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EFFECT OF CONCRETE AND ANTI-SKID RUBBER FLOOR TYPES ON SOME BEHAVIOURAL TRAITS AND STRESS LEVEL IN JERSEY COWS

NUR RAIHAN AB RAZAK

EFFECT OF CONCRETE AND ANTI-SKID RUBBER FLOOR TYPES ON SOME BEHAVIOURAL TRAITS AND STRESS LEVEL IN JERSEY COWS

NUR RAIHAN AB RAZAK

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It is hereby certified that we have read this project paper entitled "Effect of Concrete and Anti-Skid Rubber Floor Types on Some Behavioural Traits and Stress Level in Jersey Cows" by Nur Raihan Ab Razak 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.

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DR WAN MASTURA SHAIK MOHAMED MOSSADEQ
DVM (UPM), MSc (GUELPH), PhD (UPM)
Senior Lecturer,
Faculty of Veterinary Medicine
Universiti Putra Malaysia
(Supervisor)

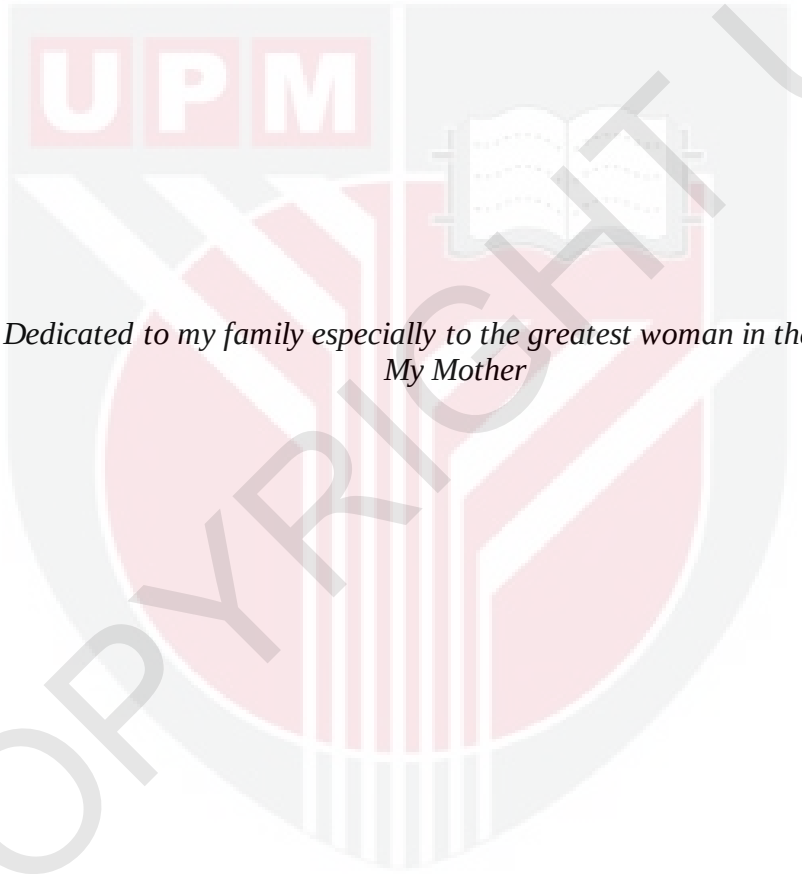
_____

DR SITI ZUBAIDAH RAMANOON
DVM (UPM), MSc (GUELPH), PhD (MURDOCH)
Senior Lecturer,
Faculty of Veterinary Medicine
Universiti Putra Malaysia
(Co-Supervisor)

_____

DR TENGKU RINALFI PUTRA TENGKU AZIZAN
BSc (KUSTEM), MSc (UKM), PhD (Canterbury, New Zealand)
Senior Lecturer,
Faculty of Veterinary Medicine
Universiti Putra Malaysia
(Co-Supervisor)

Dedicated to my family especially to the greatest woman in the world,
My Mother



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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.

KESAN LANTAI KONKRIT DAN LANTAI GETAH ANTI GELINCIR PADA BEBERAPA TRAIT TINGKAHLAKU DAN TAHAP TEGASAN LEMBU JERSEY

Oleh

NUR RAIHAN AB RAZAK

2015

Penyelia : Dr. Wan Mastura Shaik Mossadeq

Penyelia Bersama : Dr. Siti Zubaidah Ramanoon

Dr. Tengku Rinalfi Putra Tengku Azizan

Lantai getah telah digunakan oleh peladang di ladang tenusu di negara-negara Barat kerana kelebihan dari segi pengeluaran dan kesihatan kuku berbanding dengan lantai konkrit. Tidak banyak yang diketahui tentang kesan lantai getah pada ciri-ciri tingkah laku dan tahap tegasan pada lembu tenusu. Oleh itu, kajian ini bertujuan untuk membandingkan kesan lantai konkrit (CF) dan lantai getah anti-gelincir (RF) pada beberapa ciri-ciri tingkah laku dan tahap tegasan lembu tenusu dari baka jenis Jersey. Tiga puluh ekor lembu masing-masing dari ladang yang menggunakan lantai getah (n=15) dan lantai konkrit (n=15) dipilih berdasarkan umur, laktasi dan

baka yang sama iaitu semua lembu berumur 5 tahun, berada pada laktasi yang kedua dan dari baka jenis Jersey. Sistem pengurusan pemakanan lembu di kedua-dua ladang tersebut adalah sama. Kekerapan tingkahlaku berdiri, berbaring, berjalan, makan dan minum diperhatikan dan direkod menggunakan ethogram sepanjang tempoh pemerhatian selama 2 jam setiap hari selama 9 hari. Pemerhatian dijalankan dari pukul 9 pagi hingga 11 pagi untuk ladang lantai konrit dan pukul 12 tengah hari hingga 1 petang untuk ladang lantai getah anti-gelincir. Sampel darah diambil dari kesemua haiwan yang dikaji pada hari kesepuluh dan dianalisa untuk beberapa parameter hematologi. Kekerapan tingkahlaku lembu berbaring, berdiri dan berjalan ternyata dipengaruhi oleh jenis lantai ($p<0.05$). Bilangan lembu berbaring adalah lebih tinggi dalam RF (10.1±0.5) berbanding CF (3.9±0.3) manakala bilangan lembu berdiri dan berjalan adalah lebih tinggi dalam CF (masing-masing 13.8±0.2 dan 7.6±0.4) berbanding RF (masing-masing 8.7±0.5 dan 5.1±0.3). Tingkahlaku makan tidak dipengaruhi oleh jenis lantai kerana tidak ada perbezaan yang signifikan di antara RF dan CF dalam tingkahlaku ini. Terdapat perbezaan yang signifikan antara RF dan CF dalam kiraan neutrophil, kiraan limfosit dan kiraan monosit ($p<0.05$) dimana CF mempunyai neutrophil lebih tinggi dan kiraan limfosit lebih rendah berbanding RF. Lantai jenis CF mempunyai nisbah neutrophil kepada limfosit yang lebih tinggi ($p<0.05$) berbanding dengan RF dimana nisbah neutrophil kepada limfosit yang tinggi dikaitkan dengan tekanan fisiologi.

Kata kunci: lantai konkrit, lantai getah anti-gelincir, lembu tenusu, tingkahlaku, tegasan

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.

EFFECT OF CONCRETE AND ANTI-SKID RUBBER FLOOR TYPES ON SOME BEHAVIOURAL TRAITS AND STRESS LEVEL OF JERSEY COWS

By

NUR RAIHAN AB RAZAK

2015

Supervisor : Dr. Wan Mastura Shaik Mossadeq

Co-supervisor : Dr. Siti Zubaidah Ramanoon

Dr. Tengku Rinalfi Putra Tengku Azizan

Rubber flooring has been used in dairy farms by farmers in the Western countries because of its advantage in terms of production and hoof health compared to concrete flooring. Little is known about the effect of rubber flooring on the behavioral traits and the stress level of dairy cows. Therefore, this study aimed to compare the effect of concrete flooring (CF) to anti-skid rubber flooring (RF) on some of behavioral traits and stress level of Jersey cows. Thirty dairy cows from two different farms that uses anti-skid rubber flooring (n=15) and concrete flooring (n=15) were selected based on their age which is 5 years old, in second lactation and of Jersey breed. Both farms practice similar feeding management system. Behavior

of these cows such as standing, lying, walking, feeding and drinking was observed and recorded using an ethogram for a period of 2 hours daily for nine days. Observation of the behavior was done from 9 am until 11 am for the farm equipped with rubber flooring and 12 pm until 1 pm for the farm equipped with concrete flooring. Blood samples were collected from these animals on the tenth day and were analyzed for some hematological parameters. Frequency of cows lying down, standing and walking behaviours were significantly ($P<0.05$) affected by the types of floor. The number of cows lying down was significantly higher in RF (10.1±0.5) compared to CF (3.9±0.3) while the number of cows standing and walking is significantly higher in CF (13.8±0.2 and 7.6±0.4, respectively) compared to RF (8.7±0.5 and 5.1±0.3, respectively). Feeding and drinking behaviour were not affected by types of floor as there was no significant difference in these behaviour between RF and CF systems. The neutrophil count, lymphocyte count and monocyte count were significantly different between RF and CF farms ($p<0.05$),) where CF farm had higher neutrophil and lower lymphocyte numbers than RF farm. The CF farm had higher neutrophil to lymphocyte ratio ($p<0.05$) compare to RF farm where a high neutrophil to lymphocyte ratio is often associated with physiological stress.

Keywords: concrete flooring, anti-skid rubber flooring, dairy cows, behavior, stress

1.0 Introduction

Dairy farmers strive to provide dairy cows comfortable enviroment as comfortable cows can result in higher production. It is essential that dairy cows have adequate rest to maintain good health and high level of productivity (Tucker and Weary, 2004) which is why dairy cattle prioritize resting over other behaviour (Norring *et al.*, 2008). Cattle have a nearly constant daily need for lying where approximately 50-60% of the day spent lying down and the duration of time cow spent lying was suggested as an indicator of welfare and cow comfort (Herlin, 1997).

Therefore, efforts have been undertaken to improve welfare and comfort of dairy cows by providing better housing enviroment range from stall design to the type of flooring used in these stalls. Concrete, which is the common type of flooring used nowdays, does not provide the best walking and lying surface area because it is too hard and does not provide sufficient traction which lead to lower walking speed and greater risk of the cow slipping (Rushen and de Passile, 2006). The use of concrete flooring in cattle farms has been shown to be one of the important factors that predisposes dairy cows to lameness which can be detrimental to the animal's health, welfare and production (Eicher *et al*., 2013). Graunke *et al*. (2011) also reported that concrete flooring cause more interrupted lying down movement and fewer lying bouts, and less prefered lying area compared to softer material. This will not only affect the hoof health and mobility of dairy cows but also lead to increase of stress level which directly reduces the feed intake and subsequently reduce in milk production (Kremer *et al.*, 2012). Thus, many research was done to improve flooring of dairy cows by comparing concrete flooring with other softer surface material.

Thus, a great body of research was done to compare the effect of concrete flooring to other softer surface material and to assess its impact on herd health and milk production in general.

According to Tucker and Weary (2003), dairy cattle prefer to rest on softer surface compared to concrete and this is supported by Yanar *et al.* (2010) and Vanegas *et al.* (2006) who reported that dairy cattle had a clear preference for rubber mats in their stalls. Rubber flooring have been reported to improve locomotion where it increases walking speed, stride length and generally improves the gait of the cows (Yanar *et al.*, 2010; Kremer *et al.*, 2012). The use of rubber flooring has been shown to improvemeof the welfare, claw health, and some behavioral traits regarding activity, gait and mounting (Kremer *et al.*, 2012).

Thus, the objectives of this study were: (i) to assess the behaviour of cows kept on concrete and anti-skid rubber floors and, (ii) to determine the hematological indicator of stress level of dairy cattle reared in a farm equipped with either anti-skid rubber flooring system (RF) or concrete flooring system (CF).

2.0 LITERATURE REVIEW

2.1 Overview of Concrete Flooring System

For years, concrete flooring has been the most common type of flooring used in the intensive dairy farms. There are many advantages of this type of flooring which include no extra cost needed for the farmer and easier to clean and maintained compared to other type of floors such as rubber mats. Despite the advantages, unfortunately there were more disadvantages compare to advantages in term of overall health, hoof health, locomation and daily activity of the dairy cows.

According to Rushen and de Passille (2006), concrete does not provide the best walking surface as it does not have sufficient traction which lead to greater risk of falling and slipping. Concrete floor has greater abrasiveness which lead to uneven wear of hooves which results in greater pressure to the hoof and subsequently increase the risk of hoof damage (Telezhenko *et al.*, 2008). This is supported by previous research that concrete floors have been associated with an increased in the occurrence of hoof lesion and hoof disorders which then increases the chance of lameness compared to straw yards and earthen floors (Somer *et al.*, 2003; Faye and Lescourret 1989). In addition, poorly maintained concrete floors also increases the risk of hoof lesion.

Concrete flooring also caused more interrupted lying down movement, fewer lying bouts and less preferred lying area of dairy cows (Graunke *et al.*, 2011). Cows prevented from lying down show behavioral and physiological stress response which gives adverse effect to health and welfare of the animals (Norring *et al.*, 2008).

2.2 Overview of Anti-Skid Rubber Flooring System

Due to problems associated with concrete floors, many producers in the western country have started using rubber mats in their farms. This is because cows show a preference for lying on softer materials and lie down longer on soft materials (Haley *et al.,* 2001; Rushen *et al.,* 2007; Tucker and Weary, 2004). In a preference test carried out by Magnusson and Michanek (1991), it was shown that the dominant animals will displace lower ranking animals to obtain a softer lying area and this happened only when rubber mats, but not when concrete surfaces were used.

When rubber matress was placed in front of the feed bunk and concrete floors in the same pen, cows spent more time standing near the feeder compare to elsewhere in the pen (Tucker *et al.,* 2006). This also lead to increased time spent lying in front the feed bunk when provided rubber floors. Thus, it suggested that cows prefer to stand on softer flooring surfaces when eating compared to concrete surface.

However, according to previous research, some of the disadvantages of the use of rubber mats are that this material have been shown to worsen the incidence of sole ulcers, lack beneficial effect on reproductive performance and showed no differences regarding daily average milk yield (Kremer *et al.,* 2012).

2.3 Overview of the Behavioural Activity of Dairy Cows

Over the years, the welfare and comfort of cows have become one of the dairy farmers' concern, as healthy and comfortable cows reflect greatly on their performance. Behaviour, productivity, health and physiology are indicators of animal welfare during housing which can be assessed in quantitative manner (Candiani *et al.,* 2014). Daily activity of cows such as standing and lying is important as it is one of the indicator of animal comfort in a given enviroment. Estimates of time spent lying across studies is between 9.4 to 14.7 hours a day which is necessary to maintain good health and high productivity of animals.

Cows experimentally prevented from lying down for a total of 14 hours per day, have been shown to have reduced plasma concentrations of growth hormone (Munksgaard and Lovendahl, 1993), a hormone which is positively associated with milk yield (Hart *et al*., 1978). Deprivation of lying also changes the response of the hypothalamic-pituitary-adrenal axis (Munksgaard and Simonsen, 1996; Ruckebusch, 1974), which has been suggested to reflect a state of chronic stress experienced by the animal (Ladewig and Smidt, 1989).

Cows that were deprived from the opportunity to lie down for 3 hours significantly show an increase in their motivation to lie down to the extent that lying takes priority over other basic needs such as eating where after a 3 hour period of deprivation from both lying and eating, cows were found to spend their time lying rather than eating (Metz, 1985). Thus, reducing the time that dairy cattle can lie down is likely to have adverse affects on their welfare and productivity.

2.3 Overview of the Physiological Stress of Dairy Cows

Stress has become concern of the producer as it negative effects on production and concerns over animal welfare. Stress can be detected by several ways which one of them is stress leukogram. A stress response can be due to any external or internal factors, which then will increase the secretion of stress hormone that alter the leukocyte profile of the animals. Leukocyte changes can be categorized into different type of leukograms such as stress leukograms and inflammatory leukograms.

Typically, there is mild mature neutrophilia, lymphopenia, and eosinopenia in the stress leukograms where the neutrophil to lymphocyte ratio may be 2:1 to 3:1 (Jones and Allison, 2007). The average percentage of neutrophils in cattle is 15 to 45% of total WBC while the average percentage of lymphocytes is 45 to 75% and the normal ratio of N:L ratio is 1:2. (Jones and Allison, 2007). The differences between stress leukograms and inflammatory leukograms is that there is no left shift or presence of immature neutrophils in the stress leukograms. Appearance of numerous immature neutrophils in circulation typically appears within 24 hours with acute inflammation which is different to the stress response.

Stress response will lead to reduced immune function that subsequently decreases the overall health of animals (Davis *et al.*, 2008). This may cause the animals to be easily infected by various diseases agent and simple infection can be severe due to low immune function. Besides, stressed animals will reduce their feed intake and which will worsen both health and production level in the long run.

We investigate the effect of anti-skid RF and CF on dairy cows reared on semi-intensive systems to evaluate its impact on behaviour and stress level of these animals and how this effect play a role in improving the animals' welfare in general.

3.0 MATERIALS AND METHODS

3.1 Animals and Housing

Thirty Jersey cows were selected from farms equipped with anti-skid rubber rubber flooring (n=15) or concrete flooring (n=15). The animals were selected based on their similarity in age and lactation. Cows which were selected were 5 years old and in their second lactation. Both farms practice similar feeding management system.

3.2 Behavioural Studies

Behavioural activities of the cows were investigated by using instantaneous sampling method as described by Yanar *et al.* (2010). The cows behaviour were observed and recorded using an ethogram at the distance of at least 2 m fron the pen, every half an hour for two hours daily for nine days. The field observation took place between 9.00 am to 11.00 am for the farm with anti-skid rubber floor and between 12.00 pm to 2.00 pm for farm with concrete floor. The behaviour was recorded for each of the following activities and summarised in Table 1. The average frequency of each behaviour of the cow was calculated.

Table 1 : Ethogram of Cow Behaviour

Behaviour	Description
Standing	Cow was inactive in upright position
Lying	Cow's body in contact with the ground
Walking	Moving at least 3 legs forward in sequence
Feeding	Head over or in the bunk

3.3 Blood Sampling

On the 10^{th} day, blood samples were collected from the coccygeal vein of each cow using 18-gauge Vacutainer needles and EDTA tubes. All samples were stored in ice and were transported to the Clinical Pathology Laboratory, UPM for preparation of blood smear. Blood smears were dried and placed on a staining rack and flood stained with Geimsa-Wright stain. The slides were then rinsed with slow running water and dried with paper. Blood smears were observed under the microscope at 40x magnification. White blood cell (WBC) count was performed. WBC observed were neutrophils (**N**), eosinophils (**E**), lymphocytes (**L**), and monocytes (**M**). The N:L ratio was determined by dividing the number of neutrophils by the number of lymphocytes.

3.4 Statistical Analyis

Results are presented as Mean ± SEM. The data were analyzed statistically by using SPSS version 20. The behavioural data and blood data were tested for normality test. The significance of the specific comparison was analyzed by paired T-test where data were considered significant when $p<0.05$. Pearson correlation test was used to determine the correlation between behavioural data and blood data.

4.0 Results

The results of the data analysis of the behavioural studies are presented in Table 2. The analysis of variance showed significant differences between the two groups regarding standing, lying and walking behaviour. Cows housed on rubber mat floor had significantly higher frequency of lying behaviour compare to cows housed on concrete floor ($p<0.05$). Cows housed on concrete floor spent more times standing and walking during the observation period while there was no difference in times spent eating between the groups (Figure 1). There was no difference in all behaviour activity in both farms between days (Figure 2). Standing and lying behaviour had strong negative correlation ($r=-0.766$) where an increase in standing behaviour lead to decrease time spent lying (Table 3).

The result of the data analysis of the leukocytes profile are presented in Table 4. The total leukocyte for both farms was within the normal range while cows housed on concrete floor had higher percentage of neutrophils and monocytes, and lower percentage of lymphocytes count compare to the normal range. Cows housed on rubber mat floor had a normal percentage of neutrophils, lymphocytes and monocytes count and slightly higher percentage of eosinophils count. In addition, there was a significant difference in the percentage of neutrophils, lymphocytes and monocytes count between cows housed on rubber mat floor and cows housed on concrete floor ($p<0.05$).

The neutrophils and monocytes count was higher but the lymphocytes count was lower in cows housed on concrete floor compared to cows housed on rubber mat floor (Figure 3).

The neutrophils to lymphocytes ratio of cows housed on rubber mat floor was 1 to 3 while the ratio N:L of cows housed on concrete floor was 2 to 1 in comparison to the normal ratio of neutrophils to lymphocytes which is 1 to 2 (Figure 5). There was a very strong negative correlation between neutrophils and lymphocytes (r=-0.876) and strong negative correlation between lymphocytes and monocytes (r=-0.601) while there was no significant correlation for other leukocyte parameters (Table 4).

Table 2 : Frequency of standing, lying, walking and feeding behaviour of cows in farms with concrete and rubber mat flooring systems. Results are presented as Mean ± SEM.

Behaviour	Concrete Floor	Rubber Mats Floor
Standing	13.9±0.2[a]	8.7±0.5[b]
Lying	3.9±0.3[a]	10.1±0.5[b]
Walking	7.6±0.5[a]	5.1±0.3[b]
Feeding	8.6±0.5	8.8±0.5

[ab] mean within rows with different superscript differ at $p<0.05$

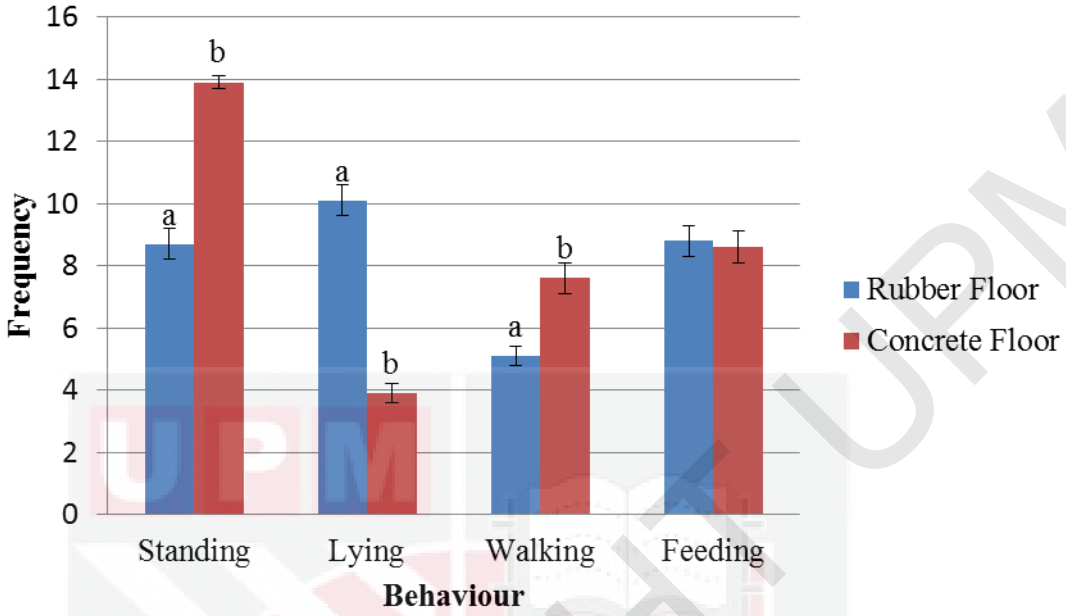

Figure 1: Frequency of standing, lying, walking and feeding behaviour of cows in CF and RF farm. Results are presented as Mean ± SEM. ^{ab} significantly different with each other at $p<0.05$.

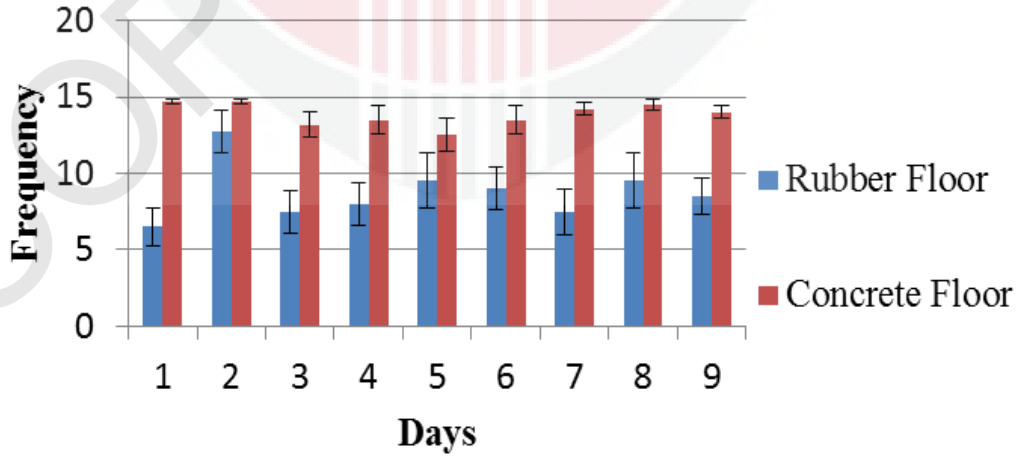

Figure 2 : Frequency of standing behaviour of cows in CF and RF farms between days. Results are presented as Mean ± SEM.

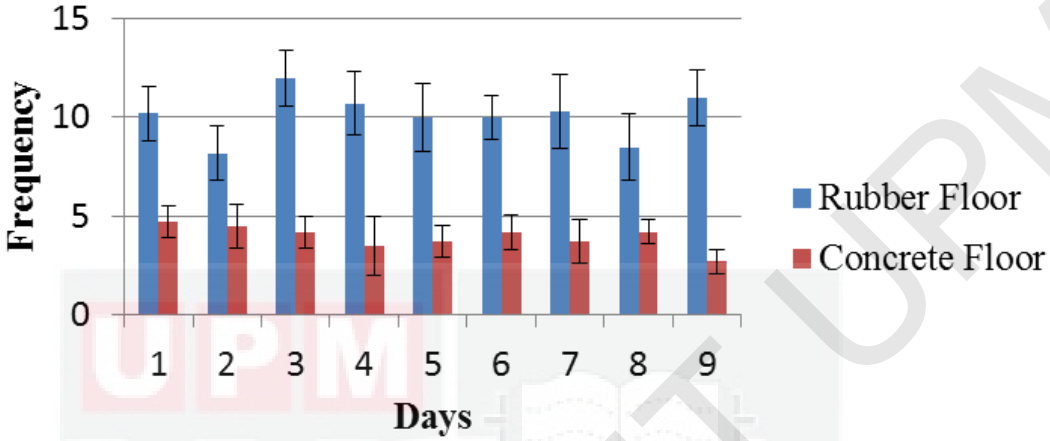

Figure 3 : Frequency of lying behaviour of cows in CF and RF farms between days. Results are presented as Mean ± SEM.

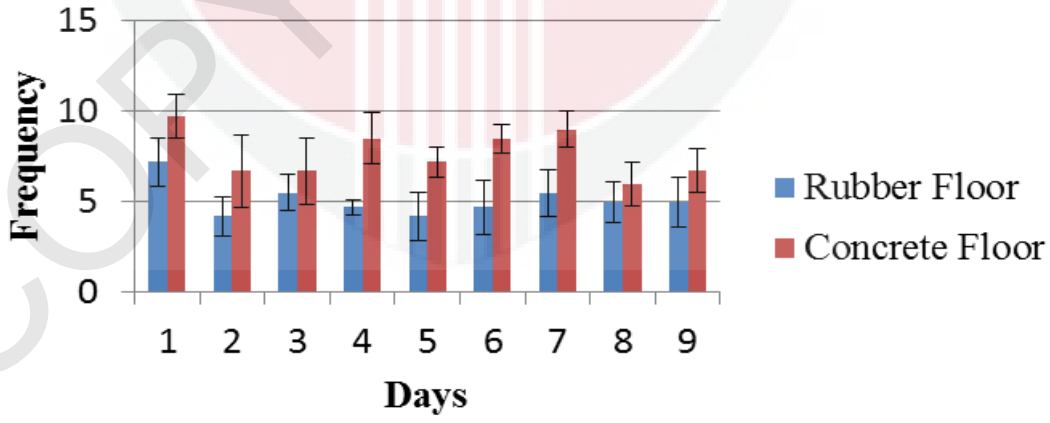

Figure 4 : Frequency of walking behaviour of cows in CF and RF farms between days. Results are presented as Mean ± SEM

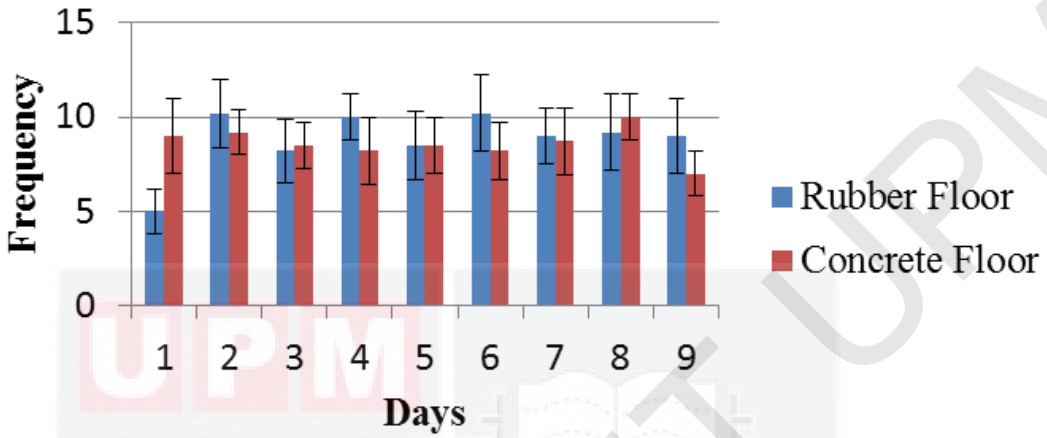

Figure 5 : Frequency of feeding behaviour of cows in CF and RF farms between days. Results are presented as Mean ± SEM.

Table 3 : Correlation coefficient between standing, lying, walking and feeding behaviour of cows in CF and RF farms.

Parameter	Feeding	Walking	Lying
Standing	**0.224**	**0.452**	**-0.766***
Lying	**-0.125**	**-0.449**	**NC**
Walking	**0.15**	**NC**	**NC**

* Significant at $p<0.05$
NC : Not Calculated

Table 4 : Counts of total white blood cell, neutrophils, lymphocytes, monocytes and eosinophils of cows in CF and RF farms. Results are presented as Mean ± SEM.

Parameter	Total WBC	Neutrophils (%)	Lymphocytes (%)	Monocytes (%)	Eosinophils (%)
Reference value	4 -12	15-45	45-75	2-10	0-9
Rubber Floor	11±1.3	20.5 ± 1.5^{a}	58.9 ± 1.6^{a}	8.6 ± 0.7^{a}	11.9±1.5
Concrete Floor	10.7±0.8	52.4 ± 2^{b}	24.7 ± 1.3^{b}	14 ± 1.5^{b}	9.5±1.2

^{ab} mean within column with different superscript differ at $p<0.05$

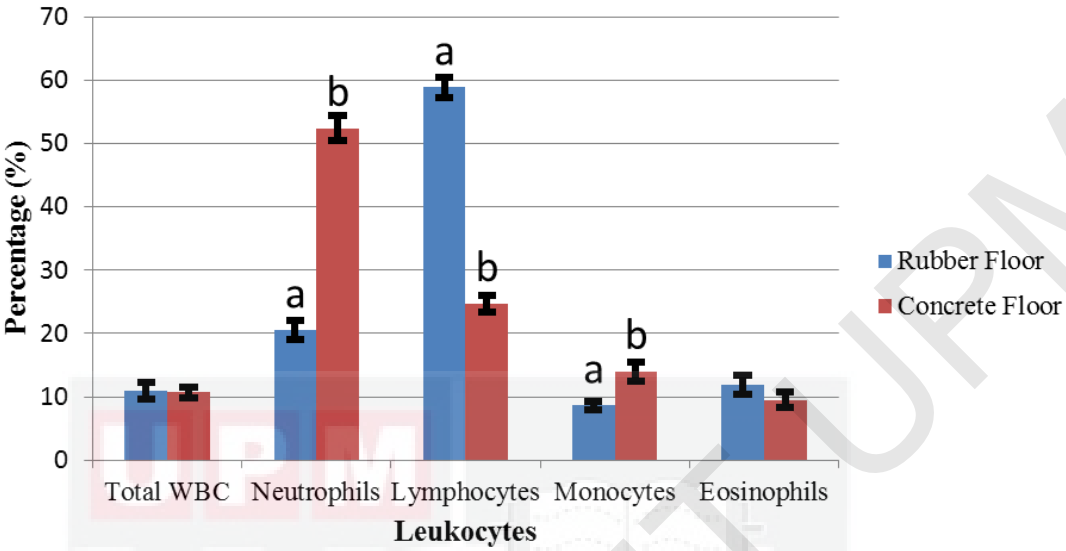

Figure 6 : Total white blood cell neutrophils, lymphocytes, monocytes and eosinophils count for cows in CF and RF farms. Results are presented as Mean ± SEM. [ab] significantly differ with each other at $p<0.05$.

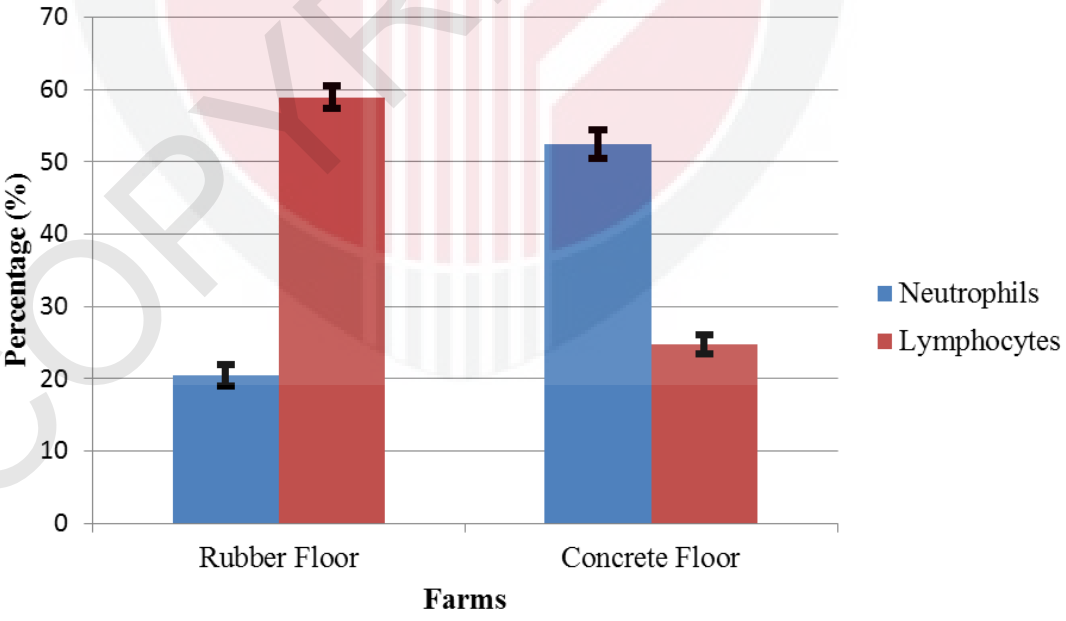

Figure 7 : Neutrophils and lymphocytes count (%) of cows in RF and CF farms. Results are presented as Mean ± SEM.

Table 5: Correlation coefficient between total white blood cell, neutrophils, lymphocytes, monocytes and eosinophils of cows in CF and RF farms.

Parameter	Total WBC	Neutrophils	Lymphocytes
Monocytes	**0.199**	**0.199**	**-0.601**
Eosinophils	**-0.57**	**NC**	**-0.135**
Neutrophils	**NC**	**NC**	**-0.876***

*Significant at $p<0.05$
NC : Not Calculated

5.0 Discussion

From the result above, we can conclude that cows on rubber floor stand less, lay down more, and walk less than cows on concrete floor which is consistent with finding by Haley *et al.* (2000) who found that cows were more inclined to lie down on softer materials such as sand or mattresses, resulting in increased lying time and a reduction in standing time. On the other hand, cows housed on concrete floor spent more time standing compared to cows housed on rubber mats. Haley *et al.* (2000) reported that standing time is higher when dairy cattle was housed on hard surfaces like concrete. Cows housed on concrete floor walk more compare to cows housed on rubber floor which was inconsistent with previous study that reported cows on rubber matress walk more due to increase in traction that lead to secure footing (Rushen and de Passille, 2006). According to Telezhenko and Bergsten (2005), adding high friction non-slip cover to the floor such as mattresess increase walking speed and stride length. However, result from this study showed that cows housed on rubber mats floor walk less compared to cows housed on concrete floor. This maybe due to different weather and climate, also other confounding factors such as the degree of roughness of the concrete floor.

There was no significant difference in the frequency of feeding behaviour in both farm. This is supported by previous research that cows on rubber mats floor and concrete floor showed no differences in the amount of time spent eating. On the other hand, cows in concrete environment spent more time standing without eating. This is not advisable as dairy cows need a minimum rest of at least 12 hour per day.

A growing amount of evidence suggest that in order to maintain the health, welfare and maximize productivity, the minimum amount of daily rest needed by dairy cows is 12 hours per day or approximately 50% to 60% of the day. Based on behavioural observations, cows on rubber floor rest more compare to cows on concrete floor which is more preferable as dairy cows need their maximum rest.

According to Cooper *et al.* (2007), cows prefer to ruminate while lying down and sufficient rumination times is important to efficiently digest the feed and increase dry matter intake (DMI) to support milk production (Botheras, 2007). Thus, it is important to make sure that dairy cows are comfortable enough to lie down and rest.

Increase lying behavior is also associated with a reduction in lameness and increased blood flow to the udder which will also increase in production and longevity as well as cow welfare (Botheras, 2007). According to Cook *et al.* (2004), increased standing time as observed in dairy cows on conrete floor will lead to other problems such lameness, lower body condition score, reduced reproductive performance, decreased production, increased level of stress hormone and reduced growth hormone which consequently reduces significant amount of profit to the farmer.

Cows housed on concrete floor had higher percentage of neutrophils count and lower lymphocytes count which indicate pysiological stress. Cows housed on concrete floor had increased monocyctes count or monocytosis which was depicted on the stress leukogram of bovine (Jones and Allison, 2007).

The normal neutrophils to lymphocytes ratio is 1 to 2 and from the present study, cows housed on rubber floor had a ratio of N:L of 1 to 3 while cows on concrete floor had a ratio of N:L of 2 to 1 which was typical for the stress leukogram. Jones and Allison (2007) reported that increased N:L ratio may be 2:1 or 3:1 since the numbers of neutrophils and lymphocytes are affected by stress in opposite directions. This ratio, according to Davis *et al.* (2008), is positively related to the magnitude of the stressor and to the circulating glucocorticoids.

According to Davis *et al.* (2008), the front-line hormone that overcome stressful situation are the glucocorticoids. Reduction in circulating lymphocytes numbers are not due to massive destruction of cell but rather due to glucocorticoid-induced alterations in redistribution of lymphocytes from blood to other body compartment. Circulating lymphocytes adhere to the endothelial cell that line the wall of blood vessels and undergo transmigration from circulation into other tissues for example lymph nodes, spleen, bone marrow and skin where there are sequested (Davis *et al.*, 2008). The escape of lymphocytes from the blood cause significant reduction in circulating lymphocytes numbers. Glucocorticoids also stimulate an influx of neutrophils into the blood from bone marrow and attenuate the egress of neutrophils from the blood to other compartments (Bishop *et al.*, 1968).

Thus, an increase in neutrophils and decrease in lymphocytes count with increase neutrophils to lymphocytes ratio suggested that cows housed on concrete floor had higher level of stress level compare to cows housed on rubber floor.

6.0 Conclusions

Cows housed on anti-skid rubber floor spent more times lying down which indicate more comfortable lying area compared to cows housed on concrete floor which spent more time standing.

Higher neutrophils and lower lymphocytes count, and higher neutrophils to lymphocytes ratio in cows housed on concrete floor maybe associated with physiological stress which is probably due to lack of comfortable resting and lying area compare to cows housed on anti-skid rubber floor.

Based upon the behavioural and leukocytes parameter, it is suggested that cows housed on anti-skid rubber floor is better especially in terms of welfare compared to cows housed on concrete floor.

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