UNIVERSITI PUTRA MALAYSIA

PREVALENCE, RISK FACTORS, IMPACT ON MILK YIELD, AND FARMERS' AWARENESS OF LAMENESS AND CLAW LESIONS IN DAIRY COWS IN SELANGOR, MALAYSIA

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By

SADIQ MOHAMMED BABATUNDE

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

January 2018

To my loving parents, for their irreplaceable support and guidance
To my siblings Ibrahim, Sherifat, Risikat and Sheriffdeen Sadiq and my lovely Habiba Abubakar, for making my study worthwhile

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirements for the degree of Master of Veterinary Science

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Lameness is an important production limiting disease in the dairy industry globally. Despite the recent development of dairy production in Selangor and Malaysia, studies on lameness occurrence and claw health are limited. The objectives of the study reported in this thesis were: i) To determine the prevalence of lameness and claw lesions; ii) To identify the cow level risk factors for lameness; iii) To determine the incidence of lameness, claw lesions and association with floor types and their impact on milk yield; and 4) To assess the level of awareness of dairy farmers in Selangor lameness occurrence, associated risk factors and claw health management practices.

A cross-sectional study involving 251 lactating cows from eight farms was conducted to estimate the prevalence of lameness, distribution of claw lesions and associated risk factors. The cows were assessed by locomotion scoring (LS), claw examination and animal-based risk factors. Pearson chi-square was used to compare the prevalence estimates from all the studied farms, as well as the association between proportion of lame cows and those with claw lesions. A binary logistic regression with backward elimination method was applied to investigate the association between independent variables and prevalence of lameness and claw lesions. The prevalence of lameness in cows was 19.1% (48/251, range: 10-33.3%) while 31.1% (78/251) of cows had claw lesions (range: 22.4-40%). Of all claw lesions (n=161) recorded, the occurrence of overgrown claw (OC), sole lesions (SL), white line disease (WLD), and digital dermatitis (DD) were 24.8, 21.7, 13.0 and 9.9%, respectively. Claw lesions were recorded in 87.5% (42/48) of the lame cows with highest being those affected with SL (54.2%; 19/35) and WLD (61.9%; 13/21). Lameness was associated with early lactation (odds ratio, OR = 3.3; 95% Confidence interval, CI 1.5, 7.3), injured hocks (OR = 4.8; 95% CI 1.4, 16.6) and dirty leg (OR=

2.6; 95% CI 1.04, 6.5) and OC (OR = 2.0, 95% CI 1.4, 4.9) whereas presence of claw lesions was associated with dirty leg (OR= 4.9; 95% CI 2.3, 10.5) and OC (OR= 2.68; 95% CI 1.3, 5.3).

The incidence of lameness, claw lesions and association with floor types and impact on milk yield was also assessed through a longitudinal study conducted from October, 2016 to July, 2017 involving four farms (120 cows total) with 60 cows each from two farm types, using either rubber mats (RM) or concrete floor (CF). Data on LS, animal characteristics and milk yield were collected monthly, and claw assessment was done twice, at the beginning and end of study. Incidence of lameness and claw lesions and their associations with floor types and cow level factors were analysed using binary logistic regression. Association between milk yield and other independent variables was done using a univariate analysis of variance (ANOVA). Overall, the cumulative incidence of lameness in the study population was 24.2% (29/120). The incidence rate (IR) of lameness in cows on CF was 43.6% (18/41.25 cow-years) and 24.6% (11/44.6 cow-years) in cows on RM. Lameness was associated with very dirty leg (OR = 6.6, 95% CI 1.7, 26.5) and OC (OR = 8.4, 95% CI 2.0, 34.5). Moderate body condition score (BCS) was a protective factor for lameness (OR=0.3, 95% CI 0.1, 0.9). A total of 34 claw lesions were recorded in 24 cows on CF while 29 claw lesions were observed in 20 cows on RM. However, the difference was not significant (P>0.05). Amongst the 44 cows affected with claw lesions, the highest were those with SL (31.7%), WLD (15.6%), DD (14.3%) and toe ulcers (TU), interdigital hyperplasia (IH), and swollen coronet (SC) (8% each). Claw lesions were present in 93% (n=27/29) of all lame cows and mostly located in the hind claws. Incidence of claw lesions was associated with very dirty leg (OR = 4.4, 95% CI 1.3-14.8) and OC (OR = 4.4, 95% CI 1.5, 12.9). Mean monthly milk yield was higher (P < 0.05) in cows at higher parity compared with primiparous cows, while lower (P < 0.05) in cows with injured hock compared with those with normal hock condition.

Based on the structured questionnaire survey distributed to 120 dairy farmers, to assess their perception on impact of lameness, risk factors and practices related to claw health management, a response rate of 68.3% (82/120) was recorded. Farmers' responses (agree or not agree) were not different regarding lameness being an important health problem in dairy cows and its negative impact on reproductive performance. A higher proportion (P = 0.01) of farmers (77%; 63/82) were aware of the factors considered to influence lameness occurrence at herd level, while comparable proportions (P = 0.91) were aware (51%; 42/82) and unaware (49%; 40/82) of the cow level factors. Awareness of the risk factors was common (P < 0.05) among farmers with higher education qualification and years of farming experience. Fifty percent of the farmers (41/82) were unaware of the welfare assessment practices related to claw health. Only 29% (24/82) of the farmers practiced claw trimming. The results suggest low awareness of lameness occurrence among the surveyed dairy farmers.

In conclusion, lameness and claw lesions are common in the studied farms. Improvement of the management factors, enlightenment on cow level factors, claw health and farmers' ability to recognize lameness early could be useful in the control of the problem in their herds.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains Veterinar

PREVALENS, FAKTOR RISIKO, IMPAK PADA PENGELUARAN SUSU, DAN KESEDARAN PENTERNAK TERHADAP KETEMPANGAN DAN LESI KUKU PADA LEMBU TENUSU DI SELANGOR, MALAYSIA

Oleh

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Januari 2018

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Ketempangan adalah satu penyakit penting yang menghadkan pengeluaran industri tenusu di seluruh dunia. Walau pun dengan perkembangan terkini pengeluaran tenusu di Selangor dan Malaysia, kajian berkenaan kejadian ketempangan dan kesihatan kuku amat terhad. Objektif kajian dalam tesis ini adalah untuk: 1) menentukan prevalens ketempangan, lesi kuku; 2) hubung-kaitnya dengan faktor risiko pada lembu; 3) menentukan insidens ketempangan, lesi kuku dan hubung-kait dengan jenis lantai dan pengeluaran susu; dan 4) untuk menilai persepsi penternak lembu tenusu terhadap kesan ketempangan, faktor risiko dan amalan berkaitan pengurusan kesihatan kuku.

Satu kajian keratan rentas melibatkan 251 lembu bersusu dari lapan ladang telah dijalankan untuk mengukur prevalens ketempangan, taburan lesi kuku dan perkaitan dengan faktor risiko. Lembu ditaksir secara skor gerak alih (LS), pemeriksaan kuku dan faktor risiko haiwan. Ujian khi kuasa dua Pearson digunakan untuk membandingkan prevalens pada semua ladang kajian, juga hubungkait antara perkadaran lembu tempang dan yang berlesi kuku. Kaedah regresi logistik perduaan secara eliminasi undur telah digunakan untuk menyiasat hubungkait antara variabel bebas dan prevalens ketempangan dan lesi kuku. Prevalens ketempangan adalah 19.1% (48/251, julat: 10-33.3%) sementara 31.1% (78/251) lembu mempunyai lesi kuku (julat: 22.4-40%). Dari semua lesi kuku (n=161) yang direkodkan, kejadian OC, SL, WLD dan DD adalah masing-masing 24.8, 21.7, 13.0 dan 9.9%. Lesi kuku direkodkan pada 87.5% (42/48) lembu tempang dengan catatan tertinggi pada lembu yang mempunyai SL (54.2%; 19/35) dan WLD (61.2%; 13/21). Ketempangan berhubung-kait dengan laktasi awal (nisbah mungkin, OR=3.3; 95% sela keyakinan, CI 1.5, 7.3), kecederaan keting (OR = 4.8; 95% CI 1.4, 16.6) dan kaki kotor (OR = 2.6; 95% CI 1.04, 6.5) dan kuku panjang (OR = 2.0, 95% CI 1.4, 4.9) manakala lesi

kuku adalah berhubung-kait dengan kaki kotor (OR = 4.9; 95% CI 2.3, 10.5) dan kuku panjang (OR = 2.68; 95% CI 1.3, 5.3).

Insidens ketempangan, lesi kuku dan hubung-kait dengan jenis lantai dan kesan pada pengeluaran susu telah ditaksir melalui kajian longitudinal dari Oktober 2016 hingga Julai 2017 melibatkan empat ladang (sejumlah 120 ekor lembu) dengan 60 ekor lembu dari setiap dua jenis ladang yang menggunakan samada alas getah (RM) atau lantai konkrit (CF). Data LS, ciri-ciri haiwan dan pengeluaran susu telah dikutip setiap bulan, manakala pentaksiran kuku dibuat dua kali (mula dan akhir kajian). Keseluruhannya, insidens kumulatif ketempangan dalam populasi kajian ini adalah 24.2% (29/120). Kadar insidens (IR) ketempangan adalah 43.6% (18/41.25 *cow-years*) pada lembu CF, dan 24.6% (11/44.6 *cow-years*) pada lembu RM. Ketempangan berhubung-kait dengan kaki sangat kotor (OR = 6.6, 95% CI 1.7, 26.5) dan kuku panjang (OR = 8.4, 95% CI 2.0, 34.5). Skor badan (BCS) sederhana adalah bersifat pelindung kepada ketempangan (OR = 0.3, 95% CI = 0.1, 0.9). Sejumlah 34 lesi kuku direkodkan pada 24 ekor lembu (40%) CF manakala 29 lesi kuku pada 20 (33%) ekor lembu RM. Namun begitu, perbezaan tidak bererti ($P>0.05$). Antara 44 ekor lembu berlesi kuku, yang tertinggi adalah SL (31.7%), WLD (15.6%), DD (14.3%) dan TU, IH dan SC (8% setiap satu). Lesi kuku adalah 93% (27/29) dari semua lembu tempang dan yang terutamanya pada kuku kaki belakang. Insidens lesi kuku berhubung-kait dengan kaki sangat kotor (OR = 4.4, 95% CI 1.3-14.8) dan OC (OR = 4.4, 95% CI 1.5, 12.9). Purata pengeluaran susu bulanan menurun secara bererti ($P<0.05$) pada lembu tempang berbanding dengan lembu tidak tempang di ladang menggunakan RM.

Berdasarkan kajian soal-selidik berstruktur yang diedarkan kepada 120 penternak tenusu, yang dijalankan untuk mentaksir persepsi mereka mengenai kesan ketempangan, hubung-kait faktor risiko dan amalan pengurusan berkenaan kesihatan kuku, kadar respons diterima adalah 68.3% (82/120). Tiada perbezaan didapati dalam respons penternak (setuju atau tidak setuju) mengenai ketempangan sebagai satu masalah yang penting dalam lembu tenusu dan kesan negatifnya terhadap pembiakan haiwan. Perkadaran yang lebih tinggi ($P = 0.01$) dalam kalangan responden (77%) sedar tentang factor-faktor risiko bagi kepincangan di peringkat kumpulan manakala perkadaran yang setanding antara responden yang sedar (51%) dan tidak sedar (49%) di peringkat individu. Kesendarn tentang factor risiko adalah biasa ($P = 0.01$) dalam kalangan penternak yang memiliki pendididikan dan pengalaman dalam bidang ternakan yang lebih tinggi. Lima puluh peratus penternak tidak sedar tentang amalan berkaitan kesihatan kuku dan haya 29% mempraktikkan pemotongan kuku. Hasil kajian telah menunjukkan bahawa kurang kesedaran dala kalangan penternak lembu tenusu yang ditinjau.

Kesimpulannya, ketempangan dan lesi kuku adalah lazim di ladang yang dikaji. Penambahbaikan faktor-faktor pengurusan, pencerahan tentang faktor risiko lembu, kesihatan kuku dan keupayaan penternak cepat mengenali ketempangan dari awal adalah berguna dalam kawalan masalah tersebut di dalam gerompok lembu mereka.

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I certify that a Thesis Examination Committee has met on 25 January 2018 to conduct the final examination of Sadiq Mohammed Babatunde on his thesis entitled "Prevalence, Risk Factors, Impact on Milk Yield and Farmers' Awareness of Lameness and Claw Lesions in Dairy Cows in Selangor, Malaysia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Veterinary Science.

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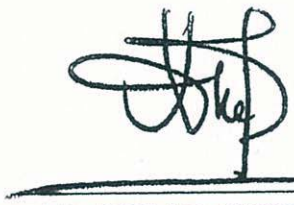

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LIST OF ABBREVIATIONS

BCS	Body condition score
CHL	Claw horn lesions
CF	Concrete floor
DEFRA	Department for environment, food and rural affairs
DC	Digital cushion
DD	Digital dermatitis
DIM	Days in milk
FAO	Food and Agricultural Organization
HCS	Hock condition score
HL	Heel lesions
HS	Leg hygiene score
LS	Locomotion scoring
OC	Overgrown claw
OR	Odds ratio
RF	Rubber floor
RR	Relative risk
RM	Rubber mats
SARA	Sub-acute ruminal acidosis
SL	Sole lesions
SC	Swelling of coronet area
TU	Toe ulcers
WF	Wall fissures
WLD	White line disease
UVH	University Veterinary Hospital

CHAPTER 1

INTRODUCTION

1.1 Overview

The dairy industry in Malaysia is growing in capacity owing to recent intensification to meet the increasing demand for milk. An indication of such expansion is the worth of the dairy industry in Malaysia which increased from (MYR) 1,687 (USD$ 540.96) million in 2006 to (MYR) 2,027 (USD$ 649.98) million in 2010 (Department of Statistics, Malaysia, 2011). The measures in place to promote milk production in the country include selective breeding of high yielding cows, importation of exotic breeds and incorporating modern management of intensive farms. The local industry was reported to provide only 5% of the demand by the populace (Boniface et al., 2010). Factors that were suggested to contribute to the slow growth in the Malaysia dairy industry include unfavourable environmental conditions characterized by high temperature, humidity and rainfall leading to reduced nutritive value of feeds (Jamaludin et al., 2014). Low compliance to herd health programs by farmers was also reported by Abdullah et al. (2017) amongst dairy farms in Selangor and Negeri Sembilan states. However, reports from the Department of Veterinary Services (DVS) in 2013 indicated growth in the local production by 50% increment (39 to 79 million liters) from 2004 to 2013 (DVS, 2013). Hence, it is reasonable to suggest increasing intensification of dairy farms in Malaysia as seen in other developing nations. This is supported by the recent efforts by the government to boost the dairy sector (Mohd Karim et al., 2014).

Historically, before the advent of intensive management of dairy cows for both commercial purpose and meeting the increasing milk demand, cows were reared on pasture offering a condition identical with the natural environment for the maintenance of claw health (Haskell et al., 2006). Although, lameness problems then were linked to nutritional factors such as ruminal acidosis causing lower circulatory perfusion of the claw corium (Thoefner et al., 2004). The growing confinement by intensive management and production of high milk yielding cows contributes immensely to increasing lameness issues (Rushen, 2012; Cook et al., 2016). Accordingly, dairy production is fast growing in South East Asia with indications of the highest global demand for milk emanating from the region (FAO, 2015).

Lameness is any condition characterized by alteration of gait resulting from pain caused by injury to the hoof or limb (Olechnowicz and Jaskowski, 2011). Lameness in dairy cows is a welfare problem and result to huge economic loss attributed to early culling, treatment or maintenance of lame cows and reduced milk yield (Vermunt et al., 2007; Kara et al., 2015). Although lameness was suggested as the second most costly disease in dairy production after mastitis (Kossaibati and Esslemont, 1997), findings have revealed that it could be the most costly in

economic terms when the indirect effects on fertility and milk yield are considered (Amory et al., 2008, Gomez et al., 2015).

The prevalence of lameness varies amongst herds between regions and countries which is attributed to the multifactorial etiology (Cook and Nordlund, 2009). For instance, a study in India revealed an increasing incidence of lameness in dairy herds of 17.2% compared to 9.4% recorded previously (Asit and Pankaj, 2016). Furthermore, several studies have identified risk factors influencing the increasing incidence and prevalence of lameness at cow and herd levels (Lim et al., 2015; Solano et al., 2015; Ranjbar et al., 2016). However, one of the most discussed housing risk factor is floor types and the interrelationship with the development of claw lesions.

Accordingly, concrete floor (CF) being the most common in dairy housing has been recognised as lacking the required compressional force for adequate locomotion in dairy cows (van der Tol et al., 2005). Other demerits ascribed to CF include enhancement of claw horn overgrowth and over loading (Bergsten et al., 2009), unstable gait and increased muscular activity (Rajapaksha et al., 2015). However, the application of cushioning material such as rubber floor (RF) and rubber mats (RM) in dairy herds has been encouraged with reported improvement in claw health (Fjeidas et al., 2004; Bergsten et al., 2015).

Claw lesions have been reported to be responsible for about 90% of lameness conditions in dairy herds (Manske et al., 2002; Shearer, 2017). Overall, claw lesions and specifically, laminitis (inflammation of the corium) have been discussed with variation in the causative mechanisms which include one or combination of nutritional-induced inflammation (Thoefner et al., 2004), hard floor surfaces (Bergsten et al., 2015) and peri-parturient hormonal changes (Tarlton et al., 2002). However, credence have been given more to the biomechanical aspects involving the influence of floor surfaces and suggested to be responsible for 75% of claw lesions in the hind limb (Bergsten et al., 2015).

Recent understanding of the pathophysiology of lameness has revealed that not all claw lesions result to lameness based on variation in severity and the generated noxious stimuli (Tadich et al., 2010; Bergsten et al., 2015). Nevertheless, presence of claw lesions without clinical lameness was associated with reduced milk yield prior to when cows became lame (Reader et al., 2010) and also prolonged recovery following treatment (Green et al., 2010). Hence, an ongoing issue is the investigation of the development of claw lesions and lameness in dairy cows.

Another important aspect is the awareness of farmers regarding the importance and welfare implications of lameness. Factors such as lack of knowledge, ineffectiveness of current advice, improper application of detection protocols were the reasons why farmers fail to identify or present lame cows for treatment (Leach et al., 2010a;

Horseman et al., 2014). The growing problem of lameness in dairy herds has also been attributed to under-estimation of lame cows by farmers based on their perception in the use of locomotion scoring (LS) (Whay et al., 2002; Leach et al., 2010a).

1.2 Statement of the Problem

Selangor is one of the 13 states with the highest population of ruminant and dairy farmers in Malaysia (DVS, 2013). With the indications of the dairy industry moving towards intensive management from the conventional semi-intensive system (Shanmugavelu et al., 2014), more care need to be provided for animals to sustain productivity. The management system and environmental conditions are pertinent in the welfare of dairy cows. In terms of lameness and claw health, intensive system where cows are confined and housed without external grazing has been suggested to majorly contribute to the increasing lameness problems in dairy herds (Haskell et al., 2006; Cook et al., 2016). As such, the system limits the benefits attached to outdoor grazing which include optimal locomotion on pasture, comfortable lying surface, and exercise. In contrast, confined cows are made to walk or stand on hard and abrasive concrete floors with continue exposure of their legs to manure contamination. These events are presumably present in dairy herds in Selangor based on the reports that most dairy housing in the tropics uses concrete floors (Moran, 2012). Also, the installation of rubber mats, herd hygiene, and prompt treatment of lameness cases were the points highlighted by dairy farmers in Peninsular Malaysia, in order to improve cow welfare (Moran and Chamberlain, 2017). Another important aspect is the environmental factors such as high temperature leading to reduced nutritive feeds suggested to limit growth in the dairy sector (Jamaludin et al., 2014). Heat stress has been reported to influence the prevalence of lameness attributed to the negative impact of lying down and standing activities, which are vital in dairy cow well-being (Foditsch et al., 2016). The high rainfall might as well contribute to increased exposure of the cows' legs to moisture leading to suboptimal claw health (Borderas et al., 2004), especially in inadequate housing facility.

Literature findings are scarce regarding the occurrence of lameness in dairy cattle farms in Selangor. However, information from the large animal ward records, University Veterinary Hospital (UVH), Faculty of Veterinary Medicine, Universiti Putra Malaysia reported lameness cases summating to 97 from the Ladang Angkat farms between 2013 to 2016 (Unpublished work). Nevertheless, the prevalence and incidence of lameness and claw lesions in dairy farms in the region is yet to be elucidated. Also, management practices vary amongst farms which might influence the occurrence of lameness in the region.

Furthermore, one could perceive the recent provisions of cushioned flooring (in form of RM) practiced by dairy farmers in Peninsular Malaysia (Moran and Chamberlain, 2017), is for the improvement of claw health. However, their application in farms is yet to be investigated on claw health and lameness occurrence. Despite the positive

effect of RM on claw health in some international studies, the outcome could be influenced by herd and cow level factors. A research to assess the input of RM as stall base in dairy housing is vital in the region to provide scientific facts on its implementation in relation to claw health.

In line with the aforementioned problems, dairy farmers play a crucial role especially in herd health issues affecting productivity. The awareness and perception of dairy farmers regarding lameness has been shown to be vital in several studies to reduce the occurrence (Leach et al., 2010b; Bruijnis et al., 2013). In the Malaysian context and Selangor specifically, dairy farmers might be unaware of the occurrence of lameness in their herds and the impact on productivity. Also, knowledge on the associated risk factors and claw health management might be lacking. Therefore, it will be logical to investigate farmers' knowledge based on the aforementioned points as they could influence their decision making in providing optimum care to lame cows.

1.3 Research objectives

1. To determine the prevalence of lameness and claw lesions in dairy farms in Selangor, Malaysia.
2. To identify the cow level risk factors associated with lameness and claw lesions
3. To determine the incidence of lameness, claw lesions and association with floor types and milk yield in dairy cows.
4. To assess the level of awareness of dairy farmers in Selangor on lameness occurrence associated risk factors, and claw health management practices.

1.4 Research hypothesis

Objective 1:

- H_0 = Cow level prevalence of lameness and claw lesion is 0% in dairy farms in Selangor
- H_0 = There is no association between cow level factors and prevalence of lameness in dairy farms in Selangor

Objective 2:

- H_0 = Incidence of lameness and claw lesions is not significantly different in cows on RM and CF
- H_0 = Milk yield is not significantly reduced between lame and non-lame cows on CF and RM

Objective 3

- H_0 = Dairy farmers in Selangor are aware of the impact of lameness, its associated risk factors and management practices related to claw health

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