Livestock Science 155 (2013) 197–204

Contents lists available at SciVerse ScienceDirect

Livestock Science

journal homepage: www.elsevier.com/locate/livsci

Diet factors and subclinical laminitis score in lactating cows of smallholder dairy farms in Thailand

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ARTICLE INFO

Article history:
Received 18 September 2012
Received in revised form
24 April 2013
Accepted 25 April 2013

Keywords:
Subclinical laminitis
Nutritional risk factor
Dairy cow

ABSTRACT

The objective of this study was to evaluate the importance of dietary crude protein (CP) content, dietary neutral detergent fiber (NDF) content and feeding regime as well as other factors related to management and demographics on the occurrence of (subclinical) laminitis under practical Thai feeding conditions. Hemorrhage of the white line and the sole, sole ulcer and white-line fissure of all four claws of milking cows ($n=119$) on 25 farms (selected based on the occurrence of lameness) were macroscopically assessed to calculate the prevalence of subclinical laminitis (SCL) on each farm. Data were collected on farm characteristics, feed and feeding management, floor type and hoof care. Dry matter intake was assessed on each farm and feed ingredients collected and analyzed for dry matter (DM), CP and NDF. No significant differences were found for farm characteristics such as herd size, number of milking cows, parity and body condition scoring between farms with a low ($<25\%$) or a high prevalence ($>25\%$) of SCL. Percentages of DM and CP content of the rations did not differ, whereas mean NDF content in the ration was significantly higher in the low compared to the high prevalence farms. Multiple regression analysis of the data showed that a ration low in NDF content and/or in combination with the separate feeding of roughage and concentrate was associated with a high SCL prevalence. The results suggest that mixing concentrate with a substantial part of the roughage is an important strategy to prevent SCL in smallholder dairy farms under Thai feeding conditions. In addition, the dietary NDF content but not the dietary CP level is associated with SCL prevalence in dairy cows under Thai feeding conditions.

1. Introduction

Lameness is a major health problem in the dairy industry worldwide (Greenough et al., 2007) including Thailand. An important cause of lameness is subclinical laminitis (SCL), which is characterized by claw lesions such as hemorrhages of the sole and the white line, and sole ulcers (Greenough and Vermunt, 1991). Subclinical laminitis is associated with low milk production, poor health and reduced reproductive performance (Nordlund et al., 2004), which negatively affect the economical return of dairy cows. Many predisposing factors are associated with the occurrence of (subclinical) laminitis in dairy cattle including farm management, housing, genetics, breeding, and nutrition (Ossent and Lischer, 1998; Vermunt and

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http://dx.doi.org/10.1016/j.livsci.2013.04.014

Greenough, 1996). The latter is considered to be an important factor (Nocek, 1997), although the underlying mechanisms by which nutrition contributes to the occurrence of laminitis are not yet fully understood.

Several reports have indicated that ration characteristics and/or feeding management are involved in the etiology of laminitis (Greenough et al., 2007; Nocek, 1997; Vermunt and Greenough, 1994). It has been shown by Weaver (1971) that the feeding of supplemental barley was associated with the occurrence of laminitis. Furthermore, work by Greenough et al. (1990) and Manson and Leaver (1988a) indicates that the dietary roughage to concentrate ratio also contributes to the development of laminitis as well as the intake of large amounts of concentrates; i.e. 11 kg/d (Manson and Leaver, 1988a). These results may be interpreted as effects of the dietary content of neutral detergent fiber (NDF) on the etiology of laminitis (Stone, 2004). Apart from the dietary NDF content, the level of rumen degradable protein also has been reported to be important in the etiology of laminitis (Manson and Leaver, 1988b). Dairy production in Thailand is characterized by small-scale operations managing 20–50 dairy cows (Aiumlamai, 2009; Koonawootrittriron et al., 2009) and common Thai feeding practices of dairy cows are not extensively documented. Generally, cows are fed poor quality forages particularly rice straw, supplemented with non-pelleted concentrates. Cassava chips are widely available in Thailand and may be incorporated up to 70% in dairy rations (Aiumlamai, 2009; Wanapat, 2003) resulting in low dietary NDF contents. However, it is unknown whether the typical Thai feeding conditions predispose cows to laminitis. The aim of the present study was to evaluate the importance of dietary CP content, dietary NDF content and feeding regime as well as other factors related to management and demographics on the occurrence of (subclinical) laminitis under practical Thai feeding conditions

2. Materials and methods

2.1. Farm selection

This study was conducted on farms located in the Saraburi and Khon Kaen provinces of Thailand, two of the top ten dairy farming areas in Thailand. The use of farms from two different provinces increased the variation in feeding management because mixed feeding of roughage and concentrate is more common in the Khon Kaen province, while farmers in Saraburi province traditionally feed concentrate and roughage separately. From each province a list of all farms under veterinary control, was provided by local veterinarians. Then, the farms on this list were divided into two groups; i.e. farms without and with reported incidences of lameness during the last six months preceding the current study. From each group of farms, individual farms were randomly selected as described by Thrusfield (1997). It was anticipated that the selection of farms with and without previous reports on lameness would increase the variation in the prevalence of SCL so as to enhance the interpretation of the data. All cows that participated in the study were a cross of Holstein–Friesian (HF) × Brahman (86.4% HF). At all farms, cows were housed in a loose-housing system as typical in these provinces and none of the farms used formaldehyde and/or copper sulfate as a prophylactic agent for hoof problems.

2.2. Cow selection

Subclinical laminitis was assessed by investigation of claw lesions in dairy cattle in the selected farms. On each farm, the sample size to detect SCL was calculated by assuming a power of 80% and SCL prevalence of 50% (Thapsitsarinya, 2007), with a confidence interval of 95%. Therefore, approximately 20% of the lactating cows on each farm were randomly selected to estimate SCL prevalence. Cows in milk on farms were randomly selected from a list containing cow numbers, which was the sole selection criterion. In total, 119 lactating cows were evaluated originating from 12 smallholder dairy farms in Saraburi and 13 in the Khon Kaen province, representing 21.1% of all lactating cows on the selected farms. Toes length of all four limbs in each of the selected cows was measured along the dorsal border using a Vernier caliper. Claw lesions were assessed by trimming the hooves using a hoof-trimming machine (Robert Bosch GmbH, Bosch®, Stuttgart, Germany). The same person throughout the study then evaluated claw lesions of all four limbs on the basis of macroscopic examination. Hemorrhage of the white line and the sole, sole ulcer and white-line fissure were scored using the 4-point scoring as 0=not present, 1=mild, 2=moderate or 3=severe according to the method described by Sogstad et al. (2005). By definition, any appearance of the white line hemorrhage, sole hemorrhage or white line fissure on one of the claws was considered as a clinical case of SCL with a score ≥2. Prevalence of SCL was calculated as a proportion of the affected cows relative to the number of selected cows on each farm. The data were categorized using medians and standard deviation.

2.3. Data collection

Each farm was visited once (May 2008–Feb 2009) during which time, cows were scored and farm owners/managers were interviewed using a standardized questionnaire. Questions related to the history of the farm and incidences of SCL were confined to a period of the previous 6 months prior to the farm visit. The questionnaire was divided into four sections, including general information concerning farm management and location, feed and feeding management, floor type and hoof care. The characteristics of housing factors and feeding management were classified into two categories as yes (1) or no (0). The categories for floor type were a solid concrete floor with a partial soil or muddy area (1) and a sand or muddy floor only (0). Feeding practice was categorized as separate (SFRC, 1) or combined (CFRC, 0) feeding of roughage and concentrate. Feeding frequency was divided in two times per day (1) and over two times per day (0). The categories for supplementation of vitamins and minerals were divided as farms with (1) and without supplementation of minerals and vitamins (0). Data related to herd size,