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EFFECTS OF ANTI-SKID RUBBER MAT ON BEHAVIOUR, STRESS LEVEL AND MILK YIELD IN DAIRY COWS

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By

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July 2020

Chair : Wan Mastura Shaik Mohamed Mossadeq, PhD
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In the present study, the effects of anti-skid rubber mat on the behaviour, stress level and milk yield of dairy cows were evaluated. Forty dairy cows from two anti-skid rubber mat (RM)-enriched farms (n=20) and two concrete flooring (CF) farms (n=20) were selected for the study. The lying, standing, walking, feeding and drinking behaviour of these cows were recorded for two hours daily for five days and further analysed off-line using the Solomon Coder© software. Results showed that cows reared on RM have a significantly higher ($p<0.05$) frequency and duration (sec) of lying behaviour compared to cows reared on CF, with values (mean ± SD) of 4.96 ± 1.33 and 3950.75 ± 744.48 (RM farms) versus 2.26 ± 1.29 and 1959.6 ± 762.84 (CF farms). However, the frequency and duration (sec) of standing behaviour were significantly higher for CF farms (CF: 6.22 ± 1.66 and 4082.73 ± 775.46 versus RM: 4.10 ± 1.49 and 2388.42 ± 801.11). A retrospective analysis of the average milk yield of cows reared on RM (n=20) indicated a significantly higher milk yield (17.8 ± 0.84 L) than cows reared on CF farms (n=20) (7.55 ± 0.72 L), $p<0.05$. Results from the glucose tolerance test (GTT), adrenocorticotropic hormone (ACTH)-challenge and total white blood cell count conducted on five random cows from each RM and CF farm were not significantly different. However, data from the adrenocorticotropic hormone (ACTH)-challenge showed that the average basal concentration level of cortisol in cows from CF farms was significantly higher ($p<0.05$) compared to cows reared on RM (38.1 ± 23.9 ng/ml versus 17.2 ± 10.8 ng/ml), indicating a higher level of stress. In conclusion, the anti-skid rubber mat encourages the natural behaviour of dairy cows such as lying and an improvement in milk yield without significant effect on the stress levels of the cows under study. However, since many factors contribute to the production of milk, it is recommended that future studies include other parameters such as environmental factors, management systems, types and duration of rubber mats used, in addition to nutritional and feed intake of cows from each farm.

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KESAN PENGGUNAAN TIKAR GETAH ANTI-GELINCIR TERHADAP TINGKAH LAKU, TAHAP TEGASAN DAN HASIL SUSU LEMBU TENUSU

Oleh

MADIHAH BINTI ABDUL TALIB

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Dalam kajian ini, kesan tikar getah anti-gelincir terhadap tingkah laku, tahap tegasan dan hasil susu lembu tenusu telah dinilai. Sebanyak 40 ekor lembu tenusu dari dua ladang tikar getah anti-gelincir (RM) (n = 20) dan dua ladang lantai konkrit (CF) (n = 20) dipilih untuk kajian ini. Tingkah laku berbaring, berdiri, berjalan, makan dan minum lembu-lembu ini direkod selama dua jam setiap hari selama lima hari dan dianalisis lebih lanjut secara luar talian menggunakan perisian Solomon Coder©. Hasil kajian menunjukkan bahawa lembu yang diternak di ladang RM mempunyai frekuensi dan durasi (saat) tingkah laku berbaring yang jauh lebih tinggi ($p<0.05$) berbanding lembu yang diternak di ladang CF, dengan nilai (min ± SD) 4.96 ± 1.33 dan 3950.75 ± 744.48 (ladang RM) berbanding 2.26 ± 1.29 dan 1959.6 ± 762.84 (ladang CF). Walau bagaimanapun, kekerapan dan durasi (saat) tingkah laku berdiri jauh lebih tinggi untuk ladang CF (CF: 6.22 ± 1.66 dan 4082.73 ± 775.46 berbanding RM: 4.10 ± 1.49 dan 2388.42 ± 801.11). Analisis retrospektif purata hasil susu lembu yang diternak di ladang RM (n = 20) menunjukkan hasil susu yang lebih tinggi (17.8 ± 0.84 L) berbanding lembu yang diternak di ladang CF (n = 20) (7.55 ± 0.72 L), $p<0.05$. Hasil daripada ujian toleransi glukosa (GTT), hormon adrenokortikotropik (ACTH) dan kiraan jumlah sel darah putih yang dilakukan pada lima ekor lembu rawak dari setiap ladang RM dan CF tidak jauh berbeza. Walau bagaimanapun, data dari ujian cabaran adrenokortikotropik (ACTH) menunjukkan bahawa tahap kepekatan asas kortisol pada lembu dari ladang CF jauh lebih tinggi ($p<0.05$) berbanding dengan lembu yang diternak di ladang RM (38.1 ± 23.9 ng/ml berbanding 17.2 ± 10.8 ng/ml), menunjukkan tahap tegasan yang lebih tinggi. Kesimpulannya, tikar getah anti-gelincir mendorong tingkah laku semula jadi lembu tenusu seperti berbaring dan peningkatan hasil susu tanpa kesan yang signifikan terhadap tahap tegasan lembu yang sedang dikaji. Namun, disebabkan banyak faktor yang menyumbang kepada pengeluaran susu, disarankan agar kajian masa depan merangkumi parameter lain seperti faktor persekitaran, sistem pengurusan,

jenis dan jangka masa tikar getah digunakan, selain pemakanan dan pengambilan pakan lembu dari setiap ladang.

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Declaration by graduate student

I hereby confirm that:

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°C	degree Celsius
µl	microliter
ACTH	adrenocorticotropic hormone
ANS	autonomic nervous system
AUC	area under the curve
BW	bodyweight
CF	concrete flooring
CPM	count per minute
CR	clearance rate
CRH	corticotropin-releasing hormone
CV	coefficient of variation
DIM	days in milk
DVS	Department of Veterinary Services
EDTA	ethylenediaminetetraacetic acid
FMD	foot-and-mouth disease
G	gauge
g/kg	gram per kilogram
GTT	glucose tolerance test
HPA	hypothalamus-pituitary-adrenal
IACUC	Institutional Animal Care and Use Committee
LID	Local Indian Dairy
MCC	Milk Collection Centre
mm	millimetre
mmol/L	millimole per litre

N: L	neutrophil: lymphocyte ratio
NAP	National Agro-food Policy
NAP2	Second National Agriculture Policy
NAP3	Third National Agriculture Policy
NDDP	National Dairy Development Program
ng/ml	nanogram per millilitre
nmol/L	nanomole per litre
PNS	parasympathetic nervous system
QC	quality control
RIA	radioimmunoassay
RM	rubber mat
RMK-2	Second Malaysia Plan
RMK-3	Third Malaysia Plan
RMK-4	Fourth Malaysia Plan
RMK-5	Fifth Malaysia Plan
rpm	rotation per minute
S. D.	standard deviation
S0	standard zero
S1	standard 1
S2	standard 2
S3	standard 3
S4	standard 4
S5	standard 5
SNS	sympathetic nervous system
SPANOVA	split-plot analysis of variance
T	total count per minute

TC	total count
TMR	total mix ration
Vs	versus
WBC	white blood cell
wt/vol	weight per volume

CHAPTER 1

INTRODUCTION

The Department of Veterinary Services (DVS) of Malaysia has reported in 2015 that out of 661, 005 cattle heads present in the country, only 34, 311 are dairy cattle while the remainder of the cattle population comprises of beef cattle. Even though the output of milk production demonstrated a slight increase throughout a decade since the year 2006, it does not comply with the requirement for self-sufficiency of milk production in Malaysia which is only about 57% for the year 2017 (Department of Veterinary Services, 2018). The low percentage of milk production could be attributed by factors such as insufficient nutritious feed (Sim & Suntharalingam, 2015) and low breed performance of dairy cows (Panandam & Raymond, 2005). In addition, cattle kept in poor management are more susceptible to diseases such as clinical mastitis and prone to traumatic injury (Azhar et al., 2016), which may impact and reduce the quality of milk product of the animals (Phillips, 2002).

In Malaysia, most dairy cows are kept under intensive or full confinement system due to biosecurity reasons, i.e. to avoid the spread of diseases from other farms by controlling the movement of the cows (Otte et al., 2007). However, confinement in a free-stall barn constructed from concrete may cause deprivation to the animals, particularly when the dimensions of the stall are inappropriate or bedding in the stall is inadequate and hence, reducing the overall efficiency of stall use (Curt, 2001). Use of poor concrete surfaces may increase the risk of hoof problems through excessive hoof wear and tear (Dirksen, 1997) or slippage of animals (Schlichtung, 1987). In an intensive system where full confinement of livestock is expected, the need to provide comfortable flooring surfaces that enable these animals to express their natural behaviour is warranted. Furthermore, the consequences that arise from the use of concrete as flooring material which causes a continuous increment in the incidence of injuries reported in dairy cows and farm workers in the dairy farms calls for alternative flooring such as the rubber mat, which may help reduce the problems faced by cows reared on concrete surfaces (Hultgren, 2001).

The anti-skid rubber mat is widely acknowledged for its benefits in the western countries. Rubber mats can either be used as stall bedding or as alternative flooring; fully covering the entire floor of the dairy barn. In dairy farms, the soft texture and friction features of the rubber mat was found to reduce the risk of slipping either to the cows and also farm workers (Rushen & de Passillé, 2006). Furthermore, due to the softness effect, cows reared on rubber mats spent less time standing and tend to spend more time lying (Rushen et al., 2007) resulting in an improvement on the health of legs and hooves (Vanegas et al., 2006). This is an important factor as the hoof and leg health is the primary aspect of concern in reference to the dairy industry animal welfare. According to the European Food Safety Authority (2009), dairy cows in zero-grazing systems and under full confinement are prone to lameness and other hoof problems. In

addition, failure for the animal caretaker to provide suitable and convenient types of flooring at the farm might reduce the cows' welfare in terms of comfort consequently affecting their production.

At present, most of the literature written on the effect of the rubber mats on cattle in farms is focused on cattle raised in temperate countries. There is a lack of literature focusing on the effect of rubber mat-enrichment on cattle raised in the tropical regions. Besides acquiring resistance to a host of tropical diseases, cattle which are native to the tropics such as *Bos indicus*, are well acclimatized to relatively hot and humid regions in the tropics (Mirkena et al., 2010). However, Huertas et al. (2009) reported that the European breeds of cattle (*Bos taurus*) displayed poorer reproductive performance, had a higher mortality rate and reduction in milk yield, when introduced to the tropics. This might be due to the cattle's inability to adapt to the extremely hot and humid climates, feeds and diseases present in the tropics. Hence, the effect of rubber flooring on the indigenous cattle performance might be slightly different due to these factors.

Other factors that may contribute to the lack of anti-skid rubber mat use in the farms are the lack of encouragement and knowledge on its benefits to the dairy industry as well as the economical factor pertaining to the maintenance of these materials in the farm setting. The cost required to provide the anti-skid rubber mat as an enrichment program for a dairy farm is high and might seem expensive to owners of the small-scale farms. However, the benefits acquired from the use of anti-skid rubber mat in intensive and semi-intensive farms such as indirect improvement of the herd health and performance of cattle through the direct improvement of the cows' well-being in these farms for example, outweigh the cost required to install and maintain the rubber mats. Nevertheless, the research on the effect of rubber mats as an alternative flooring surfaces for dairy cows should be encouraged as it would benefit animal production in the long run.

To date, there is a lack of specific study on the effect of anti-skid rubber mat on the production, herd health and reproductive performance of dairy cattle in Malaysia. Therefore, in this study, the effect of anti-skid rubber mat on behaviour, stress level and milk production in the dairy cows were evaluated. Information and results from this study will be useful to farm managers in deciding the appropriate enrichment program for their dairy farms as often than not, productions are enhanced with the provision of an enrichment material such as the anti-skid rubber mat. Finally, it is hoped that in future, farmers in Malaysia will apply the findings of these studies into practical situations and will adopt this practice as a strategy to improve production in their farms without compromising the well-being of these animals.

Objectives of the study

1. To determine the effect of anti-skid rubber mat and concrete floor on the behaviour of dairy cows
2. To determine the effect of anti-skid rubber mat and concrete floor on the stress level of dairy cows
3. To determine the effect of anti-skid rubber mat and concrete floor on the milk yield of dairy cows

Hypotheses of the study

H_O: There are no significant differences in behaviour between cows reared on anti-skid rubber mat and cows reared on concrete floor
H_A: There are significant differences in behaviour between cows reared on anti-skid rubber mat and cows reared on concrete floor

H_O: There are no significant differences in the stress level between cows reared on anti-skid rubber mat and cows reared on concrete floor
H_A: There are significant differences in the stress level between cows reared on anti-skid rubber mat and cows reared on concrete floor

H_O: There are no significant differences in the milk yield between cows reared on anti-skid rubber mat and cows reared on concrete floor
H_A: There are significant differences in the milk yield between cows reared on anti-skid rubber mat and cows reared on concrete floor

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