

## EFFECT OF SPECIES AND SEASON ON LAMINITIS PREVALENCE IN SEMEN-DONOR BULLS

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### ABSTRACT

The objective of this study is to determine the effect of species, season, and their interaction on laminitis prevalence in three semen-donor bull species in the Artificial Insemination Centre under tropical conditions. The average prevalence in each species (*Bos taurus*, *Bos indicus*, and *Bos sondaicus*) was calculated based on the number of monthly incidents compared to the current population during 2020, while the two-way ANOVA was used to determine the effect of species, seasons (wet and dry season) and species-season interactions to the prevalence of laminitis. The average prevalence in *Bos taurus*, *indicus*, and *sondaicus* during dry season was 7.582±1.841%, 1.190±1.844%, 0.451±1.103%, and during wet season was 8.521±4.808%, 1.262±1.960%, 0.451±1.103% respectively. This study revealed that *Bos taurus* bull species more susceptible to laminitis compared to *Bos indicus* and *Bos sondaicus*. However, there is no influence of seasons and interactions between seasons and species on laminitis prevalence. In conclusion, this study has proven that laminitis can occur in all semen-donor bull species despite differences in susceptibility, species, or season.

Key words: lameness, laminitis, bulls

### ABSTRAK

Kajian ini dilakukan untuk mengetahui pengaruh spesies dan musim, serta interaksi spesies-musim terhadap prevalensi kejadian laminitis pada spesies sapi-sapi jantan penghasil semen beku di balai inseminasi buatan. Rerata nilai prevalensi laminitis pada masing masing spesies (*Bos taurus*, *Bos indicus*, dan *Bos sondaicus*) dihitung berdasarkan jumlah kejadian setiap bulan selama tahun 2020 dibandingkan dengan jumlah populasi saat itu dan analisis sidik ragam dua arah digunakan untuk mengetahui pengaruh spesies, musim (hujan dan kemarau) serta interaksinya terhadap prevalensi laminitis pada masing masing spesies. Rerata prevalensi laminitis pada *Bos taurus*, *indicus* dan *sondaicus* pada musim kemarau tahun 2020 berturut turut sebesar 7,582±1,841%, 1,190±1,844%, 0,451±1,103%, sedangkan pada musim hujan sebesar 8,521±4,808%, 1,262±1,960%, 0,451±1,103%. Hasil analisis menunjukkan terdapat perbedaan prevalensi laminitis antar spesies *Bos taurus* terhadap *Bos indicus* dan *Bos sondaicus* namun tidak terdapat pengaruh musim dan interaksi antar spesies-musim terhadap prevalensi laminitis. Dapat disimpulkan jika semua spesies sapi pejantan dapat terkena laminitis meskipun terdapat kerentanan yang berbeda antar spesies di semua musim.

Kata kunci: lameness, laminitis, pejantan

### INTRODUCTION

Laminitis is a non-infectious lesion on bovine hooves that are often caused by environmental factors and metabolic disorders (Nordlund *et al.* 2004). The incidence in cattle has been reported to be high and has a reported prevalence rate varying in the range of 14% - 48.2% (Bicalho *et al.* 2009; Barker *et al.* 2010; Foditsch *et al.* 2016). Laminitis is one of the main diseases that causes significant economic losses due to decreased productivity, reproducibility, and high rates of culling (Kossaibati and Esslemont 1997).

Studies on laminitis-related lameness are widely reported in the dairy industry and feedlot cattle (Davis-Unger *et al.* 2019; Dolecheck and Bewley 2018). Moreover, lameness cases including laminitis in breeding bulls has also been reviewed by Wolfe (2018). Laminitis has a significant impact on bull fertility. The pain caused by laminitis results in reduced copulation ability due to lameness which results in decreased reproductive ability of a bull (Borrero and Córdoba 2017).

According to Vermunt and Greenough (1994), the predisposing factors for laminitis are dietary factors, systemic disease, genetics, housing type, and barn floor material. Furthermore, the effect of breed and season has also been reported. The incidence of laminitis was reported to be different in several cattle breeds (Baird

*et al.* 2009; Madadzadeh *et al.* 2013) and previous studies have also reported that the peak incidence of laminitis will occur during certain seasons (Williams *et al.* 1986; Laven and Lawrence 2006).

BBIB Singosari is a frozen livestock semen producer in Indonesia that produces frozen semen of various cattle breed originating from subtropical and tropical areas. The various breeds of bulls belong to three species, including *Bos taurus*, *indicus*, and *sondaicus* which have different adaptability to tropical climate conditions. Therefore, the objectives of this study are to determine the relationship between different bull species and the effect of the seasons in tropical regions on the prevalence of laminitis.

### MATERIAL AND METHODS

#### Data Collection

The data of this study was obtained from the treatment records of laminitis cases in National Artificial Insemination Centre-Singosari (NAIC-S) located in Malang, East Java (7° 50'14.6 "S 112° 38'43.7 "E). The location of the AI Centre is in the southern hemisphere of the equator which has 2 tropical seasons which are influenced by the direction of the Asian and Australian monsoons described in Amalo *et al.* (2018). Generally, the wet season occurs

during October-March and the dry season occurs during April-September (Rahayu *et al.* 2018).

The bulls in this study are active semen-donor bulls that can be grouped into *Bos taurus* species (Limousin, Simmental, Friesian Holstein, Angus), *Bos indicus* (Brahman, Ongole), and *Bos sondaicus* (Bali cattle). All bulls are kept under the same environmental management and feed ration. Laminitis lesions in bulls were identified during hoof trimming treatment by veterinarians who referred to ICAR Claw Health Atlas (Egger-Danner *et al.* 2020).

### Data Analysis

The monthly prevalence of laminitis is defined as the total number of bulls with laminitis lesions detected during hoof trimming compared to the total number of each species observed each month during 2020 (Thrushfield 2005).

A two-way ANOVA was performed with species (*Bos taurus*, *Bos indicus*, and *Bos sondaicus*) and seasons (Rain season: October-March; Dry season: April-September) as a factor with the monthly prevalence of laminitis as replication to determine the effect of species and seasons and their interactions on the prevalence of laminitis. The post hoc Tukey test was used to determine the difference between the observed factors, if there was a significant difference between the means. Statistical analysis in this study was carried out with open source JASP software (Love *et al.* 2019).

## RESULTS AND DISCUSSION

### Laminitis Lesion and Prevalence

Laminitis is the term used to describe a non-infectious foot lesion which is often caused by environmental factors and metabolic disorders in the major form of sole ulcer, sole hemorrhage and white line diseases (Griffiths *et al.* 2020). Based on the observations that have been made during this study, the form of lesions found in semen-donor bulls at BBIB Singosari were not far different from those previously reported (Figure 1).

The prevalence of lameness due to laminitis ranges from 1.10% to 54.80% in general (Newcomer and Chamorro 2016). Despite more cases of laminitis

having been reported in dairy cows, several cases of laminitis in breeding bulls have also been reported. Of the several cases of laminitis in breeding bulls, the reported prevalence was 12.69-23.94% in South Asia breeding bulls (Sultana *et al.* 2017; Sontakke *et al.* 2019), 16.30-74.70% in Danish bulls (Thomsen *et al.* 2017) and 73.68% in Jersey bulls (Buckle 2017).

The mean of laminitis prevalence in each species of the *Bos taurus*, *indicus*, and *sondaicus* in our study during the 2020 dry season was  $7.582 \pm 1.841\%$ ,  $1.190 \pm 1.844\%$ ,  $0.451 \pm 1.103\%$  and during the 2020 wet season was  $8.521 \pm 4.808$ ,  $1.262 \pm 1.960$ ,  $0.451 \pm 1.103$  respectively (Table 2). Therefore, the prevalence of laminitis in semen-donor bulls in our study is not too different from previously reported.

### Effect of Species on Laminitis Prevalence

The result of our study showed that there were significant differences between species with regards to the incidence of laminitis ( $P < 0.01$ ). Meanwhile, seasonal effect ( $P = 0.683$ ) and the interactions between species and seasons ( $P = 0.873$ ) were not significantly different (Table 1). Our study also showed that in addition to *Bos taurus* and *Bos indicus*, laminitis can also occur in the indigenous *Bos sondaicus*.

The variation of the laminitis incidence between different bull breeds has been reported previously by Townsend *et al.* (1989). Moreover, the laminitis incidence has also been reported to have a tendency to be higher in the *Bos taurus* bull and its crossbreed, compared to *Bos indicus* bull (Sontakke *et al.* 2019). Based on the results of our study, *Bos sondaicus* and *Bos indicus* were more resistant to laminitis than *Bos taurus* in the tropical environment of East Java (Table 2).

The morphological difference between *Bos taurus* to *Bos indicus* and *Bos sondaicus* hooves comes from hoof pigmentation. Phenotypically, the hoof color of *Bos sondaicus* and *indicus* is darker than that of *Bos taurus*. Previous study has indicated the influence of the hoof pigmentation to laminitis susceptibility on various bovine breeds (Sogstad *et al.* 2011; Kumar *et al.* 2019). According to Rabelo *et al.* (2015), pigmented nails have a higher capacity to synthesize keratin and other structural elements to form more sulfate bonds and present a higher number of horn tubules per area



**Figure 1.** Laminitis lesion found during 2020, 1= Sole hemorrhage, 2= Sole ulcer, 3= White line ulcer, 4= White line fissure

**Table 1.** Two-way ANOVA to determine the effect of species, seasons, and their interactions on the prevalence of laminitis in semen-donor bulls

Parameter	Sum of squares	df	Mean square	F	p
Species	419.871	2	209.936	34.812	< .001
Season	1.022	1	1.022	0.170	0.683
Species x season	1.642	2	0.821	0.136	0.873
Residuals	180.918	30	6.031		

**Table 2.** Variation of laminitis prevalence between semen-donor bull's species and season

Species	N	Season	
		Dry	Wet
<i>Bos indicus</i>	12	1.190±1.844 <sup>a</sup>	1.262±1.960 <sup>a</sup>
<i>Bos sondaicus</i>	12	0.451±1.103 <sup>a</sup>	0.451±1.103 <sup>a</sup>
<i>Bos taurus</i>	12	7.582±1.841 <sup>b</sup>	8.521±4.808 <sup>b</sup>

<sup>a, b</sup>Different superscripts within the same column indicate significant differences (P<0.05)

which means a more disease-resistant hoof than dyspigmented hooves.

Besides the morphological hoof differences between species, there is a trend that the cattle with higher body weights have an increased incidence of laminitis (Pérez-Cabal and Charfeddine 2016). Heavier cattle would experience more compressive stress on the hoof, resulting in the collagen fibers of the suspensory apparatus to be stretched (Schöpke *et al.* 2013). *Bos taurus* bulls have a heavier body weight compared to *Bos sondaicus*, but almost the same body weight as *Bos indicus*. Our assumption based on this study is that the predisposition to higher laminitis prevalence in *Bos taurus* is caused by stress on the hoof lamina tissue due to weight stress and the morphological differences of the hoof between species.

### Effect of Season to Laminitis Prevalence

Several previous reports have shown the effect of season on the incidence of laminitis. According to Ranjbar *et al.* (2016), the chance of lameness in Australian pasture-based system increases with increasing average daily rainfall. These findings are consistent with Ramos and Freire (2006), who reported the peak incidence of laminitis in grazing herds during the rainy season. A similar condition was also previously reported by Tranter *et al.* (1991) where the peak incidence of laminitis occurred during winter and wet weather conditions in New Zealand late spring. Meanwhile, the peak incidence of laminitis in United States intensive dairy operations is reported to always occur during the summer as a result of the combination of humidity with the use of a water as a cooling system to reduce heat stress (Sanders *et al.* 2009).

In contrast to previously reported statistics, the results of this study did not show differences in the incidence of laminitis between seasons. However, the results of previous studies indicate that the incidence of laminitis can increase in wet and humid environmental conditions. During the prolonged water contact from the environment, the moisture content of the claw horn was increased and may have caused the horn to be softer and more prone to laminitis (Van Amstel *et al.* 2004; Pritchard and King 2015). Based on the description above, it is most likely that the incidence of laminitis that occurs throughout the year at BBIB Singosari tends to be caused by decreased hoof quality

due to a combination of a humid environment and the use of water to bathe bulls every day before the semen collection process.

### CONCLUSION

The results of this study provide sufficient information that laminitis, especially in semen-donor bulls, can occur in all species. Although the prevalence of laminitis is significantly different in *Bos taurus* compared to *Bos indicus* and *Bos sondaicus*, the improvement of the bulls handling environment should be prioritized to reduce the incidence and impact of laminitis in all bulls which occurs in all seasons.

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