

Original Research Article

Determinants of Study on Equine foot dFoot Diseases in Assam- A North-eastern state of India

Formatted: Centered

ABSTRACT

Aim: To study the prevalence of various foot disorders in riding horses and their association with correlation to immediate environmental conditions, particularly equine housing patterns, as well as to establish correlations between the prevalence of diverse foot ailments and the temporal variations specific to the region.

Study design: The present study is a cross-sectional observational work designed to collect data regarding various foot affections prevalent in the equine population of selected locations of Assam, India.

Place of Study: 4th Assam Police Battalion, Kahilipara, North-East Police Academy, Barapani, 47 Assam NCC Squadron, Khanapara and SSB horse unit, Debendra Nagar, Tezpur.

Methodology: Surveys were conducted to assess the prevalence of hoof-related conditions in horses through interviews, physical examinations, and radiographic examinations. Etiological factors were investigated by recording the history of affected animals, including concentrate ration type, quantity, foot care practices, and hoof trimming routines.

Results: Thirty-Five (35) out of 49 stabled horses (71.42%) exhibited various foot lesions while the remaining 14 horses were detected with minor cuts/abrasions. The prevalence of foot afflictions was found to be higher during the summer season (42.86%) in comparison to the winter season (28.57%). The spectrum of foot ailments documented in this study includes hoof overgrowth (57.14%), hoof cracks (20%), thrush (8.57%), suppurative sole conditions (5.71%), quittor (2.86%), laminitis (2.86%) and bulb fibromas (2.86%). Interestingly, the occurrences of various types of foot afflictions were notably elevated in equine enclosures with concrete flooring (94.29%), as opposed to sand flooring (5.71%). Hematological analyses indicated significant ($P < 0.05$) alterations in various blood parameters during both summer and winter for both healthy and affected equines in Hb and mean values of RBC and WBC with the exception of neutrophil counts. Biochemical assessments revealed an noteworthy increase in mean values of serum creatinine, creatinine kinase (CK), and alkaline phosphatase (ALP) in affected horses, though AST levels remained unaffected.

Conclusion: This comprehensive investigation highlights the multifaceted interplay between equine health, housing conditions, dietary patterns, and seasonal factors in the prevalence of foot disorders in stabled horses.

Keywords: Assam, equine, foot affections, quittor, thrush, Assam

1. INTRODUCTION

Horses have been an important part of human culture since time immemorial. According to Hindu mythology, the horse is related to Lord Hayagriva- the God of 'knowledge' and 'wisdom', who had the body of a human and the head of a horse. Horses have been an integral part of warfare since ancient times. The first archaeological evidence of horses being used in warfare dates between 4000 and 3000 BC and the use of horses in warfare were widespread by the end of the Bronze Age. In

early ages, horses were also used in ~~ploughing-plowing~~ the paddy fields in some parts ~~round-of~~ the globe.

In ~~the present-present~~-day scenario, horses are used as sporting animals in various equestrian events throughout the globe. Many sports, such as dressage and show jumping are being played. However, with the increase of ~~the~~ equine population as a utility animal in various fields, the challenges of diseases are also increasing. Any sort of diseases or discomfort to these sensitive animals may lead to ~~a~~ decrease in their work utility and economic losses to the owner. Traumatic injury during work and prolonged standing on the hard concrete floor may lead to various types of foot affections which results in lameness. During ~~the~~ summer season, the wet condition of the foot due to soiling with dung and urine leads to ~~the~~ growth of numerous microorganisms.

Organisms with the morphology of *Fusobacterium necrophorum* were reported to cause foot affections resulting in lameness in equine (Petrov, 2013). There are ~~a number of some~~ serious sequelae of chronic *Fusobacterium necrophorum* in the frog of the horny hoof resulting in offensive blackish discharge from the sulci of the frog commonly called ~~as~~ thrush. Apart from thrush, canker or pododermatitis is another cause of equine lameness which results in keratolysis of the hoof. Chronic manifestation of ~~a~~ hoof infected with canker leads to verrucose proliferation (non-neoplastic) of the hoof. The present study ~~delves into various foot ailments affecting horses~~ investigates the prevalence of various foot disorders in riding horses and their correlation to immediate environmental conditions, particularly equine housing patterns, as well as to establish correlations between the prevalence of diverse foot ailments and the temporal variations specific to the region.

2. MATERIALS AND METHOD

2.1 Study Design

~~In the present study, We investigated an investigation~~ of ~~8-eight~~ months was conducted on horses from various military and paramilitary equine establishments, including the 4th Assam Police Battalion, Kahilipara (26.145911, 91.755089), North-East Police Academy, Barapani (25.679846, 91.895100), 47 Assam NCC Squadron, Khanapara (26.118861, 91.816576), and the SSB horse unit in Debendra Nagar, Tezpur (26.735574, 92.824117). The study encompassed horses of diverse cross-breeds, rendering breed-specific categorization unnecessary. Extensive surveys were conducted in these regions to assess the prevalence of hoof-related conditions, with a particular focus on their correlation with seasonal variations, flooring patterns, functional roles, dietary habits, and hemato-biochemical parameters.

Data were gathered through interviews with horse handlers and meticulous physical examinations, including visual assessments for external defects and soundness, as well as a comprehensive locomotor ~~system~~ examination, including gait analysis and hoof assessment through a hoof tester (Fig 1-4).

Radiographic examinations were carried out for cases that did not reveal any anomalies through initial assessments (Fig 11). The annual cycle was divided into winter and summer seasons to analyze the seasonal impact on foot conditions, while the type of stable flooring (Fig 13 & 14) and hygiene status

were documented to explore their role in developing hoof ailments. Etiological factors were investigated by recording the history of affected animals, including concentrate ration type, quantity, foot care practices, and hoof trimming routines.

2.2 Estimation of haemato-biochemical parameters

Blood was collected ~~aseptically~~ from ~~the~~ jugular vein of apparently healthy and affected animals for haemato-biochemical studies. Four (4) ml of whole blood was collected ~~by putting~~ two (2) ml in ~~an~~ EDTA vial) and rest two (2) ml in a clot activator vial undisturbed for collection of serum.

2.3 Statistical analysis

The quantitative estimates were analyzed as per the method described by Snedecor and Cochran (2004) and SPSS 16.0 for Windows.

3. RESULTS AND DISCUSSION

3.1 Prevalence

A total of 49 (~~forty-four~~ nine) horses were surveyed in both summer and winter, out of which 35 (71.42%) horses were found to be affected with different foot affections (Table 1a). The study ~~has~~ revealed that the prevalence of foot affections in this managerial condition was much higher compared to the observations of Talukdar (2005) who studied 142 animals and found ~~27 (19.01%) of them to be~~ affected with various claw lesions. Among the different foot affections, hoof overgrowth was the most predominant hoof lesion (57.14%) as depicted in Table 2 and Fig ~~1e-15-12~~. Nelson and Cattell (2001) also observed that laminitis was found to be highest among other foot affections with ~~a~~ prevalence rate ~~of~~ 9.8% in the culling horses and 43.5% in the culling cows (Fig ~~401j~~). However, Talukdar (2005) recorded an overall prevalence rate of 22.22% in equine farms. This discrepancy in prevalence rate may be attributed to several factors, such as variations in specific conditions or environments under which the animals in the two studies were managed. It could also be influenced by differences in the methodology employed, the selection criteria for the animals, sample size, or the time frame in which the studies were conducted.

The ~~present~~ study revealed that the prevalence of foot affections ~~were~~ was highest during the summer season i.e., 42.86% while in winter it ~~were~~ decreased to 28.57% (Table 31c). This might be due to the wet condition due to the high humidity of the north-eastern region of India during ~~the summer season that which~~ favours the multiplication and proliferation of numerous microorganisms. In support of that, French *et al.* (2013) reported that wet weather also reduces hygiene and dryness of ~~the~~ hoof.

Out of the two different types of floor patterns observed ~~under-in~~ the present study, ~~a~~ higher prevalence was found in horses housed on concrete floors i.e., 94.29%, on the contrary, the foot affections in horses housed ~~in-on~~ sand floors was much lower i.e., 5.71 % (Table 41d) & (Fig. ~~43 & 41m and n~~). Floors made up of concrete were generally not properly laid with cement or the stables considered under this study were very old and due to ~~which-this~~ the surface concrete was eroded resulting in exposure of small gravels of the floor and causing damage to the solar surface. Moreover,

due to breakage in the floor, the dung and urine get lodged in it and bacterial multiplication takes place. Bergsten (2010) also opined a similar statement ~~in regards to regarding the~~ effect of flooring on claw health and lameness. However, Gooch (2013) in his investigation concluded that the concrete was the material of choice for flooring ~~of~~ animals for minimal foot and leg problems. On the contrary, Blowey (2005) reported that higher quality horns are produced by animals that walk on rubber floors s than on concrete.

~~Highest~~ The highest prevalence of foot affections in the present study was found in animals that were ~~on~~ raised on a high concentrate ration (77.14%) compared ~~to the~~ a low concentrate ration (22.86%) as depicted in Table 5. ~~Higher~~ A higher quantity of concentrates was given to animals to support their capability to work and also to compensate for the scarcity of roughages leading to a tilt in the ratio of concentrate to roughages which might be one of the possible causes of inciting ~~feet-foot~~ related problems. In support ~~to of~~ this, Livesey and Fleming (1984) reported that 64% of cows on a high concentrate but low fiber diet developed sole ulcers leading to lameness compared with only 8% of animals receiving a high fiber ration with low concentrate. Pollitt (2004) also reported that a ~~carbohydrate-carbohydrate~~ rich diet can also induce laminitis leading to separation of the sensitive laminae.

~~Highest~~ The highest prevalence of foot diseases in the present investigation was found in animals that were engaged ~~on in~~ various sports events (88.57%) compared to the other two categories of work ~~that~~ involved either routine work (2.86%) or kept for miscellaneous purposes (6.12%) as depicted in Table 6. The reason behind the highest prevalence of foot affection under the sports category may be because of various activities like ~~long-long~~ distance walking/running on hard surfaces. Such activities often subject the animal to mechanical injuries leading to diseases like laminitis (Adams, 1966).

In the present study, forefoot affection (60.00%) in horses ~~were was~~ more common than in hind foot (25.71%) (Table 7.1g); this might be ~~due to the fact that because~~ the horses whenever takes a jump, ~~it~~ always lands on the forefeet first, so there is every possibility of injury to forelimb (Adams, 1966). Another most important thing may be the reason that the horses use their limbs in getting up and lying down which may predispose them to various foot affections. Also, the hygienic status of the stables was another reason for this as less exposure time of the hind limbs to dung and urine as a result of good hygienic practices may minimize the affections ~~in on~~ the hind limbs. This investigation was contrary ~~with to~~ the reports of Talukdare *et al.* (2005) and Konware *et al.* (2015) as they opined that foot affections were less significant in the forelimbs compared to the hind limbs.

3.2 Haematology

The present study revealed haemoglobin, Packed cell volume (PCV), and mean of red cell count and white blood cell levels of the affected animals were significantly ($P < 0.05$) higher in comparison to the normal animals during summer, while showing an insignificant decrease during the winter ~~season~~ (Tables 8.2 and 9.3). Nilsson (1963) also recorded an increase in the mean Hb values &

mean RBC count in animals with laminitis that of normal animals. This transient rise in Hb & RBC values was apparently due to the acute inflammatory state of the laminae as mentioned by Sastry (2004). On contrary to that, Khalafizadeh *et al.* (2006) recorded a significant decrease in the mean Hb and RBC values in affected animals than ~~to~~ normal animals. ~~Significant~~ A significant ($P < 0.05$) rise in WBC level was observed in the case of animals suffering from bulb fibroma during summer as compared to the other diseases while in the case of hoof wall crack, during summer and hoof overgrowth during winter it decreased insignificantly (Tables ~~82~~ and ~~93~~). Similar reports were also published by Khalafizadeh *et al.* (2006). The significant rise in WBC values might be attributed to the body's immune response against ongoing infection or inflammation within the hoof tissues. The body's immune system responds to these changes by recruiting white blood cells to the site of infection, leading to an increase in WBC count (Dabareiner *et al.*, 2001). However, Hussain and his associates (2004) failed to record any significant difference in the values of WBC count between the normal and mules affected with foot infection. ~~Findings~~ The findings of PCV values in our study are in line with Rezazadeh *et al.* (2017) who conducted a study on Arab mules. ~~Maximum~~ A maximum significant ($P < 0.05$) rise in PCV value was observed in the case of animals suffering from quittor during summer followed by hoof overgrowth and hoof wall crack. Fluctuations in PCV values ~~is~~ are non-specific and can be indirectly related ~~with~~ to various ongoing physiological and pathological reasons like oxidative stress, and inflammatory responses occurring inside the hoof microenvironment (Patterson-Kane *et al.*, 2018). ~~Non-Non~~ Non-significant differences were found in the case of neutrophil, eosinophil, and basophil both in summer and winter, however highly significant increase was found between the mean values of lymphocyte and monocyte both in summer and winter seasons. Whereas, when observed individually ~~statistically~~ significant ($P < 0.05$) rises were recorded in DLC values in suffering from quittor, laminitis, and thrush during summer whereas during winter, an insignificant decrease in neutrophil only was recorded. (Tables ~~8~~ and ~~9~~). Khalafizadeh *et al.* (2006) recorded a significant ($P < 0.05$) difference between the mean values of ~~Neutrophil~~ neutrophils and ~~Monocyte~~ monocytes, while a non-significant difference between the mean values of Lymphocyte and Eosinophil between control and affected groups. Pouyade and Serteyn (2011) reported ~~in their study that there was a~~ significant ($P < 0.05$) increase in neutrophil values in laminitis due to the release of pro-inflammatory cytokines.

3.3 Serum biochemistry

Serum enzyme values recorded a highly significant ($P < 0.05$) rise in the mean values of the Creatinine, ~~Creatine Kinase~~ CK, and ~~Alkaline Phosphatase~~ (ALP) in affected animals compared to the normal animals during summer, while it was observed that slight and significant ($P < 0.05$) increase in ~~the mean~~ Creatinine values were obtained from affected animals ~~when compared to the normal animals~~ during winter but values of ~~Creatine Kinase~~ CK and ~~Alkaline Phosphatase~~ (ALP) were decreased insignificantly (Tables ~~82~~ and ~~104~~). Similar observations were reported by O'Driscoll *et al.* (2015), Mohebbi *et al.* (2016), and Hussain *et al.* (2004). They also reported that the ~~said~~ values of diseased mules with acute laminitis and lameness due to sole ulcer were significantly ($P < 0.05$) higher when compared with those of healthy mules. The values for Aspartate aminotransferase (AST) in our study showed insignificant differences s between the normal values of the affected animals compared

to the normal animals both in summer and winter. ~~Significant~~ A significant ($P < 0.05$) increase in AST value was observed in animals with hoof wall cracks and in thrush in summer. Yaylak *et al.* (2009) in their study had also recorded an insignificant decrease in the mean AST values in affected animals compared to the normal animals. Elevated levels of Creatinine, CK, and ALP in our study horses with foot disease suggest potential muscle damage, compromised renal function, and increased bone turnover, respectively, reflecting the systemic impact of hoof pathology on various physiological processes and could be suggestive of potential biomarkers when study hoof pathology in equines (Patterson-Kane *et al.*, 2018). Also, decreased AST values can be due to reduced muscular damage due to reduced mobility of the horse due to pain and also due to medication against pain management that indirectly lowers AST values in the blood.

Table 1.

A. Overall prevalence

Animals surveyed	Number of animals affected	Overall prevalence (%)
49	35	71.42

B. Table 2 Prevalence (%) of various foot affections (n=35)

Sl. no.	Type of affections observed	Number of Animals affected	Positive prevalence (%)
1	Hoof overgrowth	20	57.14
2	Hoof wall crack	7	20.00
3	Thrush	3	8.57
4	Suppurative sole	2	5.71
5	Quittor	1	2.86
6	Laminitis	1	2.86
7	Bulb fibroma	1	2.86

Table 3C. Season

Sl. no.	Season	No. of animals affected	Prevalence (%)
1.	Winter (Nov-Dec-Jan-Feb)	14	28.57
2.	Summer (Feb-March-April-May)	21	42.86

Table 4.D. Floor pattern

Sl. No.	Floor pattern	No. of animals affected	Prevalence (%)
1.	Concrete	33	94.29
2.	Sand	2	5.71

Table 5.E. Feeding practice

Sl. No.	Type of feed	No. of animals affected	Prevalence (%)
1.	High concentrate (low fibrefiber)	27	77.14
2.	Low concentrate (high fibrefiber)	8	22.86

Table 6.F. Utility/work (n=35)			
Sl. No	Types of work	No. of animals affected	Prevalence (%)
1	Sports	31	88.57
2	Working	1	2.86
3	Miscellaneous	3	8.57

Table 7.G. Appendages (n=35)			
Sl. No.	Foot/appendage	No. of animals affected	Prevalence (%)
1.	Fore	21	60.00
2.	Hind	9	25.71
3.	Both	5	14.29

UNDER PEER REVIEW

Table 82. Blood profile of apparently healthy and affected animals

Parameters	Apparently hHealthy				Affected			
	Summer		Winter		Summer		Winter	
	Mean	+SE	Mean	+SE	Mean	+SE	Mean	+SE
Hb (g/dl)	10.48	0.04 ^B	10.08	0.02 ^B	13.79	0.70 ^A	8.33	0.14 ^C
RBC(106/cu mm)	7.17	0.05 ^B	7.12	0.03 ^B	9.04	0.37 ^A	5.80	0.22 ^C
WBC(103/cu mm)	7.18	0.13 ^B	7.75	0.13 ^B	8.72	0.48 ^C	7.47	0.60 ^B
PCV %	31.90	0.42 ^C	38.54	1.10 ^B	44.08	1.12 ^A	23.63	0.77 ^D
Neutrophil (%)	60.38	0.94 ^A	58.78	0.84 ^A	53.10	3.66 ^A	52.16	5.37 ^A
Lymphocyte (%)	25.13	0.71 ^B	28.24	0.78 ^B	44.59	3.02 ^A	28.21	3.89 ^B
Monocyte (%)	2.88	0.13 ^B	3.81	0.23 ^B	10.53	1.24 ^A	6.92	1.30 ^A
Eosinophil (%)	2.20	0.21 ^B	1.50	0.13 ^B	3.88	0.15 ^A	2.64	0.21 ^A
Basophil (%)	0.46	0.06 ^B	0.83	0.08 ^A	0.88	0.11 ^A	0.88	0.12 ^A
Creatinine (mg/dl)	1.12	0.03 ^B	1.31	0.07 ^B	2.91	0.14 ^A	1.40	0.12 ^B
Creatine Kinase (U/L)	50.93	1.23 ^D	122.65	3.46 ^C	243.34	22.06 ^A	185.52	9.90 ^B
AST(U/L)	206.19	7.56 ^A	212.65	8.46 ^A	156.74	13.48 ^B	146.83	13.14 ^B
ALP(U/L)	90.48	2.87 ^C	140.32	5.74 ^C	492.92	54.55 ^A	318.96	16.01 ^B

Script after the figure is the result of Turkey's post hoc HSD test presented row-wise ($\alpha=0.05$; $Q=2.64252$). Letters s not similar are significantly different.

Table 93. Analysis of variance of Hb ,RBC ,WBC ,PCV and DLCHematological parameters in correlation to the various studied determinants

Source	df	Mean Square
--------	----	-------------

		Hb (g/dl)	RBC(106/c umm)	WBC(103/ cumm)	PCV (%)	Neutrophil (%)	Lymphocyte (%)	Monocyte (%)	Eosinophil (%)	Basophil (%)
Animal	34	1.74	0.45	1.4	30.67	129.45	65.53	9.33	0.79	0.14
		(.89 ^{NS})	(.981 ^{NS})	(.963 ^{NS})	(.062 ^{NS})	(.526 ^{NS})	(.848 ^{NS})	(.780 ^{NS})	(.406 ^{NS})	(.923 ^{NS})
Season	1	184.11	59.27	1.88	1049.94	91.09	716.76	19.05	23.18	0.98
		(<.001 ^{**})	(<.001 ^{**})	(.387 ^{NS})	(<.001 ^{**})	(.412 ^{NS})	(.007 ^{**})	(.212 ^{NS})	(<.001 ^{**})	(.036 [*])
Affected	1	9.12	0.96	8.72	13.74	1126.09	2210.81	574.36	30.16	0.98
		(.064 ^{NS})	(.298 ^{NS})	(.065 ^{NS})	(.404 ^{NS})	(.005 ^{**})	(<.001 ^{**})	(<.001 ^{**})	(<.001 ^{**})	(.036 [*])
Season x Affected	1	137.47	53.5	16.45	3598.09	69.66	1.65	0.7	69.66	1.65
		(<.001 ^{**})	(<.001 ^{**})	(.012 [*])	(<.001 ^{**})	(.019 [*])	(.139 ^{NS})	(.075 ^{NS})	(.019 [*])	(.139 ^{NS})
Error	60	2.57	0.88	2.47	19.48	133.21	90.95	11.95	0.74	0.21

Figure-The figure within parenthesis indicates the P-value. P-value < .05 is significant; P-value < .01 is highly significant; P-value > .05 is not significant.

Table 104. Analysis of variance of **Creatinine, CK, AST and ALP** biochemical profile in correlation to the various studied determinants

Source	df	Creatinine (mg/dl)	Creatine Kinase (U/L)	AST(U/L)	ALP(U/L)
Animal	34	0.16	2265.02	2899.76	10208.3
		(.700 ^{NS})	(.697 ^{NS})	(.210 ^{NS})	(.936 ^{NS})
Season	1	8.94	1994.78	598.19	58994.1
		(<.001 ^{**})	(.391 ^{NS})	(.611 ^{NS})	(.064 ^{NS})
Affected	1	14.25	295382	65136.4	1560741
		(<.001 ^{**})	(<.001 ^{**})	(<.001 ^{**})	(<.001 ^{**})
Season x Affected	1	16.04	77519.8	1796.56	225035
		(<.001 ^{**})	(<.001 ^{**})	(.38 ^{NS})	(<.001 ^{**})
Error	60	0.19	2676.78	2292	16578.6

| *Figure-The figure within parenthesis indicates the P-value. P-value < .05 is significant; P-value < .01 is highly significant; P-value > .05 is not significant.*



Fig 1A: Lame horse subjected to walk



Fig 21B: Application of hoof tester



Fig 31C: Percussion of hoof



Fig 41D: Measuring of coronary band



Fig 51E: Hoof overgrowth



Fig 61E: Hoof wall crack



Fig 71G: Thrush



Fig 81H: Suppurative sole



Fig 91I: Quittor



Fig 401J: Laminitis showing circular rings on hoof wall



Fig 441K: Laminitis (3rd phalanx rotation)



Fig 421L: Bulb fibroma



Fig 431M: Sand floor



Fig 441N: Concrete floor

4. CONCLUSION

The present investigation encompassing 49 equine subjects within the military and paramilitary establishments of the North-East region of India, a total of 35 cases involving diverse foot afflictions were diligently examined. Among these, hoof over-growth emerged as the most prevalent malady, followed in incidence by hoof wall cracks, thrush, suppurative sole conditions, quittor, laminitis, and bulb fibromas. Notably, equines subsisting on a diet predominantly composed of high-concentrate

rations exhibited a heightened susceptibility to these foot ailments when compared to their counterparts with diets primarily composed of roughages. Furthermore, the exacerbation of such conditions was found to be associated with the suboptimal maintenance of equine living environments, particularly manifesting as unhygienic concrete flooring. In conjunction with the clinical findings, hematological and biochemical analyses unveiled a noteworthy elevation in various blood indices and serum concentrations of creatinine, (CK) and ALP values, shedding light on the systemic ramifications of these foot afflictions. This research underscores the imperative need for holistic equine health management and maintenance practices, aiming to mitigate the incidence and severity of foot disorders in equine populations.

REFERENCES

1. Adams OR. Lameness in horses. 2nd ed. Library of Congress Catalog Card Number 66:23230, United States of America; 1966.
2. Bergsten C. Impact of Flooring on Claw Health and Lameness. WCDS Advances in Dairy Technology. 2010; 22: 241-251.
3. Blowey R. Factors associated with lameness in dairy cattle. Farm Animal Practice. 2005; 27: 154-162.
4. Dabareiner RM, Carter GK, Honnas CM. White blood cell count and differential in horses with acute synovitis and horses with chronic osteoarthritis of the distal interphalangeal joint. J Am Vet Med Assoc. 2001; 218(5):696-701.
5. French EA, Lopez-Benavides M, Hemling TC. Case study: evaluation of hoof care management systems over time. Proceedings of the 17th International Symposium and 9th International Conference on Lameness in Ruminants. 2013; 162-165.
6. Gooch CA. Concrete Floors in Barns. Dairy Business East. 2013; 25-26.
7. Hussain A, Yousaf , Athar M. Effect of acute laminitis on haemogram and serum biochemistry in mules. Pakistan Vet J. 2024; 24(1): 39.
8. Khalafizadeh J, Meimandi Parizi A. Hematological Study of Cattle with Lameness. Comp Clin Path. 2006; 15(3): 189-190.

Comment [es1]: MUST BE UPDATED as 8.6% (2 out of 23) of the listed references were published in the past five years. The percentage has to increase up to at least 35-40%. Old references and lack of updates indicates that the study is no longer a point of interest

9. Konwar B, Saikia B, Bayan H. Survey of Foot Affections in Mizoram Dairy Animals. *Indian Vet J.* 2015;92(7): 82-83.
10. Livesey CT, Fleming FL. Nutritional influences on laminitis, sole ulcer and bruised sole in Friesian cows. *Vet. Record.* 1984;114(21): 510-512.
11. Mohebbi A, Mohamadnia A, Dehkardi PR. Evaluation of the serum bone specific alkaline phosphatase. *IJVCS*, 10.
12. Nelson AJ, Cattell MB. Culling and laminitis: real herds, real cows, real deaths. *Bovine Practitioner.* 2001; 35(1): 42-45.
13. Nilsson, S.A. Clinical, Morphological, and Experimental studies of Laminitis in Cattle. *Acta Vet Scand*, 1963;4(1): 14-96.
14. O'Driscoll K, McCabe M, Earley B. Differences in leukocyte profile, gene expression and metabolite status of dairy cows with or without sole ulcers. *JDS* 2009; 98(3): 1685-95.
15. Patterson-Kane JC, Karikoski NP, McGowan CM. Paradigm shifts in understanding equine laminitis. *Vet J.* 2018; 231: 33-40.
16. Petrov KK, Dicks LMT. *Fusobacterium necrophorum*, and not *Dichelobacter nodosus*, is associated with equine hoof thrush. *Vet Microbiol.* 2013;161: 350–352.
17. Pollitt CC. Equine Laminitis. *Clinical Techniques in Equine Practice.* 2004; 34-44.
18. Pouyade GR, Serteyn D. The role of activated neutrophils in the early stage of equine laminitis. *Vet J.* 2011;189: 27–33.
19. Rezazadeh F, Hosseinzadeh N, Jozani RJ, Dianati N. Comparison of some hematological parameters between horses in an endurance competition. *AVS.* 2017;4(6): 97-102.
20. Sastry GA. *Veterinary Pathology*, 7th ed. Reprint, CBS Publishers & Distributors, Delhi; 2004
21. Snedecor GW, Cochran WG. *Statistical Methods*, 8th ed. Oxford and IBH Pub.Co., Kolkata; 2004.
22. Talukdar MMAA, Alam MM, Mohammed Y Hussain MA. Claw affections of Dairy Cows in an Organized Dairy Farm. *Bangl J Vet Med.* 2005;3(2): 110-113.

23. Yaylak E, Yenisey C, Seyrek K. Effects of lameness, Stage of lactation and Body condition score on some blood parameters in Holstein Cows. *Asian J Anim Vet Adv.*2009; **4**(5): 245-251.

UNDER PEER REVIEW