35**: 181-193.

UMS
UNIVERSITI MALAYSIA SABAH

Silveira, M.F., Masson, L.M.P., Martins, J.F.P., Alvares, T.S., Paschoalin, V.M.F., Torre, C.L. and Conte-Junior, C.A. 2015. Simultaneous Determination of Lactulose and Lactose in Conserved Milk by HPLC-RID. *J. Chemistry,* vol. 2015, Article ID 185967, 6 pages.

Summer, A., Superchi, P., Sabbioni, A., Formaggioni, P., and Mariani, P. 2007. Feeding management and quality. II. Physical and chemical properties and mineral content. In: Pariolo, A., Biondi, L., Ben Salem, H., and Morand-Fehr, P., (Eds.). *Advanced nutrition and feeding strategies to improve sheep and goat.* Zaragoza: CIHEAM. Pp. 213-218.

Sutton, J. D. 1980. Influence of nutritional factors on the yield and content of milk: Dietary components other than fat. *Int. Dairy Fed. Bull. Doc.* **125**:126.

Thomas, P.C. 1983. Milk Protein. *Proc. Nutr. Soc.* **42**:407.

Tomotake, H., Okuyama, R., Katagiri, M., Fuzita, M., Yamato, M. and Ota, F. 2006. Comparison between Holstein cow's milk and Japanese-Saanen goat's milk in fatty acid composition, lipid digestibility and protein profile. *Bioscience Biotechnology and Biochemistry.* **70**: 2771-2774.

Tziboula-Clarke, A. 2003. Goat Milk. In: Roguiski, H., Fuquay, J. and Fox, P. (Eds.). *Encyclopedia of Dairy Sciences.* USA: Academic Press. Pp. 1270-1279.

Whitney, R.M., Brunner, J.R., Ebner, K.E., Farrell, H.M., Josephson, R.V., Morr, C.V. and Swaisgood, H.E. 1976. Nomenclature of the proteins of cow's milk: Fourth revision. *J. Dairy Sci.* **59**:795.

Yangilar, F. 2013. As a Potentially Functional Food: Goats' Milk and Products. *J. Food and Nutrition Research.* **1**(4):68-81.

Yano, M., Shimadzu, H., Endo, T. 2014. Modelling temperature effects on milk production: a study on Holstein cows at a Japanese farm. *SpringerPlus.* **3**:129. Available from: doi: 10.2286/2193-1801-3-129.

UMS
UNIVERSITI MALAYSIA SABAH