UNIVERSITI PUTRA MALAYSIA

MILK PRODUCTION, MILK COMPOSITION AND REPRODUCTIVE PERFORMANCE OF COWS BETWEEN TWO DAIRY FARMS IN MALAYSIA

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By

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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science.

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June 2020

Chair :Halimatun Yaakub, PhD
Faculty :Agriculture

The present study aims at evaluating the factors influencing milk composition, milk production, and reproductive performance of selected cow breeds (Friesian and Jersey cows) in two dairy farms in Malaysia. There is a need to explore ways to improve milk production efficiency in Malaysia, considering the growing demand for milk and milk-based products. Besides, there is also a need to understand the factors influencing milk production. An analysis of previous literature revealed no research was done in a holistic manner encompassing the aspects of milk composition, milk production, and reproductive performance of cows simultaneously and no research was conducted within the Malaysian context. In this regard, the researcher ascertains the need to conduct the study. This study used convenience-sampling method in selecting the dairy farms out of the various farms available in the country. The two farms selected for the study are Taman Pertanian Universiti (TPU) and RedAgri Dairy Farm. The selections of these farms were based on the convenience and feasibility of the researcher to approach the farms to collect the data. The TPU farm was considered for data collection as it breeds Friesian-Sahiwal cows, whereas Redagri Dairy Farm breeds Friesian and Jersey. Each farm was used to collect different data based on the convenience of the researcher and the permission acquired from these farms. This study collected data on lactating cows. The findings showed that there is a significant relationship between breed, parity order and year of calving on calving interval, days open, number of service per conception and days to the first insemination but not on reproductive performance of the cows. There are also associations between the various components within milk composition - blood urea and milk urea, blood protein and milk protein concentration, blood progesterone and milk progesterone. It is recommended that future studies focus on these similar factors in other countries to understand the different ways of cow milk yielding to improve the overall global milk production and cow fertility.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains.

PENGELUARAN SUSU, KOMPOSISI SUSU DAN TAHAP PEMBIAKAN LEMBU DI ANTARA DUA LADANG TENUSU DI MALAYSIA

Oleh

AMER IBRAHIM ALI

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Pengerusi :Halimatun Yaakub, PhD
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Penyelidikan ini bertujuan untuk menilai faktor-faktor yang mempengaruhi komposisi susu, pengeluaran susu, dan tahap pembiakan baka lembu yang terpilih (*Friesian* dan *Jersey*) di dua ladang tenusu di Malaysia. Terdapat keperluan untuk mengenal pasti langkah untuk meningkatkan kecekapan pengeluaran susu di Malaysia memandangkan terdapatnya peningkatan permintaan susu dan produk berasaskan susu. Selain itu, terdapat keperluan untuk memahami faktor yang mempengaruhi pengeluaran susu. Berdasarkan analisis sorotan kajian lepas, tiada kajian menyeluruh dijalankan yang melibatkan aspek komposisi susu, pengeluaran susu, dan prestasi pembiakan lembu sekali gus, dan tiada kajian seperti yang tersebut dilakukan di Malaysia. Oleh itu, terdapatnya keperluan untuk menjalankan kajian tersebut. Kajian ini menggunakan persampelan mudah dalam pemilihan ladang tenusu daripada pelbagai ladang tenusu yang ada di negara ini. Dua ladang tenusu yang terpilih adalah Taman Pertanian Universiti (TPU) dan Ladang Tenusu RedAgri. Pemilihan ladang tersebut adalah berdasarkan kepada kebolehlaksaan dan memudahkan penyelidik untuk ke ladang bagi mengumpul data. Ladang TPU dipilih kerana terdapatnya penternakan lembu baka *Friesian-Sahiwal*, manakala Ladang Tenusu RedAgri menternak lembu baka *Friesian* dan *Jersey*. Setiap ladang digunakan untuk mengumpul data berbeza yang berdasarkan kepada kemudahan penyelidik untuk mengumpul data dan kebenaran yang diperolehi daripada ladang-ladang terlibat. Kajian ini mengumpul data terhadap lembu bersusu. Dapatan menunjukkan terdapatnya hubungan signifikan antara baka, urutan pariti, dan tahun beranak terhadap selang beranak, tempoh buka, jumlah perkhidmatan pengkonseifan, dan hari sehingga permanian pertama tetapi bukan tahap pembiakan lembu. Terdapat juga hubungan di antara pelbagai komponen dalam komposisi susu iaitu, urea darah dan urea susu, protein darah dan kepekatan protein susu, progesteron darah dan progesteron susu. Dicadangkan agar kajian akan datang untuk mengkaji faktor-faktor yang serupa di negara lain untuk mewujudkan kefahaman terhadap pelbagai cara dalam penghasilan susu lembu untuk meningkatkan pengeluaran susu secara global dan kesuburan lembu.

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This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

IFCN	International Farm Comparison Network
FAO	Food and Agriculture Organization
RM	Malaysian Ringgit
PUFA	Polyunsaturated Fatty Acids
MUFA	Monounsaturated Fatty Acids
SFA	Saturated Fatty Acids
EPA	Eicosapentaenoic Acid
SPC	Services Per Conception
CR	Conception Rate
ICAR	International Committee for Animal Recording
DMY	Daily Milk Yields
BCS	Body Condition Score
NEB	Negative Energy Balance
bST	Bovine Somatotropin
AI	Artifical Insemination
BUN	Blood Urea Nitrogen
CFSI	Calving to First service interval
FAME	Fatty acid methyl esters
NDF	Neutral Detergent Fibre
OD	Open Days
PUN	Plasma Urea Nitrogen
CI	Calving Interval
SNF	Solids-Not-Fat
TS	Total Solids
AYC	Average milk Yield per Cow
FMY	Farm Milk Yield
BTSCC	Bulk Tank Somatic Cell Count
UN	Urinary Nitrogen
TPU	Taman Pertanian Universiti
ELISA	Enzyme-Linked Immunosorbent Assay
ANOVA	Analysis of variance
SAS	Statistical Analysis System
NSPC	Number of Services Per Conception

CHAPTER 1

INTRODCTION

1.1 Background of the study

Milk is an important commodity that is used in day-to-day life. Considered as one among the valuable agricultural products worldwide, milk is often considered a local commodity as it is produced locally and consumed in all nations. Milk is also considered as a global product, taking into consideration the use of skimmed milk powder and whole milk powder being produced and exported to different regions of the world (Facts, 2016). Milk is also considered as a food that is complete in all aspects, considering the presence of essentials such as fat, protein and other minerals. Milk and the related products constitute daily diet among people and vulnerable groups which include school children and people of old age (Gasmalla et al., 2017). The global production of milk in the year 2019 is found to be approximately 852 million tonnes, a striking increase of 1.4 per cent of the total milk production in the year 2018. This increase is attributed to the production increases in nations such as Pakistan, Brazil, India, the European Union, and the United States of America, whereas there was some offset by the reduction in milk production in nations such as Turkey, Columbia and Ukraine. Among the key regions of milk production, Asia is witnessing significant expansion in milk production followed by other regions which include- South America, North America, Europe and the Caribbean (Dairy market review, 2020).

Today's world scenario displays the supply and demand of/for milk and the related products to be at 7 billion consumers who consume them from 1 billion people involved in the production and the supply of dairy-related goods. The dairy sector is deemed to involve a highly complex chain which encounters several challenges which are associated with the significant changes occurring in the world (IFCN, 2019). There is a growing demand for milk and milk products which is attributed to the increasing population all around the world. Growth in population which is ever growing is a major factor driving the demand for dairy based products which are followed by per capital consumption of milk and dairy related products (FAO, 2010). The dairy industry is a significant contributor to local communities, regional economies, and national welfare. The increase in the demand for milk and milk based products is satiated by the dairy industry's efforts to globalize in the international market.

Cows that are high-yielding product lot of milk; this is important for dairy farmers as the same is the only means to satiate the ever increasing demand for milk in local and global scale considering maximum efficiency. The number of calves is considered to be of secondary importance and should be taken care of by veterinarians, and agricultural advisors. Furthermore, cows must have a calf for them to lactate and create the next generation for milk production (Dobson et al., 2007).

The two factors determining dairy cow profitability are the milk production and reproductive performance of cows. Over years, there had been considerable debates on the influence of milk performance and reproductive performance on milk based profitability wherein researchers and dairy producers tend to find the relationship between dairy production capability and reproductive performance. Many factors are deemed to impact the reproductive performance and milk production efficiency of cows. The nutritive values and the quality of milk are associated with the composition of milk which is a varying factor associated with the lactation stages, feeding, cows' health status and genetic makeup (Heck et al., 2009; Petrovska et al., 2009). Furthermore, researchers have deemed the existence of a significant correlation between milk composition traits and reproductive performance (Morton et al., 2016; Patton et al., 2007). Hence, it is quite arguable that milk traits such as fat, protein, urea and lactose can be considered as factors influencing dairy cow fertility (Bastin et al., 2014).

Reproductive efficiency in dairy cattle is influenced by factors that include health, nutrition, genetics, and milk production (Inchaisri et al., 2010; Norman et al., 2009). As a means to increase the production of milk, over the past three decades, several researches have been conducted which led to the analysis of the breed selection for high milk production. However, such selection of breeds is also known to deteriorate the reproductive performance of the cows and the global dairy population (Statham, 2011). When there is a reduction in reproductive efficiency in dairy cows, it leads to significant economic losses wherein there are impacts on calving interval being extended, reduced conception rate, reduced rate of pregnancy, and increase in the number of days open (Nishida et al., 2006). Hence, there is a need to determine the factors which might influence the reproductive success of dairy cows, and how dairy farmers can mitigate the effect of these factors on reproductive efficiency which is deemed to be a cornerstone in the production of milk and dairy farm economics.

1.2 Problem Statement

The demand for milk and milk products is increasing in Malaysia which is similar to any other nation in the world. According to a report by (MalayMail.com, 2019), it was revealed that the demand for milk in Malaysia was 67 million litres wherein around 40 million litres of milk was produced within the nation and the rest imported from other countries such as Australia and New Zealand. The nation continuously strives to increase its milk production efficiency to self-satiate the growing needs within the nation and in the near future export to other nations. This requires the need to explore the ways to improve milk production efficiency in the nation. This is a major premise for the research as there is a need to understand the factors influencing milk production.

The researcher also asserts the fact that milk production is associated with reproductive performance of the cows. While a large number of researches evaluated the different factors influencing milk production, milk composition, and reproductive performance of cows, it is clear from the analysis of previous literature that no research exists to explore the context in Malaysia, a growing nation that is aspiring to improve its milk production efficiency. In this regard, the researcher in the present research takes into consideration

the analysis of the different factors influencing milk composition, milk production, and reproductive performance of cows in Malaysia.

Some of the common breeds of cows reared in Malaysia for milk productions are the Australian Friesian Sahiwal (Friesian) and Jersey. In this regard, the researcher considers the analysis of factors influencing milk composition, production and reproductive performance of these cows in select farms of Malaysia.

1.3 Research Aim and Objectives

The present research aims to evaluate the factors influencing milk composition, milk production, and reproductive performance of select breeds of cows (Friesian and Jersey cows) in two dairy farms in Malaysia. In this regard, the following research objectives are framed:

i. To determine the influence of factors affecting reproductive performance of Friesian and Jersey cows in the selected dairy farm in Malaysia
ii. To analyze the factors associated with milk composition of Friesian and Jersey cows in the selected dairy farm in Malaysia
iii. To evaluate milk production and milk composition traits in two breeds at different lactation stages and parity order in the selected two dairy farm in Malaysia

1.4 Research Hypothesis

Based on the analysis of previous literature, the following hypotheses are framed:

Hypothesis 1: There is a relationship between breed, parity order and year of calving on calving interval, days open, number of service per conception and days to the first insemination, and reproductive performance of cows.

Hypothesis 2: There is an association between the various components within milk composition - blood urea and milk urea, blood protein and milk protein concentration, blood progesterone and milk progesterone.

1.5 Scope and Significance of the Research

The scope of the present research is limited within the analysis of milk composition, milk production and reproductive performance of select cow breeds in select farms of Malaysia. Though data is collected from two select farms, the results are generalized for all farms across the nation. Furthermore, the significance of the research lies in the fact

that the findings will provide venues for improving milk production in the nation. Besides, the outcomes of the research will also provide insights for improving the health status of cows in the farms of Malaysia.

1.6 Chapter Scheme

The research is documented based on the following chapter scheme:

- Chapter I – Introduction
- Chapter II – Literature Review
- Chapter III – Research Methodology
- Chapter IV- Results
- Chapter V- Discussion
- Chapter VI – Conclusion and Recommendations

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