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### RESEARCH ARTICLE

#### PREVALENCE OF LAMENESS AND ASSOCIATED FOOT LESIONS IN SAHIWAL DAIRY COWS

Puneet Singh<sup>1</sup>, Swaran Singh<sup>2</sup>, Dhiraj Kumar Gupta<sup>3</sup> and C.S. Randhawa<sup>3</sup>

1. M.V.Sc. scholar, College of Veterinary Science Guru AngadDev Veterinary and Animal Sciences University, Ludhiana - 141004, Punjab, India.
2. Professor cum Head, Department of Teaching Veterinary Clinical Complex, College of Veterinary Science, Guru AngadDev Veterinary and Animal Sciences University, Ludhiana -141004, Punjab, India.
3. Faculty of Department of Veterinary Medicine, College of Veterinary Science, Guru AngadDev Veterinary and Animal Sciences University, Ludhiana - 141004, Punjab, India.

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#### Abstract

Lameness is 3<sup>rd</sup> most prevalent disease after mastitis and infertility, in the dairy industry today and is an important welfare issue causing significant impact on dairy economics. Lameness leads to involuntary culling of lactating dairy cattle due to significant effect on production and reproduction. Mostly lameness occurs due to foot lesions irrespective of breed, management and of animal. Two hundred and four Sahiwal dairy cows were evaluated for lameness and associated claw lesions in the study from local dairy farms of Punjab. Clinical lameness (lameness score 2 & 3) was evident in 6 per cent of animals. After lameness scoring, each animal was restrained in chute and hooves were examined before and after paring 1 mm of hoof tissue from weight bearing surface. Seventy three per cent animals had at least one lesion in their hooves. On animal level, under run soles (45%) were found to be most prevalent claw lesion followed by white line lesions (29%), overgrown soles (7%), cork screw hooves (5%), sole avulsions (5%), sole hemorrhages (3%), heel erosions (3%), double soles (2%) and wall cracks (1%). At claw level, prevalence of lesions was 35.3 per cent, among which under run soles were the most prevalent lesion (19.3%) followed by white line lesions (16.3%), overgrown soles (2.82%), cork screw hooves (1.84%), sole avulsions (1.47%), sole hemorrhages (1.04%), heel horn erosions (0.61%), double soles (0.49%), wall cracks (0.25%) and toe hemorrhages (0.12%). Lactation length and parity had no effect on lameness. Comparatively more lesions were seen in hind limb hooves (56.8%) as compared to forelimb hooves (43.2%). Fore lateral and hind medial claws had more lesions (58.8% and 76.47%, respectively) as compared to contralateral claws 52.9% and 70.5%, respectively). Overall, a low prevalence of clinical lameness was seen in Sahiwal dairy cows.

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#### Corresponding Author:- Puneet Singh

Address:- Department of Veterinary Medicine, Guru AngadDev Veterinary and Animal Sciences University, Ludhiana-141 001, Punjab, India.

## **Introduction:-**

Lameness affects health, productivity, and welfare of dairy cattle to a great extent. It is 3<sup>rd</sup> most prevalent disease after mastitis and infertility, in the dairy industry today and is an important welfare issue causing significant impact on dairy economics (Weaver et al., 2005; Sadiqet al., 2017). Lameness leads to involuntary culling of lactating dairy cattle (Whitaker et al., 2000) due to significant effect on production and reproduction.

Lameness is not a single disease entity rather it is a clinical syndrome of different diseases. The aetiology and pathogenesis of many of these diseases is still obscure (Huxley, 2013). There could be number of factors like stage of lactation (Rowlandset al., 1985), parity, weight, genetics and/or herd factors, like housing (Haskell et al., 2006), environment, management and nutrition (Lean et al., 2013), which affect the prevalence of lameness.

Lameness in crossbred animals has emerged as the most severe problem of organized dairy farms of Punjab in recent years. More than 90 per cent of lameness episodes in cattle all over the world occur due to claw lesions irrespective of breed, use or housing (Hernandez et al., 2002; Van Amstel and Shearer, 2006). Both non-infectious and infectious lesions have been identified in crossbred cattle (Manskeet al.,2002; Singh et al., 2016). About 9 per cent of lactating crossbred cattle in Punjab have been found clinically lame while subclinical lesions range from 40 to 50 per cent (Singh et al., 2016). Sole ulcers and white line fissures have been observed as the principal lesions causing clinical lameness in crossbred dairy cattle of Punjab (Zahidet al., 2014). It was seen that sometimes sole ulcers may present bi-laterally and may not result in clinical lameness rather only stiffness of gait (Logue et al., 1994).

Sahiwal (also called Lambi Bar, Lola, Montgomery, Multani and Teli in regional languages), is a breed of Zebu cattle that originated from the Sahiwal district of Punjab province in Pakistan and is indigenous to many parts of northern India. This indigenous breed of Zebu cattle with high milk production (Nivsarkaret al., 2013), has many advantages over exotic and crossbred cattle breeds, like high parasite resistance and tolerance to high environmental temperature, good temperament, bloat tolerance, ease of calving and longevity (Ilatsiaet al., 2007). Sahiwal is also known for its A2 type milk which has medicinal value in human beings (Kalraet al.,2017). The aim of this study was to evaluate lameness and associated foot lesions in Sahiwal dairy cattle. Though, a number of studies were there on lameness is already done on exotic and crossbred cattle (Bran et al., 2019;Randhawaet al.,2016;Sadiqet al., 2017;Singh et al.,2018;Zahidet al., 2014) but no study till date is available with respect to Sahiwal dairy cows. So this may be the first study on lameness in Sahiwal dairy cows.

## **Materials and Methods:-**

### **Selection of animals**

Two hundred and four lactating Sahiwal dairy cows were included in the study. The cows were maintained at local Sahiwal dairy farms in Punjab, India. Two of the farms were well organized in which stall feeding of animals was done and one farm adopted pasture grazing system. Machine milking was done in one of the organized farm where as rest two farms practiced hand milking. Hoof trimming was not practiced in any of the farm.

## **Research Methodology:-**

### **Locomotion scoring**

On the day of examination, each animal was allowed to walk on the flat surface for 40 meters and gait of each animal was examined on a five point numerical scoring scale formulated by Randhawaet al., (2008). Score 0 was assigned for 'No gait abnormality on walking', 1 for 'Mild lameness, with slight gait asymmetry at walk', 2 for 'moderate lameness, with moderate and regular gait asymmetry', 3 for 'severe lameness, with obvious gait asymmetry or severe symmetric abnormality' and 4 for 'recumbent or non-ambulatory animals'.

### **Hoof examination**

After lameness scoring, cows were properly restrained in chute and then each claw of each foot was examined one by one for claw lesions before and after paring a layer of approximately 1mm of horn from the weight bearing surface.

### **Statistical analysis**

Data were analyzed using MINITAB statistical software (Minitab Inc.) to analyze the distribution of lesions at claw level and limb level by applying Pearson chi-square test and to analyze effect of lactation length and parity on

lameness score. Cows with a locomotion score '0' were grouped as non-lame and cows having locomotion scores 1 (mild), 2 (moderate) or 3 (severe) were placed in the lame group. Animals with lameness score 2 and 3 were considered clinically lame.

### **Ethical approval**

Institutional animal ethics committee's permission was taken at the 52nd meeting of the IAEC of Guru AngadDev Veterinary and Animal Sciences University (GADVASU) held on 15th November, 2019 (Friday) at GADVASU, Ludhiana. The study was approved with proposal number: (GADVASU/2019/IAEC/52/15).

### **Results:-**

#### **Prevalence of lameness**

Out of total 204 animals, 60 per cent animals were not lame (lameness score 0), 34 per cent were having asymmetry in gait or mildly lame (lameness score 1), 5 per cent were moderately lame (lameness score 2) and 1 per cent were severely lame (lameness score 3).

#### **Prevalence of lesions at animal and claw level**

At animal level, 73 per cent Sahiwalcattle had at least one lesion in their hooves among which under run sole (Figure 1) was found to be most prevalent which was found in 45 per cent animals followed by white line disease (29%) (Figure 2), overgrown soles (7%) (Figure 3), cork screw hooves (5%) (Figure 4), sole avulsions (5%), sole hemorrhages (3%), heel erosions (3%), double soles (2%) and wall cracks (1%).

A total of 1632 claws (204 animal×8 claws) were evaluated for lesions in current study. Claw-wise prevalence of different lesions like white line lesions, under run sole, cork screw, double sole, sole avulsion, sole hemorrhages, overgrown sole, heel horn erosion, wall cracks, sole ulcers, toe hemorrhages was 16.3, 19.3, 1.84, 0.49, 1.47, 1.04, 2.82, 0.61, 0.25, 0 and 0.12 per cent respectively. The overall claw-wise lesion prevalence was 35.4 per cent whereas 64.68 per cent of claws were normal with not even single lesion present (Figure 5).

#### **Association between lameness score and presence of lesions**

In 60 per cent animals with lameness score 0 and nearly 80 percent animals with lameness score 1 had lesions in their hooves. However, all the animals with lameness score 2 and 3 were having lesions indicating a direct relationship between number of lesions and lameness (Figure 6).

#### **Effect of lactation length and parity on lameness**

A non-significant effect of lactation length and parity was observed on lameness in Sahiwal cows. Pearson chi-square test revealed no significant difference ( $P>0.05$ ) in lameness scores of animals with different lactation lengths and parity (Table 1 and 2).

#### **Distribution of lesions at limb and claw level**

Significantly higher( $P<0.05$ ) number of lesions were present on hind limb claws than on forelimb claws (Table 3). Prevalence of lesions in fore-lateral and hind medial claws was significantly more( $P<0.05$ ) than fore-medial and hind lateral claws, respectively (Table 3).

### **Discussion:-**

The prevalence of clinical lameness was quite low i.e. 6 per cent in our study in comparison to exotic and crossbred cattle, which could be attributed to low milk production thereby low concentrate feeding to Sahiwal cows, thereby less chances of subacuteruminal acidosis and associated laminitis. Results of our study were in accordance to Sharma et al., (2019) who recorded 4.3 per cent prevalence of lameness in indigenous breeds. However, Bagateet al., (2012) reported 14.88 per cent cases of clinical lameness in indigenous cattle which was still less than exotic dairy cattle in which clinical lameness was seen around 25-38 per cent.

In Punjab, Randhawa (2006) reported clinical lameness in 11 per cent of crossbred lactating cattle on organized dairy farms. Nandi et al., (2008) also observed an annual incidence of clinical lameness of 9.42 per cent in West Bengal with variations in summer and winter between 7.25 per cent and 11.6 per cent, respectively in crossbred cattle breeds. Sadiqet al., (2017) reported 19.1 per cent lameness in Mafriwal breed of cow which is cross of Fersian

and Sahiwal in Malaysia. In the recent study, Bran et al., (2019) reported 42.1 per cent clinical lameness in exotic and crossbred cattle breeds, out of which 20.9 per cent cattle were severely lame.

Lesions were also observed in animals with lameness score 0 and 1. However it was seen that not all the lesions were causing clinical lameness in Sahiwal dairy cows. Zahidet al., (2014) asserted that only sole ulcers and white line lesions were responsible for clinical lameness in crossbred dairy cattle. From previous studies also, it is evident that most of the lesions do not cause clinical lameness, but are rather subclinical contributors (Manskeet al., 2002; Somers et al., 2003). Not mere presence rather severity of lesion was associated with clinical lameness (Tadichet al., 2010). The possible fact may be that several claw and digital lesions do not seem to inflict sufficient pain to cause clinical lameness (Manskeet al., 2002). Moreover, the individual susceptibility to foot lesions, pain, and resulting lameness vary from animal to animal (Vermunt, 2000). Furthermore, the potentially painful corium insult occurs several weeks before the lesions are visible on the sole (Leach et al., 1997). So, ignoring these cows with insults at dermis level may reduce the probability of detecting risks for lesion development by misclassifying these cows as non-lame in spite of having lesions in their feet.

Under run soles were the most prevalent lesion in Sahiwal dairy cows in our study while sole ulcers were not observed even in a single animal. Other observers like Chakrabarti and Kumar (2016) found nearly 17 per cent prevalence of foot lesions was recorded in a survey on mixed indigenous and crossbred cattle in Bihar, with highest incidence of overgrown hooves (6.66%) followed by scissors claw (3.30%), cracked hoof (2.29%), bruising of sole (1.26%), interdigital lesions (1.11%), wound at heel/swelling (0.97%), traumatic injury (0.64%), chronic laminitis (0.54%), interdigital growth (0.43%), acute arthritis (0.18%) and congenital defects (0.14%), respectively. Crossbred animals were more prone (24.74%) to foot abnormalities than non-descript or Zebu cattle (13.05%). Malchiodiet al., (2020) measured the prevalence of eight lesions which were frequently observed i.e. digital dermatitis, sole ulcers, sole haemorrhages, white line lesions, heel erosions, inter digital dermatitis and interdigital hyperplasia to be 16.9, 8.5, 7.4, 4.7, 2.8, 2.6 and 2.2 per cent, respectively. Faridet al., (2020) recorded that double sole (28.5%) and subclinical laminitis (23.5%) were the most prevalent diseases followed by sole ulcers (13%), toe ulcers (9.3%), heel ulcers (7.7%), white line disease (7.75%), hoof fractures (5.75%), and interdigital hyperplasia (2.1%) whereas interdigital necrobacillosis (0.8%), horizontal cracks (0.8%), and vertical cracks (0.8%) were the least prevalent lesions.

High prevalence of under run soles, white line lesions and over grown soles was observed in the present study. These lesions were related to the frequent episodes of ruminal acidosis in crossbred dairy cows (Dewaganet al., 2016). However, the severity of these acidotic episodes might be low that could have resulted in these lesions instead of sole hemorrhages and sole ulcers. It was seen that sole hemorrhages and ulcers were more frequent on those farms where intensive feeding practices were followed. Moreover, lack of regular trimming and abrasive concrete flooring might have caused further damage to the hoof horn. Low prevalence of heel erosions and sole hemorrhages and absence of sole ulcers in our study could be associated with low level of concentrate feeding in Sahiwal dairy cows in comparison to crossbred/exotic cows with respect to their milk production. Infectious lesions like foot rot, digital dermatitis and interdigital dermatitis were not observed in Sahiwal cows indicating their high innate immune response against the pathogens which cause these lesions. A special perception of this indigenous breed to keep herself clean (personal observation) might be another factor for low prevalence of infectious lesions.

A non-significant change in lameness score among animals of different lactation lengths in present study could be attributed to low concentrate feeding of Sahiwal cows leading to less probability of hyperinsulinemia and hyperglycemia which could probably lead to insulin resistance and inhibition of glucose uptake in hooves. Adaptation of Sahiwal cows to fulfil their energy demands from the locally grown fodder could be another factor. Otherwise, hormonal and metabolic changes occurs when cow transforms from non-lactating to lactating leading to glucose synthesis by hepatic gluconeogenesis (Reynoldet al., 2003) and reduced oxidation of glucose in peripheral tissues (Bennicket al., 1972). During late pregnancy, animals are generally fed high concentrate diet which ultimately leads to hyperinsulinemia and hyperglycemia (Vermunt and Greenough 1994) in which insulin resistance occurs (Cowiet al., 1980). Insulin receptors are also present in hoof dermis so, insulin resistance could inhibit glucose and amino acid uptake (Hendry et al., 1999) producing poor quality hoof horn.

Parity has no effect on lameness in the present study. Milk yield was low in Sahiwal cattle so nutritional demand was less and chances of metabolic lesions which could cause clinical lameness were also less due to low concentrate feeding. Contrary to this, Alban (1995) found comparatively more lameness in first and fourth lactation. Lischeret

al.,(2002) observed that heifers experienced more lameness due to major changes in the housing conditions, social environment, nutrition and physiologic demands than senior lactation cows. It was also suggested that tissues of the claw like the digital cushion might not be fully developed in heifers. Primiparous cows had more hemorrhages of the sole and asymmetric claws than pluriparous cows (Sogstadet al., 2005). Sahiwal cows might have fully developed digital cushion at first calving thus, odds of lameness were less in primiparous Sahiwal cows in the present study. Manskeet al.,(2002) and Singh et al., (2018) observed significant rise in locomotion score with increase in parity. Repeated scraping of the corium with increasing parity may lead to irreversible damage (Lischeret al.,2002). Sahiwal cows were likely to have sufficient subcutaneous fat (personal observation), irrespective of parity so they must also be having more fat in digital cushion also, leading to higher shock absorbing capacity of hooves even if lesions were present. This could have lead to increase in their pain threshold thus decreasing prevalence of lameness in them.

More lesions in hind limb claws could be attributed to the fact that the hind limbs are connected by the coxo-femoral articulation to the pelvic girdle which has a limiting effect on the overall shock absorption function of the limbs and thus increases the predisposition of hind limbs to lameness. The softer hind feet horn (Borderaset al., 2004) due to urea in urine (Gregory et al., 2006) was seen as the other factor that could have increased the predisposition of hind limbs to lameness (Divers and Peek, 2007). On the other hand, the fore extremities are supported by the massive serratusventralis muscles with no bony touch between the axial and abaxial skeletons. Similar findings were reported by Murray et al (1996) who reported that 92 per cent of lameness-related lesions were in the hind feet.

More lesions in fore-lateral and hind medial hooves in Sahiwal calves could be due to different confirmation of Sahiwal cows in comparison to crossbred cows (personal observation). The other possibility may be that fore lateral and hind medial claws might be suffering from more ground reaction forces in comparison to their contralateral claws. This finding is contrary to what is generally observed in exotic and cross bred cattle, in which fore-medial and hind-lateral claws are most affected, as observed by Bagateet al., (2012) and Murray et al., (1996) who recorded that hoof lesions were more in hind limbs (61.21%) with greater involvement of outer claw (61.89%) than in forelimbs (38.78%) with greater involvement of inner claw (56.14%).

**Conclusions:-**

Sahiwal dairy cows have low prevalence of lameness. Under run sole is the most common lesion followed by white line lesion, overgrown soles, cork screw hooves, sole avulsions, sole hemorrhages, heel erosions, double soles and wall cracks. Parity and lactation length has no affect on lameness in Sahiwal cows. More lesions are present in hind limb claws than fore limb claws and that too in front lateral and hind medial claws than their contra-lateral claws. A comprehensive study on etio-pathogenesis of claw lesions is very much required to identify the facts related to low prevalence of lesions causing clinical lameness in Sahiwal dairy cows.

**Table1:-** Lameness score in relation to lactation length of Sahiwal cows.

LL \ LS	0-4 months	4-8months	>8months	Grand total	P-value
0	44(35.7%) <sup>a</sup>	56(45.5%) <sup>a</sup>	23(18.7%) <sup>a</sup>	123(100%)	0.107
1	24(34.7%) <sup>a</sup>	32(46.4%) <sup>a</sup>	13(18.8%) <sup>a</sup>	69(100%)	
2+3	0(0%) <sup>a</sup>	7(58.3%) <sup>a</sup>	5(41.7%) <sup>a</sup>	12(100%)	

<sup>a,b,c</sup> value of the different superscriptshowing significant difference (P<0.05)

**Table 2:-** Lameness prevalence in relation to parity.

Parity \ LS	1	2	3	4	>4	P-value
0	64% <sup>a</sup>	59.5% <sup>a</sup>	55.7% <sup>a</sup>	66.6% <sup>a</sup>	55.5% <sup>a</sup>	0.571
1	36% <sup>a</sup>	30.9% <sup>a</sup>	34.6% <sup>a</sup>	30.3% <sup>a</sup>	37.07% <sup>a</sup>	
2&3	0% <sup>a</sup>	9.52% <sup>a</sup>	9.6% <sup>a</sup>	3.03% <sup>a</sup>	7.41% <sup>a</sup>	

<sup>a,b</sup> value of the different superscriptshowing significant difference (P<0.05)

**Table 3:-** Pearson chi-square testdepicting prevalence of lesions at limb and claw level.

Claw		FL	FM	HL	HM	Front limb	Hind limb

Lesion						hooves	hooves
<b>Lesion present</b>	Number(1055)	240	216	287	312	456	599
	Per cent	58.82 <sup>a</sup>	52.94 <sup>b</sup>	70.52 <sup>c</sup>	76.47 <sup>d</sup>	43.22 <sup>a</sup>	56.78 <sup>b</sup>
	P-value	0.000				0.000	
<b>WLL</b>	Number(266)	81	88	58	39	169	97
	Per cent	30.45 <sup>a</sup>	33.08 <sup>b</sup>	21.80 <sup>c</sup>	14.66 <sup>d</sup>	63.53 <sup>a</sup>	36.47 <sup>b</sup>
	P-value	0.000				0.0000017	
<b>Under run sole</b>	Number(316)	100	117	52	47	217	99
	Per cent	31.65 <sup>a</sup>	37.03 <sup>b</sup>	16.46 <sup>c</sup>	14.87 <sup>d</sup>	68.67 <sup>a</sup>	31.33 <sup>b</sup>
	P-value	0.000				0.000	
<b>CS</b>	Number(30)	0	14	16	0	14	16
	Per cent	0.00 <sup>a</sup>	46.67 <sup>b</sup>	53.33 <sup>c</sup>	0.00 <sup>a</sup>	46.67 <sup>a</sup>	53.33 <sup>a</sup>
	P-value	0.000				0.710	
<b>Sole avulsion</b>	Number(24)	6	9	6	3	15	9
	Per cent	25 <sup>a</sup>	37.50 <sup>b</sup>	25 <sup>a</sup>	12.5 <sup>c</sup>	62.50 <sup>a</sup>	37.50 <sup>a</sup>
	P-value	0.385				0.218	
<b>Sole overgrowth</b>	Number(46)	5	22	13	6	27	19
	Per cent	10.87 <sup>a</sup>	47.83 <sup>b</sup>	28.26 <sup>c</sup>	13.04 <sup>d</sup>	58.70 <sup>a</sup>	41.30 <sup>a</sup>
	P-value	0.001				0.233	

<sup>a,b,c,d</sup> value of the different superscript showing significant difference (P<0.05).

(WLL-white line lesions, URS- under run soles, CS- cork screw hooves, DS- double soles, SA-sole avulsions, SH-sole haemorrhages, OS- overgrown soles, HHE- heel horn erosions, SU- sole ulcers, FL- fore lateral, FM- fore medial, HL- hind lateral, HM- hind medial)



**Figure 1:-** Under run sole.



**Figure 2:-** White line lesion.



**Figure 3:-** Overgrown sole.



**Figure 4:-** Cork Screw hoof.

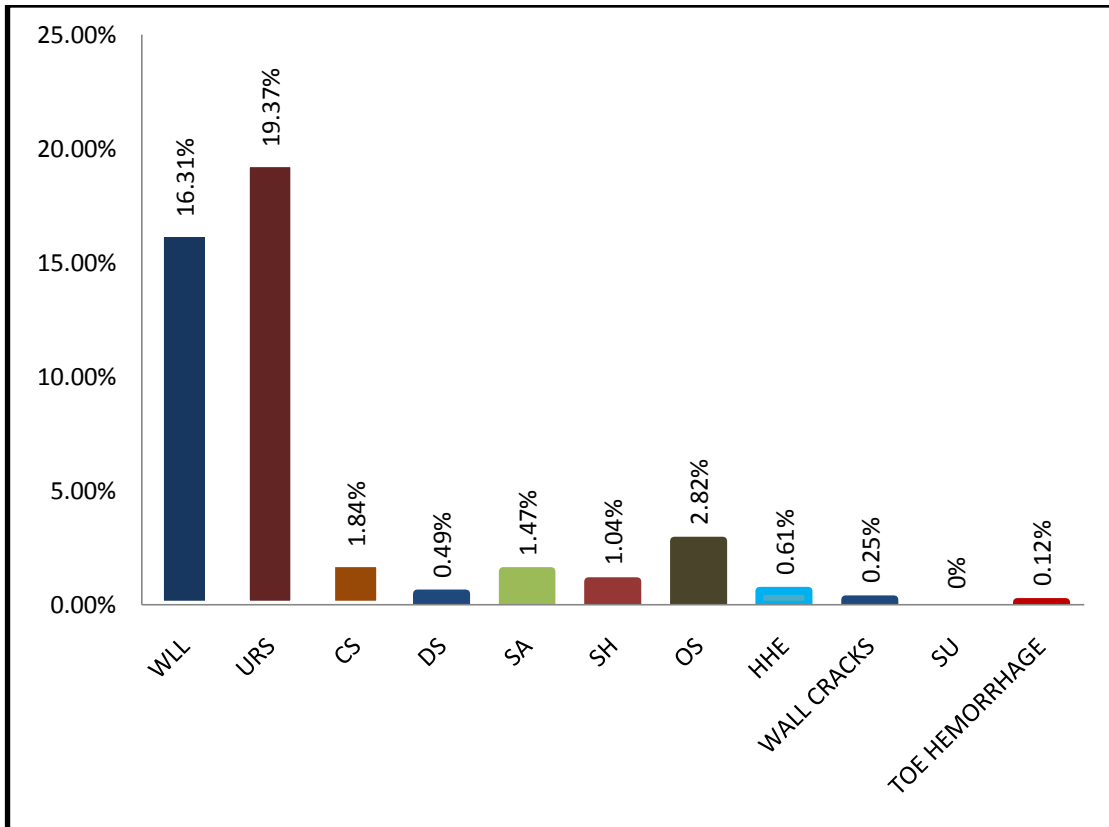


Figure 5:- Prevalence of lesions at claw level.

(WLL-white line lesions, URS- under run soles, CS- cork screw hooves, DS- double soles, SA-sole avulsions, SH- sole haemorrhages, OS- overgrown soles, HHE- heel horn erosions, SU- sole ulcers)

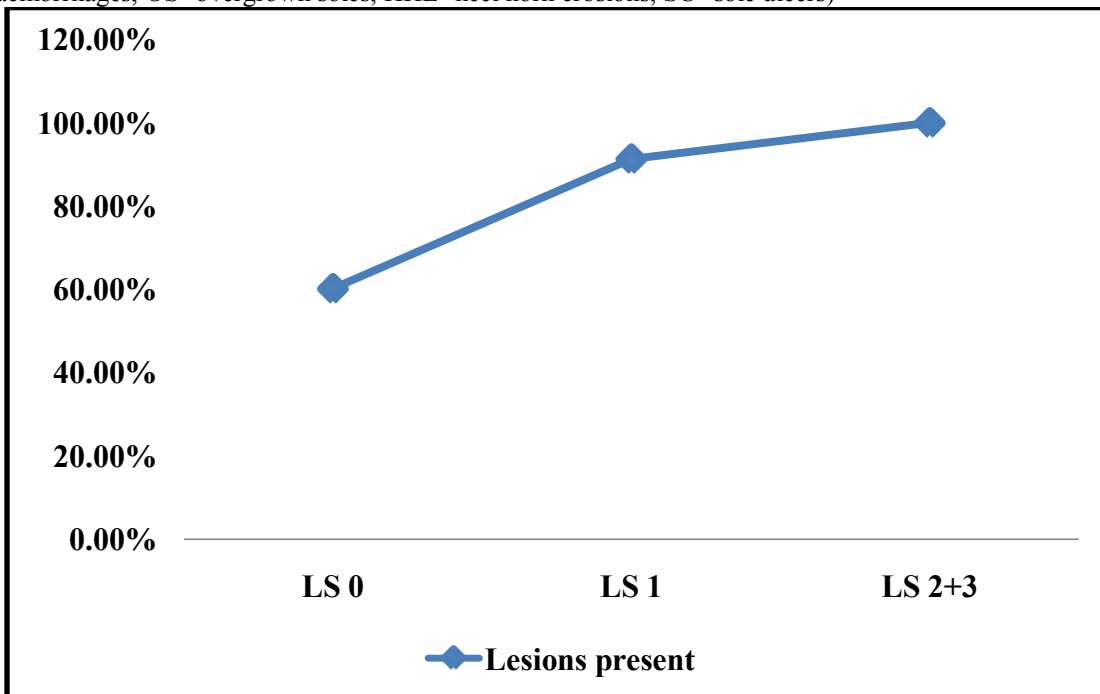


Figure 6:- Graph showing percentage of animals having lesions with different lameness scores.

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