



UNIVERSITI PUTRA MALAYSIA

***COMPARISON OF MILK YIELD, SELECTED REPRODUCTIVE
PERFORMANCE AND HEALTH PROBLEMS BETWEEN A DAIRY FARM
ON CONCRETE AND ANOTHER ON RUBBER MAT FLOORING***

NUR DIYANA BINTI MOHAMAD TAHIR

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PERFORMANCE AND HEALTH PROBLEMS BETWEEN A DAIRY FARM ON
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NUR DIYANA BINTI MOHAMAD TAHIR

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the Faculty of Veterinary Medicine, Universiti Putra Malaysia
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It is hereby certified that we have read this project paper entitled “Comparison Of Milk Yield, Selected Reproductive Performance And Health Problems Between A Dairy Farm On Concrete And Another On Rubber Mat Flooring”, by Nur Diyana Binti Mohamad Tahir and in our opinion it is satisfactory in terms of scope, quality, and presentation as partial fulfilment of the requirement for the course VPD 4999 – Final Year Project.

DR. SITI ZUBAIDAH RAMANOON

DVM(UPM), MVM (GUELPH), PHD (GUELPH),

Lecturer,

Faculty of Veterinary Medicine

Universiti Putra Malaysia

(Supervisor)

DR. NURHUSEIN YIMER

DVM (AAU), PHD (UPM),

Lecturer,

Faculty of Veterinary Medicine

Universiti Putra Malaysia

(Co-supervisor)

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ABSTRAK

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada keperluan kursus VPD 4999 – Projek Ilmiah Tahun Akhir.

PERBANDINGAN HASIL SUSU, PRESTASI PEMBIAKAN TERPILIH DAN MASALAH KESIHATAN DI ANTARA LADANG LEMBU TENUSU BERLANTAI KONKRIT DAN LADANG BERLANTAI ALAS GETAH

Oleh

Nur Diyana Binti Mohamad Tahir

2015

Penyelia: Dr. Siti Zubaidah Ramanoon

Penyelia bersama: Dr. Nurhusien Yimer

Objektif kajian ini adalah untuk membandingkan hasil susu, prestasi pembiakan dan kesihatan lembu tenusu di antara ladang berlantai alas getah (RF) dan lantai konkrit (CF). Dua buah Ladang Angkat Universiti Putra Malaysia telah dipilih: RF yang terletak di Lenggeng, Negeri Sembilan dan CF di Kajang, Selangor. Tiga puluh ekor lembu berlaktasi dari setiap ladang telah dipilih dan hasil susu telah direkodkan selama sembilan hari berturut-turut. Penternak telah ditemuduga untuk mendapatkan maklumat ladang berkenaan prestasi pembiakan dan masalah kesihatan. Mastitis klinikal telah ditaksir berdasarkan keabnormalan ambing dan susu manakala ketempangan ditaksir menggunakan skor lokomosi. Keputusan analisis menunjukkan

purata hasil susu setiap hari pada lembu tenusu dari RF adalah 18.01 liter (sisihan piawaian, SD=1.5) dan 8.3 liter (SD= 1.4) pada lembu tenusu dari CF, yang mana perbezaannya adalah signifikan (nilai-t=77.8, p<0.05). Prestasi pembiakan terpilih untuk kedua-dua ladang adalah sama (p>0.05). Prevalens ketempangan ladang RF adalah signifikan lebih rendah ($\chi^2=18.4$, p<0.05), begitu juga dengan mastitis klinikal (ujian tepat Fisher, p<0.05), berbanding ladang CF. Kajian ini umumnya mencadangkan bahawa lembu tenusu yang ditenak di ladang RF mungkin berprestasi lebih baik berbanding lembu tenusu di ladang CF.

Kata kunci: lembu tenusu, getah, hasil susu, prestasi pembiakan, ketempangan, mastitis

ABSTRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial fulfilment of the course VPD 4999 – Final Year Project.

COMPARISON OF MILK YIELD, SELECTED REPRODUCTIVE PERFORMANCE AND HEALTH PROBLEMS BETWEEN A DAIRY FARM ON CONCRETE AND ANOTHER ON RUBBER MAT FLOORING

By

Nur Diyana Binti Mohamad Tahir

2015

Supervisor: Dr. Siti Zubaidah Ramanoon

Co-supervisor: Dr. Nurhusien Yimer

The objective of this study was to compare the milk yield, reproductive performance and health of dairy cows between a farm with rubber mat flooring (RF) and a farm with concrete flooring (CF). Two ‘Ladang Angkat’ Universiti Putra Malaysia farms were selected: RF farm is located in Lenggeng, Negeri Sembilan and the CF farm is in Kajang, Selangor. Thirty lactating cows from each farm were selected and the milk yield was recorded for nine days consecutively. Farmers were interviewed for farm information on reproductive performance and health problems. Clinical mastitis was assessed based on udder and milk abnormalities and lameness by locomotion score. The results revealed that the average daily milk yield of cows from RF farm

was 18.01 litres (standard deviation, SD=1.5) and cows from CF farm was 8.3 litres (SD=1.4), of which the difference average milk yield was statistically significant (t-value=77.8, df=538, p<0.05). The selected clinical reproductive problems for both farms were similar (p>0.05). Farm on RF had significantly lower prevalence of clinical mastitis (Fisher's exact test, p<0.05) and lameness ($\chi^2=18.4$, p<0.05), compared to CF farm. This study generally suggests that dairy cows kept on RF farm may perform better compared to cows from CF farm.

Keywords: Dairy cows, rubber, milk yield, reproductive performance, lameness, mastitis

1.0 INTRODUCTION

Concrete flooring (CF) is the most common type of floor for confined dairy herds because it is easy to construct and easy to clean (Telezhenko *et al.*, 2007). According to Gooch (2013), flooring system employed in a dairy farm is one of the aspects of housing that may cause excessive stress on cow's feet and legs due to the nature of the floor surface (i.e. either too rough or too smooth). In a study by the United States Department of Agriculture (USDA) from 1991 to 2007, the three most important diseases or conditions in dairy cattle identified by producers are clinical mastitis (16.5%), lameness (14.0%) and infertility (12.9%) and the two most important traits that determine the value of a cow and affect a farmer's decision on culling are the fertility and milk yield (Kremer *et al.*, 2012) while the reproductive health problems causes economic loss to dairy industry (Kremer *et al.*, 2007).

Currently, rubber flooring (RF) system as an alternative to the traditional CF has been used by some farms in Malaysia. Therefore, research is needed to determine the effect of RF on the production and reproduction of dairy cows in local settings.

This study aims to compare the milk yield, selected reproductive performance indicators (i.e. age at first calving, pregnancy rate, calving interval, days open and number of parity) and health problems such as clinical reproductive problems (i.e. dystocia, abortion, retained placenta and repeat breeders), clinical mastitis and lameness, between cows under CF and RF systems.

2.0 LITERATURE REVIEW

2.1 Types of flooring

Concrete is the most commonly used alley flooring in confined dairy herds due to its qualities of construction and ease of cleanliness (Telezhenko *et al.*, 2007). A usual practise in finishing the concrete flooring in a barn is to roughen the finished floors. According to Bray (1998), rough finished floors will speed foot wear by 20% and result in cows being culled in three weeks of new barn occupancies. Therefore, a concrete floor must not be too rough or cause excessive wear or too smooth to cause slippage and injuries. According to Gooch (2013), desirable characteristics of a grooved concrete floor includes flat surface between grooves, smooth surface between grooves, smoothed grove edged with a right angle between the groove and the floor surface and lastly proper groove width, spacing and depth. Gooch (2013) also described the different types of concrete flooring and its drove dimensions, orientation and configuration besides construction considerations when constructing with concrete as flooring for barn.

In the dairy herd, there is an increased number of farmers showing interest in alternative flooring materials which gives better friction for the hoof and softer than concrete (Rushen and Passile, 2006). The hardness, abrasiveness and slipperiness of concrete floors have adverse effects on animal well-being and health. Therefore rubber flooring is becoming popular as alternative to improve the flooring conditions (Telezhenko *et al.*, 2007). The Swedish-based study also concluded that the majority of cows preferred to walk and stand on soft rubber rather than on concrete flooring (Telezhenko *et al.*, 2007).

Rubber matted flooring provides a labour-saving self-cleaning management system and cattle-friendly (Platz *et al.*, 2008). Benz (2002) concluded that rubber matted flooring has an unimpeded and improved self-cleaning function because of the higher activity of the cows. There are a variety of different rubber mats on the market today, with different design and thickness. A thickness of 5mm is needed to produce a floor that minimises the risk of slipping on both clean and manure-fouled alleys (Jungbluth *et al.*, 2003). Rushen and Passile (2006) concluded that regardless of the floor type used, the removal of manure is important to decrease the risk of slipping. Hultgren (2001) showed softer rubber floors decrease the risk of slipping by reducing the prevalence of foot diseases in hind feet at trimming which was significantly lower (odds ratio 0.23 for dermatitis, 0.09 for heel horn erosion and 0.34 for sole ulcer).

2.2 Milk production

Milk production is the core of the economics of a dairy farm. Eighty to 90% of farm income comes from milk sales (Brant *et al.*, 2001). Milk production is affected by three main operational functions which are reproduction, health care and nutrition. Reproduction functions enable the farmer to utilise and optimise the calving interval for milk production and improve the genetic make-up of his herd. Optimum milk yield can be achieved when the health aspect of the cow and herd is taken care of. Nutrition is also a major factor because nutrients from the feed is used to maintain the cow and used to produce milk. Cow comfort enhances its welfare thereby increasing overall health, milk yield and productive life (Wagner-Storch *et*

al., 2003). Kremer *et al.* (2007, 2012) found the mean daily milk yield between group of cows on CF and RF did not differ significantly.

2.3 Reproductive performance

In the dairy system, reproduction is a vital process because milk production will only start after a calving. Ideally, a dairy cow's reproductive life starts at 24 months with the first pregnancy, with gestation period approximately 280 to 285 days, and to produce one calf per year (Brand *et al.*, 2001). The period of lactation is 205 days and following lactation, the drying off period will allow for udder tissue regeneration so to prepare for the next lactation. After calving, a cow will be re-bred 45 to 60 days post-partum so that she will get pregnant by day 80 post-calving (Brand *et al.*, 2001).

Many studies suggest that the optimal age at first calving is less than 24 months (Stevenson *et al.*, 2008). However, Ettema and Santos (2004) have used whole economic measurements instead of just on milk production to measure the optimal age at first calving. They found that only 2.7% of US Holstein dairy farms were able to achieve that target. Hoffman (1996) concluded the advantages of reduced age at first calving were reduced feed costs, greater cumulative production per month, shorter generation interval, and lower overhead costs while the disadvantages that should be considered include lower conception rates, increased dystocia, reduced milk production per lactation, diminished longevity, and costs of increased nutrient density in the ration of feed.

Reproductive efficiency is an outcome of insemination rate and conception rate within a herd, which can be combined in a variable termed pregnancy rate

(Ferguson and Galligan, 1993). Pregnancy rate determines the proportion of non-pregnant cows that become pregnant every 21 days from the voluntary waiting period, and it is the main determinant of days open and economic returns associated with reproduction (Ferguson and Galligan, 1993). Median days open is 123 days with a range of 28 days to 430 days (Bahonar *et al.*, 2009).

According to Boyle *et al.*, (2007) the usage of RF in replacement on the CF had no significant effect on the reproductive performance in a dairy herd during breeding season. In contrast, Kremer *et al.* (2012) reported that RF affects an earlier onset of regular oestrous behaviour and improves calving interval through earlier pregnancy and less days open.

2.4 Health problems related to milk production and reproductive performance

2.4.1 Lameness

Lame cows have been shown to have significantly lower activity during daytime, as well as per hour observed, which indicates that cows in pain avoid movement (Callaghan *et al.*, 2003). Therefore, lame cows limp because their foot hurts and this aspect of cow welfare needs to be taken into consideration to achieve sustainable dairy production with healthy and high-yielding cows. According to Wagner-Storch *et al.* (2003), cow comfort enhances its welfare thereby increasing overall health, milk yield and productive life.

The most common cause of lameness is injuries and disorders in the claws and this can be either infectious, traumatic, or diet-related (Norberg, 2012). The

study categorised the disorder into either claw lesion or hock lesion or injuries. Claw lesion can be either due to sole haemorrhages, sole ulcers, dermatitis, or heel horn erosion while hock injuries can be due to extreme exposure and sensitivity to pressure while lying down on a hard, abrasive surface with poor hygiene. This can manifest as loss of hair, swelling or ulcerative lesions. Lameness in the dairy industry causes great economic losses and is an important welfare issue that affects the productivity of the dairy farm (Green *et al.*, 2002).

Claw diseases are multifactorial which involve management, nutrition, genetics, housing, and claw trimming as crucial factors, but the development of lameness is also directly linked to flooring conditions (Shearer and Van Amstel, 2000; Bergsten, 2004; Vanegas *et al.*, 2006).

Leach *et al.* (2012) has developed a three point lameness score of 0 to 3 for mobility assessment in dairy cows: 0 being a sound cow with good mobility, 1 to a cow with imperfect mobility with uneven gait, a score of 2 to a cow with impaired mobility and is mildly lame and a score of 3 to a cow with a severely impaired locomotion and is very lame. The study applied the lameness scoring to identify lame cows so that the effects of early treatment for hindlimb lameness in dairy cows can be detected.

2.4.1.1 Association of lameness and type of flooring

Concrete floors have been associated with an increase incidence of lameness and health problems (Vokey *et al.*, 2001; Somers *et al.*, 2003; Cook *et al.*, 2004). In other studies, poor flooring impairs locomotion of cows (Jungbluth *et al.*, 2003; van der Tol *et al.*, 2005) and increases the risk of injury (Weeks *et al.*, 2002).

Most dairy cattle facilities use hard, unyielding alleys that can have an adverse effects on claw health and the development of lameness is directly linked to flooring conditions (Shearer and Van Amstel, 2000; Venegas *et al.*, 2006).

Some CF are abrasive and disrupt the equal rates of hoof growth and wear that occur under natural conditions (Vermunt and Greenough, 1995).

Results from previous studies showed the positive effects of RF on claw health in tie-stall (Bergsten and Frank, 1996) and in free stall (Venegas *et al.*, 2006) barns.

Kremer *et al.* (2007) concluded that elastic flooring in free-stall systems reduces horn wear. However, claw trimming is more important in RF systems. Furthermore, the study concluded that cows on RF have an increased activity indicating increased comfort during the time spent moving. In the same study, a greater level of walking comfort by elastic flooring did not lead to significantly greater milk yield. Hultgren (2001) reported that RF prevents lateral slipping, and locomotion in both lame and non-lame cows was improved (Telezhenko and Bergsten, 2005).

Hard, abrasive, or slippery concrete floors may contribute to trauma and predispose to claw horn lesions while rubber mat floorings provides decreased pressure on the claw soles thus have a positive impacts on claw health (Cook *et al.*, 2004), and the use of rubber mats improves locomotion comfort and reduces the risk of injury (Telezhenko and Bergsten, 2005; Rushen and de Passille', 2006).

2.4.2 Mastitis

Mastitis can be defined as the inflammation of the udder which results in abnormality of the milk, udder and cow. Besides pathogens, the other factors contributing to the occurrence of mastitis include environmental factors or determinants (Kivaria *et al.*, 2007). These factors include hygiene due to splashing of manure onto the udder and this is especially so in confined dairy herds (Kivaria *et al.*, 2007). Other factors include poor milking procedures, milking machine faults, teat injuries, teat sores, and exposure to environmental pathogens (Kivaria *et al.*, 2007). Mastitis can be categorised into subclinical mastitis or clinical mastitis. Mastitis can be detected by clinical signs and by indirect tests for subclinical mastitis to detect the increased number of white blood cells in the milk or the somatic cell count (Erskine, 2011).

Mastitis is the most prevalent health problem in dairy cows and is one of the main reasons for culling from herds (USDA, 2007). Also, mastitis causes great economic losses due to reducing in milk production thereby increasing the cost of production, reducing milk quality, reduced longevity, increased labour and treatment costs and more importantly transmitting mastitis causing pathogen to other animals (Pinzon-Sanchez and Ruegg, 2011).

The severity of clinical mastitis are mild (grade 1) when only the milk was abnormal; moderate (grade 2) when abnormal milk was accompanied by swelling or redness of mammary gland; or severe (grade 3) when the cow shows systemic signs of illness such as depression, anorexia, dehydration and fever (Pinzon-Sanchez and Ruegg, 2011).

2.4.3 Reproductive problems

Reproductive problems cause a great deal of frustration to farmers. Usually, they occur as a result of multiple factors including managerial, environment, metabolic and nutritional and are interrelated to the reproduction and milk yield (Stevenson and Call, 1988).

Dystocia may be defined as calving difficulty resulting from prolonged spontaneous calving or prolonged or severe assisted extraction (Mee, 2006). Dystocia can result in loss to the farm due to calf mortality, dam mortality and premature culling (McDermott *et al.*, 1992). Uematsu *et al.* (2013) reported that dystocia in a common local breed of Japanese Black in Japan is associated with low ambient temperature, primiparity, and short and long gestation lengths. In the most recent review of temporal trends in dystocia internationally, Mee (2008) concluded that national dystocia rates in Ireland in dairy cows varied between 2% and 14%.

Abortions were the most common in heifers and very old cows, cows that were thin at pregnancy testing, and cows that were pregnant with twins (Waldner, 2013). Also, abortions are also more common in cows that had adverse outcomes during the previous calving season and had been retained in the herd (Waldner, 2013). An abortion risk of less than 2% has been reported as a goal for cow-calf herds with greater than 5% labelled as a critical level (Rae, 2006).

Repeat breeder affects dairy farm profit by wastage of semen and insemination costs, increasing interval to conception, veterinary treatments, increased culling and replacement costs and lost genetic gain through increased generation interval (Bartlet *et al.*, 1986). Cows failing to conceive after a defined

number of inseminations (generally three or more) with fertile semen are classified as repeat breeders (Levine, 1999). Recently reported mean prevalence of repeat breeder ranges from 10% to 14% in dairy cows in Japan (Yusuf *et al.*, 2010).

Retained placenta is defined as foetal membranes not being expelled within 24 hours after calving (Qu *et al.*, 2014), is a costly disease in multiparous dairy cows that has been linked to immune suppression, infections, elevated lipid mobilization, and depleted status of antioxidants including α -tocopherol, and that increases the risk of other diseases in early lactation (Qu *et al.*, 2014). Retained placenta is an economically important disease that affects approximately 7.8% (range: 1.3 to 39.2%) of US dairy cows (USDA, 2009).

3.0 Materials and methods

3.1 Farms and animals

Two dairy farms were selected from the 'Ladang Angkat' Universiti Putra Malaysia (UPM): RF in Lenggeng, Negeri Sembilan and CF in Kajang, Selangor. Thirty lactating cows were selected from each farm. Several interview sessions with the farmer were conducted to obtain data on reproduction and health problems. During the visit, clinical mastitis was assessed by abnormalities in the udder and milk while lameness was assessed using the lameness score. The cows from RF farm were all Jersey cows, 2 years old and 90 days in milk (DIM), while the cows from CF farm were of Jersey and Friesian-Sahiwal crossbreeds, aged 2 years to 8 years old, and 150 DIM. Both herds from RF and CF are milked twice daily with a portable automatic milking machine. Both farms practised a semi-intensive system and the cows are tie-in during milking in the milking barn.

3.2 Data collection

Individual cow milk production was recorded daily for nine consecutive days and lameness scoring was done three times based on the following:

Score	Description	Definition
0	Good mobility-sound	Walks with even weight-bearing on all four feet. Long fluid strides possible
1	Imperfect mobility-uneven	Steps uneven (rhythm or weight-bearing) or strides shortened, but affected limb(s) not easily identifiable. May or may not have an arched back
2	Impaired	Uneven weight-bearing and/or shortened strides on a

	mobility-mildly lame	limb that is immediately identifiable, but still able to keep up with the healthy herd (i.e. brisk human pace)
3	Severely impaired mobility-very lame	Severely lame on one or more limbs, arched back and marked head nod (if forelimb lameness); struggling to bear weight at rest, and unable to keep up with the healthy herd (i.e. brisk human pace). Requires immediate veterinary attention

Table 1: Lameness scoring used in this study (adopted from Leach *et al*, 2007)

The rubber mat used by the RF farm has a dimension of 12mm to 17mm in thickness and the size of approximately 1.22 metre by 1.83 metre with embossed top surface and grooved underside.

3.3 Data analysis

The data were organised and analysed in SPSS IBM® version 20. Descriptive statistics of the mean milk yield for each cow per day, each farm per day and the overall mean milk yield for the total number of days of collection were generated. Independent samples t-test was performed to analyse the mean difference of milk yield between RF and CF. The association between lameness and types of flooring were measured using the Chi-Squared test and when there is an association, the odds ratios were calculated to measure the degree of association. A binary score was used for the lameness scoring in order to perform the Chi-squared test. Cows with score 0 was considered not lame, while others were considered lame. Similar statistical test was performed for clinical mastitis. Case summaries of the reproductive disorders and reproductive performance respectively were tabulated.

All tests were considered significant when the p-value is less than 0.05 at 95% confidence interval (CI).



4.0 Results

4.1 Milk yield

The average milk yield (litre/cow/day) was higher in RF than in CF (Table 1). The RF farm recorded an average of 18.01 litres of milk per cow per day (range of 14.40 - 20.80 litres), while the CF farm recorded an average daily production per cow of 8.28 litres (range of 5.80 - 12.20 litres). The difference between the two farms was significantly different (t-value=77.83, df=538, p<0.05).

FARM	N	Mean	SD
Rubber flooring	270	18.01	1.48
Concrete flooring	270	8.28	1.42

Table 1: Descriptive statistics of daily milk yield in cows from RF and CF farms

The milk produced (litres) for nine consecutive days by the 30 cows from each farm is shown in Table 3. Within each farm, there was no significant difference of milk yield between day1 to 9 (p>0.05). However, the daily mean milk yield between farm was statistically significant (p<0.05).

Farm	Statistics	DAY								
		1	2	3	4	5	6	7	8	9
Rubber	Mean	18.1	18.0	18.0	18.1	17.9	18.0	17.9	17.9	17.9
	N	30	30	30	30	30	30	30	30	30
	SD	1.46	1.51	1.53	1.55	1.54	1.51	1.49	1.49	1.48
Concrete	Mean	8.6	8.4	8.2	8.3	8.2	8.2	8.3	8.3	8.2
	N	30	30	30	30	30	30	30	30	30
	SD	1.47	1.47	1.41	1.43	1.42	1.39	1.44	1.48	1.43
Total	Mean	13.3	13.2	13.1	13.2	13.1	13.1	13.1	13.1	13.1
	N	60	60	60	60	60	60	60	60	60
	SD	5.00	5.10	5.16	5.15	5.14	5.15	5.12	5.12	5.15

Table 2: Milk yield (in litres) produced by the 30 cows each from RF and CF farms over the nine days of recording

From Figure 1, the distribution of mean milk yield by cow showed the mean milk yield of cows from CF were lower compared to cows from RF.

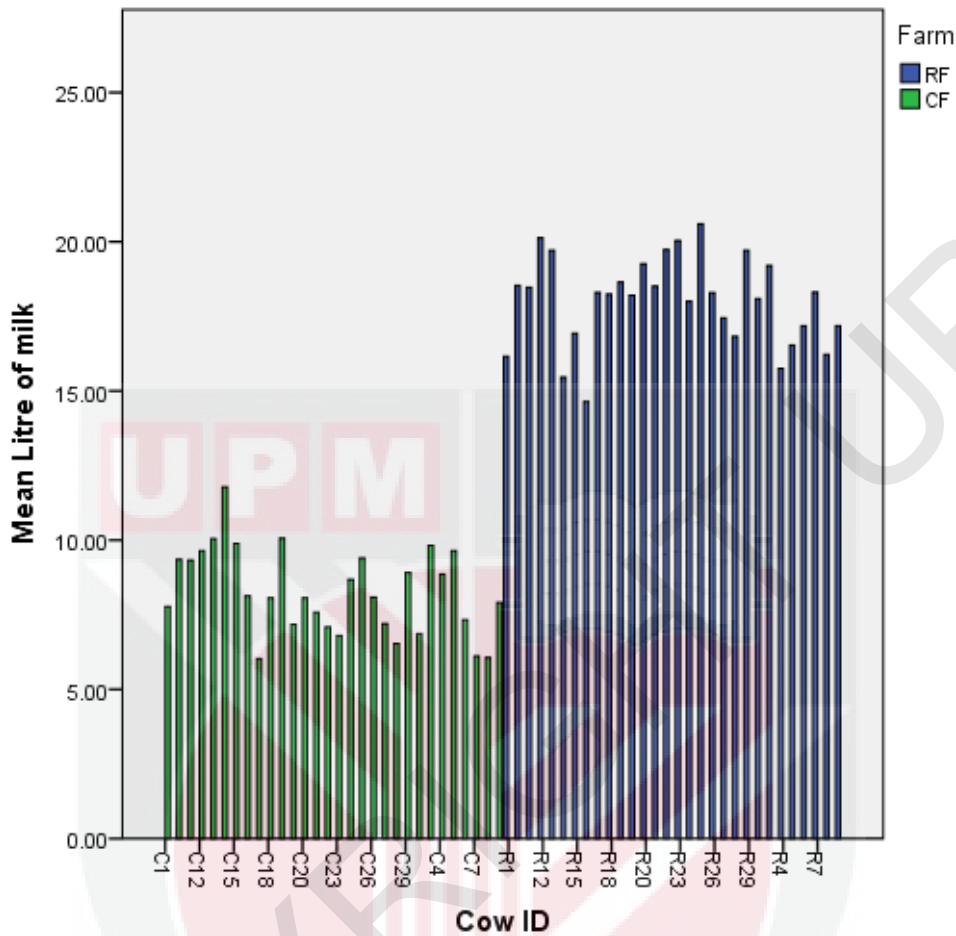


Figure 1: The distribution of mean milk yield for each cow for nine days.

4.2 Reproductive performance

The inventory of the two farms is displayed in Table 4.

Parameters	Rubber Mat	Concrete Flooring
No. of milking cows	70	35
No. of dry cows	24	30
No. of heifers	6	25
Total	100	90

Table 3: The number of milking cows, dry cows and heifers farm respectively.

The reproductive parameters calculated for each farm include pregnancy rate, age at first calving rate, calving interval, days open, number of parity as well as days in milking.

There was no significant difference between the parameters of selected reproductive performance (Table 5). The reproductive performance of all cows was similar between the two farms (p -value >0.05).

Parameters (Average)	Rubber Mat	Concrete Flooring
Pregnancy rate (%)	100	50
Age at first calving (months)	29	26
Calving interval (months)	12.5	14
Days open (days)	90	90
No. of parity	≤ 2	> 2
Day in milking (days)	90	150

Table 4: Results of the selected reproductive performance for CF and RF farms

4.3 Clinical reproductive problems

Based on the data obtained, the number of cases of clinical reproductive problems for RF and CF were similar with just one case per year (Table 6). However for abortion, RF has 5 cases compared to CF with 4 cases. There was no significant difference of clinical reproductive problems between the two farms (p -value >0.05).

Farm	Number of cases per year			
	Retained placenta	Dystocia	Repeat breeder	Abortion
RF	1	1	1	5
CF	1	1	2	4
Total	2	2	3	9

Table 6: Annual number of cases of clinical reproductive problems

4.4 Clinical mastitis

The number of animals with clinical mastitis was one animal (11%) in RF and eight animals (89%) under CF (Table 7). The association of type of flooring with clinical mastitis shows that clinical mastitis was significantly lower in RF compared to CF (Fisher's Exact test p -value <0.05). The risk estimate shows that cows on RF had 10.5 (95%CI: 1.23, 90.7) less likely to have clinical mastitis compared to cows on CF.

	Number of clinical mastitis cases		Total
	YES	NO	
Rubber flooring	1	29	30
Concrete Flooring	8	22	30
Total	9	51	60

Table 5: Annual number of cases of clinical mastitis

4.5 Lameness

The distribution of lameness according to locomotion score in each farm is shown in Table 8. Farm with CF has higher number of cows with lameness compared to RF and the difference was significantly different after dichotomising the data (Chi-squared test=18.4, $p<0.05$). The odds ratio was cows under RF have 15.54 chance of not developing lameness compared to cows under CF (95%CI: 3.8, 63.4)

Farm	Lameness Score		
	0=NORMAL	1=MILD	2=MODERATE
Rubber mat	27	3	0
Concrete Flooring	11	16	3
Total	38	19	3

Table 6: Frequency distribution of locomotion score in RF and CF farms

5.0 DISCUSSION

In this study, the mean milk yield for the nine consecutive days of study revealed that there was significant difference of milk yield between RF and CF farm. RF farm cows were producing more milk daily compared to CF cows. This result is contrary to Norberg (2012), Kremer *et al.* (2007) and Eicher *et al.* (2013) who reported non-significant findings. This study utilised the existing resources available in the two selected farms, therefore, unlike those previous studies, the effect of potential confounding factors such as age, parity, breed and days in lactation were not taken into account. However, a multivariate statistical analysis could be used to elucidate the confounding effect of some factors on the association between milk yield and CF or RF farm. Kremer (2007) reported that age, calving, genetics and metabolic stress of lactation stage were all factors influencing milk yield. In that study, the mean milk yield of the concrete slatted flooring group and rubber matted slatted flooring group were 24.59 kg and 24.51 kg respectively, and there were no difference between the mean milk yield ($p=0.489$).

The reproductive performance between the two studied farms was similar. This is in contrast with a study by Kremer *et al.* (2012). They reported RF affects an earlier onset of regular oestrous behaviour and improves fertility trait of calving interval by earlier pregnancy and less days open. The different findings could be resulted from the method of data collection in which in this study, data were collected by interviewing the farmers, whom they recalled the cases by memory and not based on physical records. Furthermore, this study was conducted in a short

period of time compared to Kremer *et al.* (2012) which also involved 91 cows with 139 lactation periods.

Similarly, there was no difference between the parameters within the clinical reproductive disorders included in this study. In an Irish study by Mee *et al.* (2011), they concluded that factors associated with dystocia are cow-specific risk factors such as month of birth, parity, calf gender, single or twin birth, whether a difficult calving had been experienced previously by the same cow, rather than environmental factors such as flooring. For abortion (i.e. foetal loss), the associated maternal factors include age of dam at conception, the interval between calving/abortion and next conception, number of previous abortion(s), the outcome of previous pregnancy as to whether abortion occurred before/after 60 days of gestation, and the number of previous confirmed pregnancies or gravidity (Rafati *et al.*, 2010). Other studies also reported the role of maternal factors, rather than flooring, in repeat-breeder syndrome (Moss *et al.*, 2002) and retained placenta (Heringstad *et al.*, 2005) in dairy cows. These findings indicate that fertility and reproductive performance of the cow are therefore the main factors for the studied reproductive disorders.

Our study revealed that RF farm had a lower level of clinical mastitis compared to CF. One explanation could be that RF is easily cleaned or auto-cleaning properties which improves hygiene condition of the cows and subsequently the cow udder compared to CF. Rubber mated flooring provides a labour-saving self-cleaning management system and a cattle-friendly flooring (Platz *et al.*, 2008). In a Tanzanian study, Kivaria *et al.* (2007) concluded that factors such as herd size, parity, the body condition score, days in milk and dirty barn floor, has a significant association with

the occurrence of clinical mastitis. Dairy cows that are housed under conditions of sub-optimal hygiene have been shown to be associated with high incidence of clinical mastitis (Radostits *et al.*, 2000).

Based on this study, RF farm has less lameness problems compared to CF farm with the higher score occurred in CF farm. Furthermore, cows in CF have higher risk of developing lameness compared to cows in RF farm. As stated by Vanegas (2006), the cause of lameness is multifactorial which involves management, nutrition, genetics, housing, and claw trimming, and the development of lameness is also directly linked to flooring conditions. The concrete flooring is hard, abrasive and can cause excessive wear but also when not cleaned properly can be slippery and causes injuries (Cook *et al.*, 2007). Rubber flooring on the other hand is easy to be cleaned, minimises the risk of slipping and increases cow comfort and provides a soft surface to reduce excessive wear and reduces slippage (Telezhenko and Bergsten, 2005). It is worth to note that both studied farms practice a semi-intensive farming system in which the cows are let out for grazing during the day and are milked twice daily in the barn. The results from this study are in agreement with others on the finding of less lameness in RF farm compared to CF farm. The reason could be that RF increases cow comfort while walking and standing and thus improves cow locomotion (Vanegas *et al.*, 2006; Telezhenko *et al.*, 2009; Rushen and de Passillé, 2006). Lameness is one of the most important diseases causing great economic losses to farmers and is one of the main reasons for culling in a survey by the USDA in 2007. Green *et al.* (2002) reported that milk production decreased up to several months before and after the onset of a disease or disorder such as lameness.

This problem has caused up to 360 kg of milk losses for each lame cow and year which is considered a great economic loss to a dairy farmer. In another study, cows that are more severely lame experience a greater drop in milk yield as for older cows in later parity (Warnick *et al.*, 2001).

The cost of lameness can differ depending on the severity and duration of the claw lesion causing the lameness and the relative contribution to the costs differed between the disorders (Norberg, 2012). Cha *et al.* (2010) concluded that a reduction in milk yield was the largest economic loss in cases with sole ulcers (38%), impaired fertility was the main cost for foot rot (50%), and treatment was the largest expense for digital dermatitis (42%). However, Kremer (2007) concluded that the type of flooring whether soft flooring or concrete does not affect the incidence of clinical lameness if claws are trimmed frequently and functionally.

6.0 CONCLUSIONS AND RECOMMENDATIONS

In conclusion, floor type matters for dairy cow comfort in this study. Cow comfort is important to ensure the longevity of the cow productivity and reproductive life. In turns, this might generates more income to the farm. Equipping the farm with rubber mats does increase cow's milk production, reduces the risk of lameness and occurrence of clinical mastitis. However, reproductive performance and clinical reproductive problems were similar between RF and CF. Generally, this study provides an insight of the potential benefits of using a rubber matted flooring.

Further work on comfort level and preferences of cow to walk on either concrete or rubber flooring is recommended. Besides that, diagnosis of the cause of lameness should also be investigated further. Also, subclinical mastitis occurrence between the two farms should be studied.

Based on the findings from this study, the use of RF in dairy farms might be beneficial to improve the milk yield, and reduced occurrence of lameness and clinical mastitis. However, conclusive recommendation on the implementation of RF in dairy farms in general cannot be made until confounding effect is studied.

One of the limiting factors in this study was the lack of recording system of the farm. A practical recording system should be established so that the farm performance can be monitored more objectively and improvements can be made.

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