

Effects of Floor Characteristics on Locomotion Scores in Dairy Cows under Smallholder Zero-Grazing Units in Kikuyu District, Kenya

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Abstract: A cross-sectional study was carried out within smallholder zero-grazing dairy units in Kikuyu District, Kenya, to evaluate floor characteristics and slurry management and association of these factors with locomotion scores. A total of 100 smallholder zero-grazing units and 161 dairy cows in them were evaluated respectively. Data on floor factors, frequency of slurry removal and its relative cover on the floor were obtained through direct observation and questionnaires. Gaits of cows were assessed using established locomotion scoring system. Among the 100 smallholder zero-grazing dairy units evaluated, 92% had concrete floors and 8% had earthen floor. Out of those with concrete floors, 38% had well-finished intact concrete, 57.6% had poorly constructed or worn-out concrete with holes and loose stones, while 4.4% were excessively smooth. Out of those with earthen floor, 6 units were bare while 2 were covered with straw and grass. At the time of visit to each zero-grazing unit, the slurry cover on the floor was scanty in 36%, moderate in 62% and excessive in only 2% of them. Frequency of slurry removal from floors of the zero-grazing units was done once per day in 41% of them, twice per day in 45% of them, while in 14% of them it remained on the floors longer than a day. Floor type was found to be strongly associated with locomotion scores (O.R. =1.5, $\chi^2=40.47$, $p=0.0016$). It is concluded that, floor type particularly when combined with slurry accumulation in smallholder zero-grazed dairy units, may influence gait and subsequently the locomotion scores of dairy cows. Therefore, there is need to train smallholder dairy farmers on the importance of maintaining good claw health through proper housing design with well finished floors that provide good claw ground-grip and ease of cleaning.

Key words: Dairy Cows • Floor • Locomotion Scores • Slurry • Smallholder

INTRODUCTION

Smallholder zero-grazing dairy units in Kenya vary in their design, floor type and management practices. The management practices at times vary even within the same unit. These variations exacerbate the risk factors of lameness in dairy cows especially from claw disorders [1, 2].

Claw disorders and lesions cause about 60% to 90% of all lameness in cattle [1,3]. Cattle under zero-grazed units are more predisposed to claw conditions as a result

of housing factors, nutritional, environmental and management stresses [1, 4, 5]. Moreover, zero-grazed cattle spend most of their time standing in small confined spaces in which their claws are exposed to excessive moisture from accumulated slurry and if the floor is made of concrete, pressure stress under the weight of the animal aggravates development of claw lesions [1, 4].

Structure and functional integrity of the horn of the claw is the foremost single requirement for maintaining claw health in dairy cows. Hence, any factor that weakens the horn or alters its conformation is likely to predispose

the animal to conditions that lead to lameness [5, 6]. The factors that affect claw health in the Kenyan smallholder dairy units are mainly farm-based and include housing design, floor type, slurry accumulation, as well as nutrition and management [1].

Lameness scoring systems are gaining wide application in dairy cows owing to their enhancement in making early diagnosis of lameness possible [7, 8], which is paramount for successful remedial measures. The observational locomotion scoring systems require that cattle be evaluated as they walk on flat unyielding ground [7], hence the importance of floor characteristics for both diagnosis making and maintenance of claw health.

Application of locomotion scoring for making diagnosis of lameness in dairy cows has been reported in the well-designed floors of cattle housing units of Europe and America with repeatably reliable outcomes. However, there is no literature available on its use to evaluate the gait of dairy cows in the substandard floors of smallholder zero-grazing units. The varied types of floors and presence of much slurry found in these units are likely to influence the locomotion scores of dairy cows. Hence the reason for this study to find out if locomotion scoring can be applied in such smallholder units with reliability.

MATERIALS AND METHODS

Geographical Study Area: The study was carried out in Kikuyu District, Kiambu County of Kenya, between June and August 2013. Kikuyu District is a peri-urban area of Nairobi, the capital city of Kenya. The district occupies an area of 236 square kilometers with an approximate population of 265,829 and 77,045 households. It has a high number of smallholder dairy production units prompted by enhanced market for milk owing to the large urban and peri-urban population. The study area was divided into 4 zones, which were designated as North, South, West and East from which the smallholder zero-grazing dairy units were selected and data collected. *Study Design and Selection of the smallholder zero-grazing units*

The study was a cross-sectional in which each selected smallholder zero-grazing dairy unit was visited once and each selected cow within the smallholder zero-grazing unit was examined only once during the period of data collection. A total of 100 smallholder zero-grazing dairy units were selected. For purposes of this study, a smallholder zero-grazing dairy unit was defined as one with a minimum of 2 and a maximum of 10

adult dairy cows. With the help of the local veterinarians and animal health assistants, 25 zero-grazing units were purposively selected from each zone. The purposive selection was due to logistical reasons, which included willingness of the farmers to allow their dairy units to be used for the study and the challenges of getting units that met the study criteria.

Animal Selection: The animals that qualified to be recruited for the study were adult dairy cows that had calved at least once. In the selected smallholder zero-grazing dairy units, all the cows were examined if the total number that met the study criteria were = 3. But if the number that qualified for the study was > 3, then only 3 cows were selected by simple random approach. A total of 161 cows were examined in all the selected smallholder zero-grazing dairy units.

Data Collection on Floor Factors and Slurry Removal: During visiting each of the 100 smallholder zero-grazing dairy units, data on floor factors (type and texture) and management of slurry (frequency of removal and how much covered the floor) were obtained. Data on type and state of the floor as well as the current state of the slurry in each zero-grazing unit were obtained through observation by the investigator. But data on frequency of slurry removal was obtained through questionnaire administered by the investigator. All these data were recorded in the data collection sheets.

Evaluation of Locomotion Scores: Each cow that was selected had its gait assessed by observation as she stood without movement and then as she walked on the walk-alley of the zero-grazing unit. The gait was evaluated using a conventional locomotion scoring system, which is based on evaluation of the back posture as well as limb placement on the ground while the animal is standing without motion and then as the animal walks as described by Sprecher *et al.* [7].

RESULTS

Floor Type: Among the 100 smallholder zero-grazing dairy units evaluated, 92% (92) had concrete floors and 8% (8) had earthen floors. Out of those with concrete floors, 38% (35) had well-finished intact concrete, 57.6% (53) had poorly constructed or worn-out concrete with holes and loose stones and 4.4% (4) had excessively smooth concrete floors. In the zero-grazing units that had earthen floors, six had bare floors and 2 had floors overlaid with

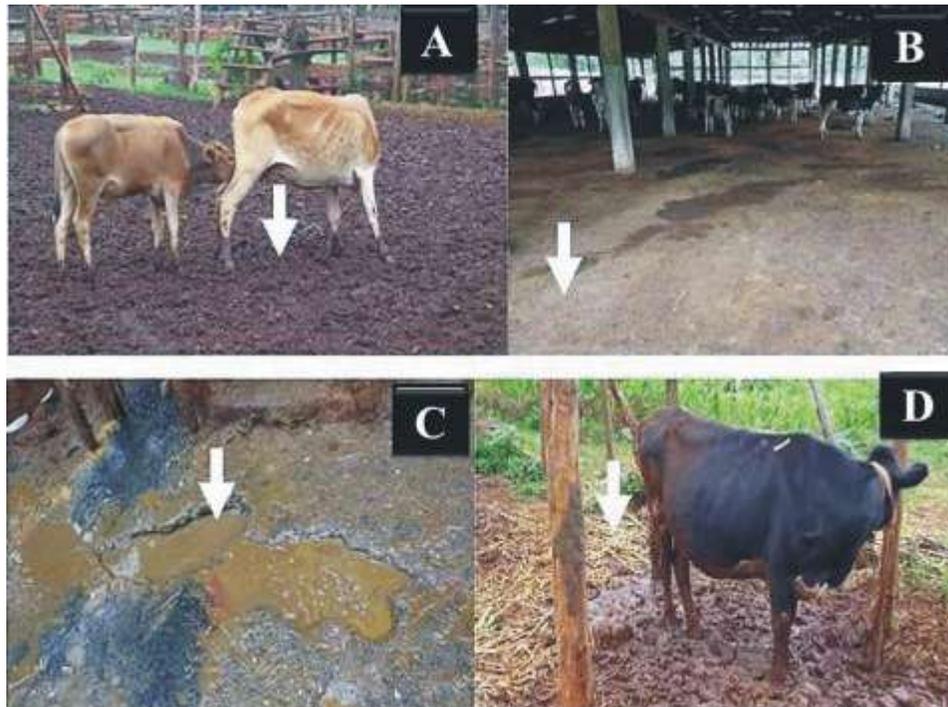


Fig. 1: Different characteristics of floors in the smallholder zero-grazing units. A: earthen floor on an open area (bold arrow), B: clean good quality concrete floor, C: cemented floor with large holes that retain slurry (bold arrow) and predisposes the cows to injuries, D: grass and straw on earthen floor (bold arrow) in an open area where the cow is tied to a pole.

Table 1: Average locomotion scores for the 161 dairy cows examined on the various floor types in the smallholder zero-grazing dairy units in Kikuyu District, Kenya.

Floor Type	Average Locomotion Score
Overly smooth concrete	1.75
Straw/ Grass covered	1.40
Concrete with holes/ Loose stones	1.34
Good concrete	1.32
Earthen	1.17

straw and grass. The various types of floors observed in the study are shown in Figure 1. Animals in zero-grazing units with overly smooth concrete floors recorded highest average locomotion scores while those on earthen floors recorded the lowest average locomotion scores (Table 1).

Management of Slurry: Out of the 100 smallholder zero-grazing dairy units evaluated, the floors of 36% (36) of them were scantily covered with slurry at the time they were observed, 62% (62) were moderately covered with slurry and only 2% (2) were excessively covered with slurry. Slurry was considered to be scanty when it appeared as small patches with parts of the floor devoid of it, Moderate slurry covered most of the floor with only

minimal patches of the floor without it, while excessive slurry covered the floor completely. Removal of slurry from the floor at least once per day was done in 41% (41) of the zero-grazing units, twice per day in 45% (45) of the units, while in 14% (14) of the zero-grazing units, slurry remained on the floor longer than one day without being removed. Average locomotion score was 1.32 for dairy cows kept on floors with scanty slurry, 1.34 for those on floors with moderate slurry and 1.0 for those on floors with excess slurry.

Association Between Farm-level Factors and Locomotion Scores: The farm-level factor that was found to be strongly associated with locomotion scores among those that were evaluated in the smallholder zero-grazing dairy units was the type of floor ($\chi^2 = 40.47, p = 0.0016$). Higher locomotion scores were observed in cows that were in zero-grazing units with excessively smooth floors and generally in those units that had concrete floors, while lower locomotion scores were observed in cows that were in units with earthen floors. Although the level of slurry did not influence locomotion scores, it nevertheless had a significant influence when combined with the floor type.

DISCUSSION

The fact that 92% of the smallholder zero-grazing dairy units had concrete floors despite some of them having floor defects and some being overly-smooth, shows a tendency of adopting cleanable floors for improvement of hygiene in these units. However, ignorance of the effects of the state of floors on dairy cow claw health was manifested by more than 50% of the zero-grazing units having concrete floors that were poorly constructed, worn-out with holes and loose stones.

Although it is easier to maintain hygiene on concrete floors, their abrasiveness to the claws and long hours that cows stand on such hard ground are some of the factors that predispose to claw lesion development [9, 10]. These floor types and associated defects may be some of the factors contributing to high prevalence of claw disorders seen in the cows in the smallholder zero-grazing dairy units as established in the current study. Overly-smooth concrete floors were associated with higher mean locomotion scores most likely due to slipperiness of the floor that results in unstable gait. The slipperiness of over-smooth floors has been reported to result in smaller movement amplitude of cows' proximal joints and reduced walking velocity [11] as well as shorter strides [6]. Conversely, earthen floors were associated with lower locomotion scores possibly due to better ground grip, which improves the gait. The findings also agree with those of previous researchers who found the gait of cattle to be impaired on hard floors, hence affecting the locomotion score [6].

The finding in the current study, of more than three quarters of the smallholder zero-grazing dairy units with scanty or moderate slurry may be attributable to the fact that in 41% and 45% of all the units, slurry was removed once and twice per day, respectively. This may also explain the reason why the amount of slurry, as established in this study, had no influence on locomotion scores. It has previously been found that slurry left to accumulate more than one day without removal from the zero-grazing unit, may predispose the cows to likelihood of developing laminitis, which may eventually influence locomotion score [1,12, 13].

Although slurry in this study did not influence locomotion scores, as stated in previous reports, it causes slipperiness of the floor that affects gait. Subsequently, the cows lack treading confidence, hence affect their natural locomotion behavioral activities [11]. In the current study, the slipperiness was probably minimized by the excessive roughness of worn out concrete floors that existed in more than 50% of these zero-grazing units.

It is concluded that, floor type particularly when combined with slurry accumulation in smallholder zero-grazed dairy units, may influence gait and subsequently the locomotion scores of dairy cows. There is therefore need to train smallholder dairy farmers on the importance of maintaining good claw health through proper housing design with properly finished floors that provide good claw ground-grip without abrasiveness and from which slurry removal is frequent and regular (at least once per day).

Competing Interest: The authors declare that they have no competing interest.

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