1. INTRODUCTION

Livestock is an integrated part of our farming system and plays an important role in the traditional economy of India. About 80% of the population is employed in agriculture and livestock farming. Farmers are interested in rearing goats due to their docile behavior, low food intake, highest fertility rate (95%) and multiple kidding efficiency (Islam et al., 2012). In Madhya Pradesh the livestock contributes 8-10 % to GDP of state with 1.8 crore cattle, 75.7 lakhs buffaloes, 81.4 lakh goats and 5.4 lakh sheep (Singh et al., 2011).

Foot diseases are major causes of lameness in small ruminants and responsible for great economic losses, due to reduced forage intake, milk production, decreased reproduction rate and premature culling of animals (Pugh, 2004). Sheep and goat are predisposed to lameness leads to less body weight gains by a number of factors such as hard environmental terrain, wetness of housing floor, unkempt and overgrown hoof, fracture and trauma, systemic and local microbial infection, inflammation of anatomical structures and glands. The role of predisposing factors varies depending on the age, herd size and management systems adopted by farmers (Harris et al., 1988, Blood and Radostits, 1990, Mohammed et al., 1996).

The hoof is an extremely important structure in an animal’s body responsible for ambulation. Although an animal with hoof problems in able to function but performances are always sub-optimal depending upon the severity of the problem (Hernandez et al., 2001).

Most lameness arises from disease and lesions of hooves viz. punctured sole, cracked hoof, sole wear, sole ulcer, white line abscess, solar hemorrhages, fissured hoof and foot rot. The site and depth of injuries determine the extent of structural damage (Weaver, 1980; Devendra and McLorey, 1982). Apart from direct injury to the hoof laminitis has been reported as the most common non-infectious cause of lameness in goats (Winter, 2008).

Although some hoof problems are unavoidable, sound hoof management procedures can greatly reduce the incidence of hoof problems in
all types of animals. A good hoof care program leads to lowered expenses in
treatment of problems as well as minimizes losses due to sub optimal
performance and productivity of the animal (Webster, 2002).

In India, along with systemic medication herbal drugs play a
major role in many diseases. Subapriya and Nagini (2005) suggested that all
parts of the neem tree- leaves, flowers, seeds, fruits, roots and bark have
been used traditionally for the treatment of inflammation, infections, fever, skin
diseases and dental disorders. Neem leaf exhibit immunomodulatory, anti-
inflammatory, antihyperglycaemic, antiulcer, antimalarial, antifungal,
antibacterial, antiviral, antioxidant,antimutagenic and anticarcinogenic
properties. Wadankar et al. (2011) also suggested that custard apple has
antimicrobial and anti-inflammatory properties which is beneficial for wound
healing.

Paste of custard apple leaves is used to treat ulcer, maggotted
wounds and abscess. Custard apple contains high amount of vitamin A and C
which is beneficial for wound healing of skin and the wound as well Chandra
et al. (2014).

In India a lot of work has been done on hoof disorders in cattle
however, due importance has not been given to goats under present
husbandry practices. The data on hoof disorders in goats is less, primarily due
to varied managerial practices and animal housing pattern. The genesis of
hoof disorders in goats is not comprehensively studied under our climatic and
managerial condition (Hill et al., 1997; Mazurek et al., 2007 and
Christodoulopoulos, 2009). Further, this problem has economic bearing and
mostly affects marginal farmers and lower strata of the society.

Therefore, looking to paucity of work in India and the importance
of hoof health in goats, the present study was designed with following
objectives.

**OBJECTIVES-**

1. To study the incidence of various hoof affections in goats.
2. To evaluate the response of neem (*Azadirachta indica*) and custard
   apple (*Annona squamosa*) leaves on healing of hoof lesions.
2. REVIEW OF LITERATURE

Lameness is defined as an abnormal stance or gait caused by either a structural or a functional disorder of the locomotor system (Whitton, 2010). It is the manifestation in the act of progression by one or more limb of pain, disease, weakness, deformity or impediment (Hickman, 1964). Hoof disorders and lameness has emerged as one of the major causes of economic loss to the goat farmers due to decreased production and reproductive performance (Collick et al., 1989; Esslemont, 1990).

2.1 Hoof anatomy

Sisson and Grossman (1953) and Getty (1975) described the structural anatomy of the caprine hoof. Goats are cloven-footed animals. There is outer or lateral claw and the inner or medial claw. In goats, the lateral claw is slightly larger in hind feet while the medial claw is larger in fore feet. The space between the two claws is known as the interdigital cleft and the area of skin is called the interdigital skin. The horn is a hard surface structurally similar to the human fingernails but functionally it is related to the epidermis of the skin. The cells that form the horn beneath the hoof wall called the corium. The corium is a nutrient-rich tissue that contains many important blood vessels and nerves inside the hoof. Underneath the hoof is a slightly softer region called the sole, the tissue that makes up the sole is produced from the corium of the sole. The point where the hoof wall binds to sole is called the white line. The white line is a flexible junction between the sole and wall allowing the hoof to expand as the animal moves.

2.2 Incidence of various hoof lesions

Smedegaard (1964) recorded that vertical fissures, separation of white line, chronic hoof overgrowth and losses of hoof horn were the major cause of lameness in sheep, because of the long toe, animal transfers the weight to the posterior parts of the claw thus increasing the risk of hoof lesions.

Raven (1989) stated that hoof disorder in farm animals were frequently associated with damage to the underlying dermal and epidermal...
soft tissues causing impaired production of horn, further increased weight bearing was associated with asymmetries which predisposed to claw lesions, such as sole ulcers. The sole concavity restored when animals were turned-out for grazing on dry, non-abrasive grounds.

Mgasa and Arnbjerg (1993) evaluated a herd of 200 cross breed goats from Malya and 1056 indigenous Tanzanian goats. In the survey, digital lesions were maximum accounted for 90.9% of lameness and the most frequent lesions were white line disease and foreign body (thorns) punctures in the sole which were responsible for 66.6% of lameness. The rainy season had the highest frequency of lameness compared to dry season.

Chakrabarti et al. (1996) studied 419 goats at Kerala Agricultural University Goat Farm, Mannuthy and found 10 (2.39%) cases were positive for various foot disorders. Among the foot disorders, highest incidence was of overgrown hoof (1.19%) followed by traumatic injury (0.72%), bruising of sole (0.24%) and cracked hoof (0.24%). Higher incidence of foot disorders was observed in fore feet (1.19%) than hind- feet (0.95%).

Hill et al. (1997) recorded foot lesion and lameness in goat in a random sample of 307 goats from four large commercial farms. Overall proportion of lame goats was 9.1 per cent. The abnormalities detected were horn separation (29.60%), white line separation (13.00%), slippering (10.10%), abscess of the sole (4.20%), foreign body, and granulomatous lesions (1.00%). Between 83.10% and 95.50% of the goats had overgrown horn on at least one foot. Horn separation, abscess of sole and foot rot were significantly associated with lameness, but white line separation, slippering and granulomatous lesion were not associated with lameness. It was concluded that routine foot trimming reduced the prevalence of lameness.

Nonga et al. (2009) recorded lameness in goats at Magadu Farm, Morogoro, Tanzania during the rainy and dry seasons of 1996, 1997 and 1998 involving 383, 449 and 438 animals, respectively. A significantly higher prevalence of lameness was recorded during rainy seasons than dry season (7.30%). Adult goats suffered more (69.50%) than the young ones
and male goats were more affected by lameness (85.00%) than females (67.30%). The hind limbs appeared to be more affected (62.40%) as compared to forelimbs (37.60%).

Gildeni et al. (2011) reported the occurrence and epidemiology of outbreak of foot rot and other diseases in goats and sheep. The prevalence of foot lesions was 19.41% (170/876) in sheep and 17.99% (52/289) in goats, ranging between 5.77% and 33.85% in different farms. Foot rot was the most common disease, affecting 12.10% of the animals examined (141/1165). White line disease was found in 3.95% of the animals, sole ulcers in 1.29%, foot abscess in 1.03% and hoof overgrowth in 0.5%.

Lasisi and Akpan (2013) examined 3672 goats in various farms of Nigeria between November, 1999 and October, 2009. The mean prevalence rate of clinical lameness was 20%. Foot rot, overgrowth of hooves, trauma of the limbs, interdigital pouch inflammation, white line separation and sole haemorrhage predisposed the small ruminants wound and lameness. Hoof overgrowth ranked highest as the cause of lameness while, digital dermatitis ranked lowest in small ruminants.

Karim et al. (2014) to determine the general clinical prevalence of diseases and disorders in cattle and goats at the Upazilla Veterinary Hospital, Mohammadpur, Magura during the calendar year. A total of 536 clinical cases (327 cattle and 209 goats) were recorded and analyzed. In which overgrown hoof were maximum (33.30%) and hoof abscess was observed only in 5.60% of goats.

Mehta et al. (2015) screened 6000 goats were during the survey, of which 1160 had different foot lesions. The foot lesions encountered and their incidence was calculated as, overgrown hoof 420 (36.20%), white line separation 295 (25.43%), sole ulcer 190 (16.37), sole haemorrhage 85 (7.32%), foreign body in sole 31 (2.67%), interdigital hyperplasia 29 (2.5%), laminitis 22 (1.89%), maggot wound 19 (1.63%), hoof avulsion 17 (1.46%), vertical fissure 25 (2.15%), joint and tendon affection 16 (1.37%) and Pedal bone dislocation 01 (0.09%).
2.3 Effect of housing pattern and floor type on hoof diseases

Weaver (1974) concluded that interdigital disease could accompany a general increase of limb injuries on the introduction of animals to slatted floors and poor husbandry practices lead to overcrowding and unhygienic under foot condition.

Issac (1981) found that in free-range area, especially on rocky or gravelly terrain, little foot trimming of goats was required however, foot trimming was essential in goats that were kept in small plots or backyards. Untrimmed hooves grow into a variety of shapes, eventually putting unusual pressures on ligaments and tendons, causing pain and distorting their normal shape. Affected goats had difficulty in walking and might go down on their knees.

Bergsten (1994) suggested that standing for prolonged periods due to unfavourable housing caused increased blood pressure inside the claws lead to reduced perfusion. This resulted in inadequate oxygenation and nutrition supply to the horn-producing tissues which lost vitality. Ultimately it reduced circulation of blood inside of the foot which decreased the removal of toxins and resulting animal become more prone for hoof disorder. Because of these drawback, Bergston and Frank (1996) recommended deep bedding or rubber matting on hard flooring to minimize incidence of hoof diseases.

Egerton (2002) stated that feet exposure for extended periods at ambient and wet pasture, faeces and urine predisposed to infection and disease transmission between animals.

Christodoulopoulos (2009) studied a herd of 170 goats that were kept indoor during a period of one year and stated that long housing period had resulted in overgrown hooves, which were trimmed every 6 months.

Whittier (2009) suggested that two different type of solution were commonly used for footbath. Zinc sulphate and Copper sulfate for treatment of foot rot and scald 1-2 times per week for several weeks. Comparitively Zinc sulfate was found to be more effective than Copper sulfate. Copper sulfate was found more corrosive and it stained the wool also.
Battini et al. (2013) reviewed animal-based welfare indicators to develop a valid, reliable and feasible on-farm welfare assessment protocol for dairy goats. The indicators were considered four accepted principles good feeding, good housing, good health and appropriate behaviour.

Mehta et al (2015) found that out of 1160 affected goats, 820/1160 (70.68%) were maintained on kachha floor with poor hygienic condition and the rest 340/1160 (29.31 %) on pakka floor with hygienic conditions indicating that the floor condition on which the animals were maintained as the main predisposing factor for hoof disorders in goats.

2.4 Limb wise incidence

Chakrabarti et al. (1996) studied 419 goats at Kerala Agricultural University goat farm, Mannuthy and suggested that higher incidence of foot disorders was observed in fore feet (1.19%) than hind- feet (0.95%). The fore limbs of animal bear approximately 60% of the body weight. However, in case of high yielding animal and heavy weight animals about 50% of their weight was born by hind limb (Scott et al., 1999).

Shearer and Amstel (2000) found that during locomotion the weight-bearing on the inside claw was more even. Higher incidence of hoof disorders involved the lateral claw. Meyer et al. (2004) also suggested that the pattern of stride and first contact differed between fore and hind limb and demonstrated that the lateral hind claw took the first impact of each step therefore it was more prone to disorders.

2.5 Incidence of lameness

Smith and Sherman (1994) stated that the problem of lameness has not as widely reported in goats as in sheep and cattle, even though the pattern of foot diseases was similar. Research had shown that lameness contributed to reduced weight gain, milk production and reproductive failure. Furthermore, previously lame animal were more prone to future reoccurrences (Nocek, 1997).
Bokko and Choudhary (2001) recorded prevalence of lameness in 3914 sheep in North East region of Nigeria, out of 3914 sheep only 697 showed signs of lameness. The common conditions that predisposed sheep to lameness were overgrown hooves, traumatic injuries to the limbs, interdigital pouch inflammation, limb conformational deformities and fracture. Hoof overgrowth ranked highest as a cause of lameness. More cases of lameness were recorded in the forelimbs than in the hind limbs. Sheep below 4 years of age showed higher incidence of lameness compared to those above 4 years. There is however decreasing frequency and increasing severity of lameness with age in the sheep. There was no sex predisposition to the development or manifestation of lameness.

Whay et al. (2002) specified four key issues in preventing chronic pain and hyperalgesia related to lameness viz., early detection of lame animal, prompt and effective treatment and sympathetic care and use of analgesia.

Winter, (2008) stated that hoof health was an important aspect of goat management. Animal with hoof problems failed to perform up to their genetic potential. Lameness could also be a welfare issue. The two most common diseases affecting the hooves of goats were footrot and foot scald.

Christodouloupolous (2009) studied foot lameness in a dairy herd of 170 goats. The herd was kept mostly indoors for a year during this period, 15% of the goats showed lameness with foot lesions and 24% of the goats showed lameness without foot lesions.

2.6 Traumatic wound of hooves

Issac (1981) stated that hoof wound occurs from a variety of causes such as a foot being caught in a wire fence between slates or in the fork of a tree. In goats traumatic injury leads to abscess formation. The symptoms of abscess were observed which include lameness and swelling at the hairline just above the hoof and open wounds. Foot abscess in sheep also were characterized by swelling of soft tissues immediately above the hoof and advanced cases draining abscess were found in this area.
2.7 Treatment

Issac (1981) suggested that in traumatic injuries of hoof, wound should be washed with an antiseptic to remove all the debris followed by antibiotic ointment application and affected foot should be bandaged, antibiotic injection was required for severe wound. Tetanus toxoid should be given to the goats to prevent any chance of tetanus.

Barua et al. (2010) studied the wound healing activity of the methanol extracts of leaves of *Azadirachta indica* plant using excision and incision wound models in Sprague Dawley rats. The healing effect produced by plant extracts, was assessed by rate of wound contraction, skin breaking strength and histopathology of healing tissue. The Methanol extract of leaves of Neem (*A. indica*) significantly promoted the wound healing activity in both excision and incision wound models. In incision wound, tensile strength of the healing tissue of Neem (*A. indica*) treated group was found to be significantly higher (P<0.05) compared to the control group. It was concluded that neem can be used for wound management.

Wassink et al. (2010) in a study on 700 ewes using parenteral and topical antibacterial along with foot trimming, found to significantly reduce the incidence (<2%) and prevalence (<9%) of lameness by footrot and interdigital dermatitis the above treatment improved the health and productivity of the animal as well.

Wadankar et al. (2011) found that in exploratory work on ethno-botany of medicinal plants of Washim district that 39 Plants were having wound healing properties and are used traditionally as well as in Washim district. These were known for curative properties for various ailments apart from their use as wound healers. Neem and Custard apple plants were used for curing various diseases along with wound healing. It was concluded that the entire plant, either parts of plants in fresh or dry form or as plant juices could be used for wound healing.

Himesh et al. (2012) evaluated 46 plant belonging to 44 genera and 26 family documented and their therapeutic activity on wound and related
injury like burn, cuts and stated that *Annona squamosa* (custard apple) leaves have good wound healing property. Leaves of *A. squamosa* contain tannin and vitamin C which promotes wound healing, anti-inflammatory and insecticidal activity. It enhanced the level of hydroxyproline, hexoamine and elastin in the wound, which enhanced the wound healing activity.

Kaler et al. (2012) reported that parenteral use of long acting Oxytetracycline and Enrofloxacin and topical application of KMnO₄ solution for the treatment of both acute and chronic foot rot in sheep was very effective.

Ponrasu and Suguna (2012) strongly substantiated the beneficial effects of the topical application of *Annona squamosa* leaves for the acceleration of normal and diabetic wound healing.

Purohit et al. (2013) evaluated ethanolic extract of *Azadirachta indica* (Neem) leaves for wound healing through topical route on excision wound model. The activity was compared with standard drug Povidone Iodine ointment (5% w/w). Ethanolic extract of *Azadirachta indica* leaves was found to have better and faster wound healing effect than standard drug Povidone Iodine ointment on excision wound model.

Strobel et al. (2013) in a study used parenteral antibiotic in sheep footrot. It was conducted on 10 farms in southern Germany to obtain information on the efficacy of Gamithromycin and Oxytetracycline under practical use conditions compared with a positive control. It was observed that both the treatments reduced clinical lameness and concluded that overall response rate was 99 per cent in both the parenteral antibiotic treatments.

Ansari et al. (2014) conducted a study on 104 sheeps divided into 4 groups using parenteral antibiotic Amoxicillin and Cloxacillin, Oxytetracycline, Gamma benzene Hexachloride and Enrofloxacin respectively along with 10% Zinc sulphate foot bath it was concluded that maximum decrease in mean recovery time was observed with amoxicillin and cloxacillin treated group (4.17±0.31) compared to other groups. It was concluded that administration of parenteral antibiotics in combination with 10% Zinc sulphate footbath was highly effective to treat the acute foot rot in sheep.
Pandey et al. (2014) studied on 50% ethanolic extract of Neem leaves for qualitative and quantitative estimation of phytoconstituents by HPTLC analysis. The DPPH free radical scavenging activity was conducted to understand the antioxidant potentials of Neem leaves. The antibacterial effect of extract was studied against Gram negative *Escherichia coli* and Gram positive *Staphylococcus aureus*. It was reported that total Phenol, Flavonoid and tannin content were estimated to be 1.03%, 5.33% and 1.83% respectively. HPTLC studies revealed the presence of β-Sitosterol, Lupeol, Rutin, Ellagic acid, Ferulic acid and Quercetin in 50% ethanolic extract. The extract showed significant free radical scavenging activity with an IC50 of 110.36μg/ml. Ascorbic acid was taken as the standard antioxidant and its IC50 value was 42 μg/ml. The extract showed significant antibacterial activity against *E. coli* and *S. aureus*, though it inhibited the growth of *S. aureus* more effectively as compared to *E. coli*. It was concluded that leaves of *A. indica* possess significant antioxidant and antibacterial properties, and contain phytoconstituents that may contribute to its medicinal properties.
3. MATERIAL AND METHODS

3.1 Location of work

The present research work was carried out in the Department of Surgery and Radiology, Livestock farm, Adharthal, Aamanala goat farm, College of Veterinary Science and Animal Husbandry Nanaji Deshmukh Veterinary Science University (N.D.V.S.U.) and villages around Jabalpur, Madhya Pradesh (M.P.).

3.2 Meteorological data and features of place

Jabalpur is situated at 23.17° latitude and 79.57° East longitudes at 410.87 mean sea level in the southern part of second agro-climatic zone, including Satpura plateau and Kymore hills. It has a tropical climate having average rainfall of 1241 mm.

3.3 Study period

The study was conducted for a period of six months from October 2015 to March 2016.

3.4 Experimental animals

3.4.1 Screening

All the goats referred to department of Surgery and Livestock form, Adhartal, Amananala goat farm and villages in and around Jabalpur were screened. Total 714 goats were screened during study period to record incidence, identification and characterization of various hoof lesions. Out of these 24 goats were selected suffering with wounds in hoof irrespective of age, breed and sex for present study.

3.5 Instrumentation

Hoof trimming kit was used for pairing of hooves which consists of hoof tester (1), hoof trimmer (1), hoof knives one each (narrow left, narrow right, straight and broad hoof knives), hoof pincer (1), rasper (1) and buffer (1) (plate 01).
3.6 Management and surgical treatment for hoof lesions

Hoof cleaning was done with diluted solution of potassium permanganate (1:10000) to remove dirt, debris and necrotic material.

3.6.1 Therapeutic trimming

In all the cases suffering with hoof disorders therapeutic trimming was done. In cases of hoof overgrowth of toe and lateral wall therapeutic trimming was done to maintain the ground level of sole (plate 02). In few goats suffering with severe lameness, excessive overgrowth and cork screw, hoof pairing was scheduled two times after a gap of 15 days to maintain the normal shape of hoof (plate 03).

White line separation was more evident after therapeutic trimming. In all the goats, fissure was cleaned with the help of either hoof knife or curator, 5% povidone iodine solution was applied (plate 04). Goats suffering with vertical fissure after cleaning with potassium permanganate solutions ointment povidone iodine and was prescribed for 15 days (plate 05). All the goats suffering with traumatic wound were selected for further study and treated as per the experimental design.

3.7 Experimental design

All the 24 goats suffering with traumatic lesions irrespective of age, sex, breed and etiology were randomly divided into 3 equal groups of 8 animals each. Each group was further subdivided into A and B consisted of 4 animals in each subgroup. Extent of trauma was evaluated on the basis of scorecard given by Schoenian (2011) and minimum 1-2 animal from score 3 and 4 were placed in each subgroup.

Table 01: Score card to evaluate extent of trauma in goats

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Observation</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No sign of inflammation/ infection</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Inflammation of digital skin and odour</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Erosion and separation of hoof wall, mild lameness and odour.</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Excessive erosion of one or more feet, infection and moderate lameness</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Chronic trauma with excessive damage to sensitive structure of hoof and severe lameness</td>
<td>5</td>
</tr>
</tbody>
</table>

In each group and subgroup following treatment regimen was given.
Table 02: Experimental design

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Group</th>
<th>Subgroup</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I</td>
<td>A</td>
<td>Antiseptic dressing of hoof lesions was done by 2.5% Zinc sulphate ointment and 5% Povidone iodine ointment once daily till complete healing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B</td>
<td>Treatment of group IA + Inj Streptopenicillin @ 10000 IU / kg body weight IM for 5 days</td>
</tr>
<tr>
<td>2</td>
<td>II</td>
<td>A</td>
<td>Application of fine paste of fresh Neem leaves (<em>Azadirachta indica</em>) once daily till complete healing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B</td>
<td>Treatment of group IIA + Inj Streptopenicillin @ 10000 IU / kg body weight IM for 5 days</td>
</tr>
<tr>
<td>3</td>
<td>III</td>
<td>A</td>
<td>Topical application of fine paste of fresh Custard apple leaves (<em>Annona squamosa</em>) till complete healing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B</td>
<td>Treatment of group IIIA + Inj Streptopenicillin @ 10000 IU / kg body weight IM for 5 days</td>
</tr>
</tbody>
</table>

3.8 Parameters of study

3.8.1 Anamnesis

Complete history was recorded, including breed, age, sex, floor condition, housing system, feeding practice and duration of lameness. Tentative etiology was hypothesized on the basis of history.

3.8.2 Clinical examination

Rectal temperature (°F) was recorded to evaluate the health status of animal.

3.8.3 Inspection

Posture and gait was observed, while standing and in locomotion to evaluate mild, moderate and severe lameness.
3.8.4 Observation of hooves

Each hoof was closely observed on 0 day followed by 5th, 10th, 15th, and 20th day post treatment to evaluate the status of wound healing and lameness.

3.9 Treatment

Treatment of the all hoof lesions was done as described in the experimental design (Plate 06).

3.10 Post treatment evaluation

Evaluation of wound healing of hoof lesion was done on 0 day and subsequently on 5th, 10th, 15th and 20th day post treatment by measuring wound surface area (mm$^2$) and calculating the percent healing. The surface area of each wound (mm$^2$) was calculated as per the method described by Shaw and Bell (2012).

In this method wounds were traced and measured with a ruler and standard formula for the calculation of area of an ellipse was applied. The surface area was calculated by taking the radius of the longest side of wound, multiplying it by the radius of the shortest side of the wound at 90° to the long side that value was multiplied by $\pi$ (where $\pi = 3.14$ ). The surface area was obtained in mm$^2$.

$$\pi \times a \times b = \text{surface}$$

Figure: Area is calculated by using formula $\pi ab$

Percent healing was calculated from the surface area by the formula given by Sussman and Bates –Jensen (2006)
\[
\frac{\text{SAI} - \text{SAC}}{\text{SAI}} \times 100 = \% \text{ Reduction}
\]

Where,
SAI = surface area on admission / or at 0 day
SAC = surface area currently / at different time intervals.

### 3.11 Statistical analysis

Data obtained was analyzed by hierarchical design, as per the method described by Snedecor and Cochran (1994).
4. RESULTS

4.1 Incidence

In the present study, hooves of 714 goats were screened conducted from October 2015 to March 2016 at Teaching Veterinary Clinical Complex, Livestock Farm, Adhartal, Amanala, Goat Farm, Jabalpur, and various villages in and around Jabalpur, including Ghugri, Ghamapur, Karmeta and Katra belkheda. The goats were clinically examined for various hoof disorders and lesions were recorded. The number of goats surveyed at various locations during the study period is presented in Table 03.

Table 03: Total number of goats examined

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Location of survey</th>
<th>Number of goats surveyed</th>
<th>Number of goats affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Teaching Veterinary Clinical Complex (TVCC)</td>
<td>517</td>
<td>53</td>
</tr>
<tr>
<td>2</td>
<td>Amanala Goat Farm</td>
<td>57</td>
<td>14</td>
</tr>
<tr>
<td>3</td>
<td>Live Stock Farm</td>
<td>20</td>
<td>03</td>
</tr>
<tr>
<td>4</td>
<td>Ghugri</td>
<td>47</td>
<td>18</td>
</tr>
<tr>
<td>5</td>
<td>Ghamapur</td>
<td>19</td>
<td>04</td>
</tr>
<tr>
<td>6</td>
<td>Karmeta</td>
<td>28</td>
<td>09</td>
</tr>
<tr>
<td>7</td>
<td>Katra belkheda</td>
<td>26</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>714</td>
<td>112</td>
</tr>
</tbody>
</table>

4.1.1 Incidence based on hoof lesions

Incidence based on hoof lesions is shown in table 04. Total 714 goats were screened during the study period, out of which 112 had different hoof lesions. Thus overall incidence of hoof lesions in goats was 15.68 %. Incidence of specific hoof disorder diagnosed was calculated from the whole population. Out of 714 animals hoof over growth was observed maximum, in 46 animals (06.44%). In most of the goats abaxial wall overgrowth (commonly known as slippering or sledge runner) was observed and toe overgrowth (Turkish slipper) was less frequent. In chronic cases, toe overgrowth started to twist inward just like cork screw condition in cattle hoof. White line
separation was the second most common condition, observed in 04.34% goats, followed by traumatic injury 03.78%, vertical fissure 0.84% and cork screw 0.28%.(figure 01).

**Table 04: Incidence based on hoof lesions in goats**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Hoof lesions</th>
<th>Number of goats</th>
<th>Per-cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Overgrown hoof</td>
<td>46</td>
<td>06.44</td>
</tr>
<tr>
<td>2.</td>
<td>White line separation</td>
<td>31</td>
<td>04.34</td>
</tr>
<tr>
<td>3.</td>
<td>Traumatic injury</td>
<td>27</td>
<td>03.78</td>
</tr>
<tr>
<td>4.</td>
<td>Vertical fissure</td>
<td>06</td>
<td>0.84</td>
</tr>
<tr>
<td>5.</td>
<td>Cork screw</td>
<td>02</td>
<td>0.28</td>
</tr>
</tbody>
</table>

**4.1.2 Incidence of hoof lesions based on age of goats**

Incidence of hoof lesions based on age of goats is given in table 05. In the present study maximum incidence of hoof lesions was recorded in the age group of 4-6 years, which accounted 58.04% followed by 0-3 years 29.46% and more than 6 years 12.50% (figure 02).

**Table 05: Incidence based on age of goats**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Age (Years)</th>
<th>Number of goats</th>
<th>Per-cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>0-3</td>
<td>33</td>
<td>29.46</td>
</tr>
<tr>
<td>2.</td>
<td>4-6</td>
<td>65</td>
<td>58.04</td>
</tr>
<tr>
<td>3.</td>
<td>&gt;6</td>
<td>14</td>
<td>12.50</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>112</td>
<td>100</td>
</tr>
</tbody>
</table>

**4.1.3 Incidence of hoof lesions based on breed of goats**

Incidence of hoof lesions based on breed of goats is depicted in table 06. Out of the 112 affected animals, incidence of the hoof disorders were recorded maximum in Jamnapari breed, it accounted 43.75% followed by non-descript 31.25%, Sirohi 13.39% and Barbari breed of goats 11.60% (figure 03).
Table 06: Incidence of hoof lesions based on breed of goats

<table>
<thead>
<tr>
<th>S No.</th>
<th>Breed</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Jamnapari</td>
<td>49</td>
<td>43.75</td>
</tr>
<tr>
<td>2.</td>
<td>Non descript</td>
<td>35</td>
<td>31.25</td>
</tr>
<tr>
<td>3.</td>
<td>Sirohi</td>
<td>15</td>
<td>13.39</td>
</tr>
<tr>
<td>4.</td>
<td>Barbari</td>
<td>13</td>
<td>11.60</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>112</td>
<td>100</td>
</tr>
</tbody>
</table>

4.1.4 Incidence of hoof lesions based on sex of goats

Incidence of hoof lesions based on sex of goats is presented in table 07. Out of the 714 surveyed animals 496 were female and 218 were male, out of which 70 females and 42 males were affected with hoof disorder it was 14.11% and 19.29% respectively (figure 04).

Table 07: Incidence of hoof lesions based on sex of goats

<table>
<thead>
<tr>
<th>S No.</th>
<th>Sex</th>
<th>Number of goats surveyed</th>
<th>Number of affected goats</th>
<th>Per-cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Female</td>
<td>496</td>
<td>70</td>
<td>14.11</td>
</tr>
<tr>
<td>2.</td>
<td>Male</td>
<td>218</td>
<td>42</td>
<td>19.26</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>714</td>
<td>112</td>
<td></td>
</tr>
</tbody>
</table>

4.1.5 Incidence of hoof lesions based on housing system of goats

Incidence of the hoof lesions based on housing system of goats is displayed in Table 08. Maximum hoof disorders were observed in those animals which were kept in intensive housing system, under unhygienic management and long term captivity of the animals at the same place without any outdoor grazing. In this kind of intensive housing system incidence was 46.42% followed by open housing 28.57% and semi-intensive housing system 25.00% (figure 05).
Table 08: Incidence of hoof lesions based on housing system of goats

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Housing</th>
<th>Number</th>
<th>Per-cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Intensive</td>
<td>52</td>
<td>46.43</td>
</tr>
<tr>
<td>2.</td>
<td>Open</td>
<td>32</td>
<td>28.57</td>
</tr>
<tr>
<td>3.</td>
<td>Semi-intensive</td>
<td>28</td>
<td>25.00</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>112</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

4.1.6 Incidence of hoof lesions based on floor condition

Incidence of hoof lesion based on the type of floor condition is represented in Table 09. Maximum hoof disorders were recorded in those animals which were kept on pakka floor, unhygienic management and long duration keeping of animal on hard floor condition. Incidence of hoof lesions were 62.50% in pakka floor followed by kachha floor (37.50%) condition (figure 06).

Table 09: Incidence of hoof lesions based on floor condition

<table>
<thead>
<tr>
<th>S No.</th>
<th>Type of floor</th>
<th>Number</th>
<th>Per-cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Pakka floor</td>
<td>70</td>
<td>62.50</td>
</tr>
<tr>
<td>2.</td>
<td>Kachha floor</td>
<td>42</td>
<td>37.50</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>112</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

4.1.7 Incidence of hoof lesions based on feeding habit of goats

Incidence of hoof lesions based on feeding habit of goats is given in Table 10. Maximum incidence of the hoof lesions was recorded in those animals which were kept on regular high concentrate diet (43.75%), followed by green leaves (33.92%) and concentrate along with green leaves (22.33%) (figure 07).

Table 10: Incidence of hoof lesions based on feeding habit of goats

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Feeding</th>
<th>Number</th>
<th>Per-cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Concentrate</td>
<td>49</td>
<td>43.75</td>
</tr>
<tr>
<td>2.</td>
<td>Green leaves</td>
<td>38</td>
<td>33.92</td>
</tr>
<tr>
<td>3.</td>
<td>Concentrate and green leaves</td>
<td>25</td>
<td>22.33</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>112</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
4.1.8 Distribution of hoof lesions in fore and hind limbs

Distribution of lesion in fore and hind limbs is displayed in table 11. In all the animals suffering with hoof disorders maximum fore limbs were affected (59.83%) followed by hind limbs (30.35%). In few animal lesions were observed in both fore and hind limbs (9.82%) (figure 08).

Table 11: Distribution of hoof lesions in fore and hind limbs

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Limb affected</th>
<th>Number of goats</th>
<th>Per-cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Fore limb</td>
<td>67</td>
<td>59.82</td>
</tr>
<tr>
<td>2.</td>
<td>Hind limb</td>
<td>34</td>
<td>30.35</td>
</tr>
<tr>
<td>3.</td>
<td>All limb</td>
<td>11</td>
<td>09.82</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>112</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

4.1.9 Degree of lameness in different hoof lesions

Lameness in various kinds of hoof lesions is narrated in Table 12. Out of 112 animals severe lameness (23.21%) was found in hoof overgrowth, cork screw and traumatic injuries. Although 46.93% animals showed mild lameness and 30.36% exhibited moderate lameness. All the animals suffering with lateral wall overgrowth and white line separation showed mild lameness, overgrowth of apex of hoof was less common although it produced moderate to severe lameness and in chronic cases animals were walking on knees (figure 09).

Table 12: Degree of lameness in different hoof lesions

<table>
<thead>
<tr>
<th>S No.</th>
<th>Lesions</th>
<th>Number of goats affected</th>
<th>Degree of lameness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mild No. of goats</td>
</tr>
<tr>
<td>1.</td>
<td>Hoof overgrowth</td>
<td>46</td>
<td>19</td>
</tr>
<tr>
<td>2.</td>
<td>Cork screw</td>
<td>02</td>
<td>-</td>
</tr>
<tr>
<td>3.</td>
<td>Traumatic injury</td>
<td>27</td>
<td>02</td>
</tr>
<tr>
<td>4.</td>
<td>White line separation</td>
<td>31</td>
<td>26</td>
</tr>
<tr>
<td>5.</td>
<td>Vertical fissure</td>
<td>06</td>
<td>05</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>112</strong></td>
<td><strong>52</strong></td>
</tr>
</tbody>
</table>
4.2 Treatment of traumatic lesion

4.2.1 Wound area

Wound area calculated in all the animals of different groups and sub-groups is depicted in table 13.

During study period total 27 goats suffering with traumatic injury in hooves were observed, out of which 24 goats were selected for the present work, rest of the goats were suffering with fracture of metatarsal. Healing of hoof wound in each groups was evaluated on the basis of wound area mm\(^2\) and percent healing to evaluate the extent of trauma.

On day 0 before the start of treatment the size of wound varies from 455.25 ± 50.81 to 542.50 ± 85.77 mm\(^2\) in all the groups. The size of wound started to reduce significantly on 10\(^{th}\) post treatment day in all the groups except subgroup IIIA where a non significant reduction was observed from the day 0 values. The size of wound reduced significantly (p<0.05) further on 15\(^{th}\) and 20\(^{th}\) day interval in all the groups. It was calculated 139.00 ± 22.66, 137.25 ± 15.74, 121.00 ± 22.19, 91.25 ± 14.00, 171.50 ± 39.26 and 186.25 ± 13.90 mm\(^2\) at 20\(^{th}\) post treatment day from the 0 day values of 512.00 ± 43.80, 517.75 ± 49.36, 455.25 ± 50.81, 542.50 ± 85.77, 513.00 ± 77.26 and 504.50 ± 50.60 mm\(^2\) in group IA, IB, IIA, IIB, IIIA and IIIB respectively (plate 07 to 12).

No significant difference was observed between the groups at any time interval. However significant reduction in wound area was observed at 20\(^{th}\) day post treatment in all the groups and it was observed lowest in group IIB and IIA, Neem (Azadirachta indica) treated animals followed by subgroup IA and IB Zinc sulphate and povidone iodine treated goats and slightly less reduction in wound area was observed in Custard apple (Annona squamosa) treated goats. Complete healing was observed between 35-45 days in all the groups.
### Table 13: Mean ± SE of wound area in (mm²) in goats of different subgroups at different time intervals

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Interval</th>
<th>Sub-group</th>
<th>GROUP I</th>
<th>GROUP II</th>
<th>GROUP III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>IA</td>
<td>IB</td>
<td>IIA</td>
</tr>
<tr>
<td>1.</td>
<td>0</td>
<td></td>
<td>512.00</td>
<td>517.75</td>
<td>455.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>±43.80</td>
<td>±49.36</td>
<td>±50.81</td>
</tr>
<tr>
<td>2.</td>
<td>5th</td>
<td></td>
<td>462.00</td>
<td>477.00</td>
<td>409.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>±50.19</td>
<td>±47.09</td>
<td>±44.93</td>
</tr>
<tr>
<td>3.</td>
<td>10th</td>
<td></td>
<td>350.25</td>
<td>400.50</td>
<td>335.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>±37.50</td>
<td>±41.15</td>
<td>±35.64</td>
</tr>
<tr>
<td>4.</td>
<td>15th</td>
<td></td>
<td>263.00</td>
<td>277.50</td>
<td>224.50</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>±31.37</td>
<td>±25.58</td>
<td>±19.65</td>
</tr>
<tr>
<td>5.</td>
<td>20th</td>
<td></td>
<td>139.00</td>
<td>137.25</td>
<td>121.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>±22.66</td>
<td>±15.74</td>
<td>±22.19</td>
</tr>
</tbody>
</table>

**Note:** a,b,c,d- Values within same treatment group with different superscript differ significantly (p<0.05) at different time intervals.

#### 4.2.2 Wound healing percent

Wound healing percent calculated in all the groups is represented in table 14. In all the groups wound healing percent increased gradually up to day 20th post treatment. At day 5 post treatment maximum healing (19.49%) was observed in group IIB where wound were treated with fine paste of Neem leaves (Azadiracta Indica) with systemic antibiotic streptopenicillin. Followed by groups IIIB in Custard apple (14.62%) treated animals and rest of the groups also it was near to these value. Wound healing percentage increased gradually in all the groups at 10th and 15th post treatment days.

At day 20 maximum healing was observed in group IIB (83.18%) followed by group IIA and IB where it was almost equal (73.4%). It was slightly lower in group IA (72.85%) where wound were treated with Zinc sulfate ointment and Povidon iodine ointment without systemic antibiotic however in
group IIIA and IIIB only 66.57% and 63.08 % healing was observed where fresh leaves of custard apple were applied without and with antibiotic respectively.

**Table 14: Per-cent healing in all the groups**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Interval</th>
<th>Sub-group</th>
<th>Percent healing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>GROUP I</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>IA</td>
</tr>
<tr>
<td>1.</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>5</td>
<td></td>
<td>09.76</td>
</tr>
<tr>
<td>3.</td>
<td>10</td>
<td></td>
<td>31.64</td>
</tr>
<tr>
<td>4.</td>
<td>15</td>
<td></td>
<td>48.63</td>
</tr>
<tr>
<td>5.</td>
<td>20</td>
<td></td>
<td>72.85</td>
</tr>
</tbody>
</table>
5. DISCUSSION

In the present study screening of hooves of 714 goats was conducted from October 2015 to March 2016 at Teaching Veterinary Clinical Complex, Livestock farm, Adhartal, Amanala, goat farm, Jabalpur and various villages in and around Jabalpur, including Ghugri, Ghamapur, Karmeta and Katra belkheda.

The screening of goats was aimed to record the incidence of different hoof lesions in and around of Jabalpur and to evaluate efficacy of Neem and Custard apple leaves as medicinal treatment for healing of hoof wound in goats.

5.1 Incidence

In the present study incidence of hoof disorder was 15.68%, out of which hoof overgrowth accounted maximum 06.44% followed by white line separation (4.34%), traumatic injury (3.78%), vertical fissure (0.84%) and corkscrew (0.28%).

Incidence observed in the present study coincides with the findings of Chakrabarti et.al (1996), Karim et.al (2014) and Mehta et.al (2015) in goats. Gildeni et al. (2011) also reported that the prevalence of foot lesions was 19.41% (170/876) in sheep and 17.99% (52/289) in goats, however in contrast to present study minimum incidence of hoof overgrowth 0.5%. Instead foot rot was the most common disease (12.10%) followed by, white line disease (3.95%) of the animals, sole ulcers (1.29%) and foot abscess (1.03%).

The higher incidence of hoof overgrowth in the present study may be due to lack in awareness in goat owners and also negligence towards the managemental practices.

5.1.2 Incidence based on age

In present study highest incidence was observed in 4 to 6 year (58.04%) followed by 0 to 3 years (29.46%) and more than 6 years (12.50%).
Similar incidence was also reported during survey of lameness in goats at Magadu farm, Morogoro, Tanzania by Nonga et al. (2009) that, adult goats suffered more (69.5%) than the young ones (31.5%). Mehta et al. (2015) calculated age wise incidence of hoof disorders in goats and observed low incidence (9.48%) in young animals between 0-2 years, in contrast highest in adult animals above 6 years of age (45.51%). Bokko and Choudhary (2001) and Nonga et al. (2009) also suggested higher incidence of hoof disorder in adult sheep and goats respectively these findings were in consonance to present study.

Higher incidence of hoof lesions at 4 to 6 years of age animals may be because more number of goats of above age were received in TVCC and, in and around villages of Jabalpur. Moreover more number of female lactating goats of this age group was observed during the study period. The increased incidence in older animals may also be attributed to absence of regular hoof trimming under Indian conditions of goat farming and diverse management practice.

5.1.3 Incidence based on breed

In the present study maximum incidence of hoof disorder was recorded in Jamnapari breed (43.75%) followed by non-descript (31.25%), Sirohi (13.39%) and Barbari breed (11.60%). In a study Scott et al. (1999) suggested higher incidence of hoof disorders in high yielding animals and heavy weight breeds. These findings were in agreement with the present study.

Higher incidence in Jamnapari breed may be because of higher population of this breed at Jabalpur district. This may also be hypothesized that body weight of Jamnapari breed of goat was higher as compared to other breed which may predispose the goats for hoof disorders.

5.1.4 Incidence based on sex

In the present study higher incidence of hoof lesions was recorded in male 19.26% than female 14.11%. Nonga et al.(2009) reported lameness in 85% male goats in comparison to 67.3% female goats. On the other hand in a study of prevalence of lameness in sheep Bokko and
Choudhary (2001) found that there was no sex predisposition to the development or manifestation of lameness and hoof disorders

Higher incidence in male may be because most of the population of male goats were kept for meat purpose and to increase the weight of animal, owner preferred high concentrate diet and stall feeding of animal, heavy weight and indoor feeding of male may be responsible for higher incidence.

5.1.5 Incidence based on housing system and floor conditions

In present study maximum hoof disorder were recorded in those animals which were kept in intensive housing system (46.43%), followed by open housing (28.57%) and semi-intensive housing system (25.00%). On the basis of floor condition incidence was more on pakka floor 62.50% and less on kachha floor 37.50%

These findings were in accordance with the finding of Christodouloupolous (2009) who stated that goats that were kept indoor for long duration housing period had resulted in overgrown hooves. Similarly Weaver (1974) concluded that introduction of animals to slatted floors overcrowding and unhygienic under foot condition promote hoof disorders in goats.

Issac (1981) also found that in free-range area, especially on rocky or gravelly terrain, little foot trimming of goats was required however foot trimming was essential in goats that were kept in small plots or backyards. In the present study higher incidence of hoof lesions was observed in intensive housing system may be because animals were kept indoor and lack of area for locomotion, overcrowding and unhygienic under foot condition. It may be predisposed hoof disorder especially for hoof overgrowth.

5.1.6 Incidence based on feeding habit

In present study maximum incidence of the hoof disorder were recorded in those animals which were kept on high concentrate diet (43.75%) followed by green leaves (33.92%) and concentrate along with green leaves
(22.33%). Amrpal et al. (2004), Khushwaha et al. (2009) and Unmack (2011) suggested that high concentrate diet was fed by goat owners to achieve rapid growth which may also be responsible for hoof disorders in the present study.

Moreover, higher incidence in concentrate fed animals may also be because most of the marginal farmers and Muslims population keep the male goats for meat and religious purpose (kurbani), they preferred high concentrate diet along with indoor feeding on hard flooring to increase the body weight. Heavy weight of the animals leads to hoof disorders. Lack of grazing area in and around Jabalpur for goats may be another reason of concentrate feeding.

5.1.7 Distribution of hoof lesions in limbs

In the present study higher incidence of hoof lesions was recorded in fore limbs (59.82%) followed by hind limb (30.35%) and all the four limbs (09.82%).

Chakrabarti et al. (1996) and Bokko and Choudhary (2001) also recorded highest incidence foot disorders in forelimbs in goat and sheep respectively. However, contradictory findings were given by Scott et.al (1999) suggesting that in goats weight distribution on fore and hind limb was equal and both the limbs have equal (50%) amount of lesion. Higher incidence of hoof lesion in the forelimbs in the present study may be attributed to the fact that forelimbs bear approximately 60% weight of animal and were more prone for disorders.

5.1.8 Lameness in various hoof lesions

In the present study lameness due to hoof disorder was mild in 46.43% goats, moderate in 30.36 % and severe in 23.21% goats. In chronic cases of hoof overgrowth and cork screw formation animals were walking on knees. Lameness because of hoof overgrowth and cork screw formation was much higher followed by traumatic injury vertical fissure and white line separation.
These finding were resembling with the finding of Bokko and Choudhary (2001), Nonga (2009) and Magasa and Arnbjerg (1993) in adult goats however Mohsina (2014) recorded less incidence of lameness in caprine presented to the Veterinary Polyclinic, Indian Veterinary Research Institute, Izatnagar during the period from January 2006 to December 2010 suffering with hoof disorders which accounted 7% only.

Lameness in the present study observed may be attributed to uneven distribution of weight of goats on the surface of sole due to lesion which leads to moderate to severe lameness. It may also possible that Untrimmed hooves grow into a variety of shapes, eventually putting unusual pressures on ligaments and tendons, causing pain and distorting their normal shape. Affected goats had difficulty in walking and might go down on their knees.

5.2 Treatment of traumatic lesions

5.2.1 Wound healing

On day 0 wound area was ranging between 455.25+50.8 to 542.50+85+77 mm$^2$ in all the groups. Size of wound reduced significantly on day 10$^{th}$ post treatment in all the groups, except sub group IIIA where non significant reduction was observed. On day 20$^{th}$ maximum reduction was observed in groups IIB where the animals were treated with neem with systemic antibiotic followed by groups IIA Neem alone. In groups IA and IB almost equivalent healing was observed, however in groups IIIA and IIIB where custard apple was applied less reduction in the size of wound was observed, though, significant difference between the groups was not observed.

Similar reduction in wound size was recorded by and Baura (2010) and Emeka (2013) in Neem treated wounds in rats. It was suggested that ethanol extract of Neem leaves increase the tensile strength of healing tissue. Ansari (2014) used 10% Zinc sulphate foot bath and parenteral antibiotic amoxicillin and cloxacillin in sheep and suggested it as the most effective treatment for foot rot.

Purohit el al. (2013) found in a study on evaluation of *Azadirachta indica* (Neem) leaves ethanolic extract for wound healing activity
through topical route on excision wound model. The activity was compared with standard drug Povidone Iodine ointment (5% w/w). *Azadirachta indica* leaves ethanolic extract was found to have better and faster wound healing effect than standard drug Povidone Iodine ointment on excision wound model which is in agreement with the findings of present study.

Himesh *et al.* (2012) suggested that cuts and found that *Annona squamosa* (custard apple) leaves have good wound healing property. Leaves of A. squamosa contain tannin and vitamin C which promotes wound healing, anti-inflammatory and insecticidal activity. It enhanced the level of hydroxyproline, hexoamine and elastin in wound, which enhanced the wound healing activity. However, slightly less healing in comparison to Neem treated wound was observed in the present study.

Maximum reduction in wound was observed in Neem leaves treated group, may be due to antibacterial and anti-inflammatory properties and slightly less healing in Custard apple leaves treated wound may be because Custard apple has more insecticidal properties in comparison to antibacterial and anti-inflammatory properties.

### 5.2.3 Wound healing percent

Neem leaves with antibiotic streptopenicillin showed 83.17% healing where as neem alone and conventional treatment with Zinc sulphate ointment and Povidone iodine with and without antibiotic showed about same healing potential. Custard apple leaves treated group showed slightly less wound healing (63.08% to 66.56%) these findings were in consonance with the findings Barua *et al.* (2010) and Pandey *et al.* (2014). Emeka *et al.* (2013) observed 72.34% wound contraction on 6th day in Neem extract treated wound which was observed 85.19% at 9th day post treatment group.

In the present study better healing in Neem treated group was observed may be due to antibacterial and antioxidant effect of Neem leaves. At the same time it may also increase epithelisation, wound contraction and tensile strength, these properties also present in Zinc sulphate, Povidone iodine and leaves of Custard apple but slightly lesser extent.
6. SUMMARY, CONCLUSION AND SUGGESTIONS FOR FURTHER WORK

6.1 Summary

Foot diseases are major causes of lameness in small ruminants and responsible for great economic losses, due to reduced forage intake, milk production, decreased reproduction rate and premature culling of animals. Sheep and goat are predisposed to lameness leads to less body weight gains by a number of factors such as hard environmental terrain, wetness of housing floor, unkempt and overgrown hoof, fracture and trauma, systemic and local microbial infection, inflammation of anatomical structures and glands. The role of predisposing factors varies depending on the age, herd size and management systems adopted by farmers.

The present research work was carried out in the Department of Surgery and Radiology, College of Veterinary Science and Animal Husbandry, Livestock Farm, Adharthal, Aamanala - Goat Farm, Nanaji Deshmukh Veterinary Science University (N.D.V.S.U.) and villages around Jabalpur, Madhya Pradesh (M.P.).

Total 714 goats were screened during study period to record incidence and identification and characterization of various hoof lesions. Out of which 24 goats irrespective of age, breed and sex suffering with wounds in hoof were selected for present study.

All the goats irrespective of age, sex, breed and etiology were randomly divided into 3 equal groups of 8 animals each. Each group was further subdivided into A and B consists of 4 animals in each sub-group. Group IA and IIB was treated zinc sulphate ointment 2.5 % and povidone iodine ointment without and with Streptopenicilline respectively. Group IIA and IIB was treated fine paste of fresh Neem leaves (Azadirachta indica) without and with antibiotic (Streptopenicilline) respectively. Group IIIA and IIIB were treated with fine paste of fresh Custard apple leaves (Annona squamosa) with and without antibiotic.
Out of 714 animals, 112 (15.68%) were found to have various hoof affections. Maximum incidence was recorded for hoof overgrowth i.e. 06.44%. Age group of 4-6 years was fond maximally (58.04%) affected. 59.82% hoof affections were recorded in fore limbs followed by hind limbs (30.35%) and both the limbs (9.82%). Male animals were more prone to hoof affections (19.26 %) than to female animals (37 %). Maximum incidence was in Jamnapari breed (43.75%) followed by Non-descript (31.25%) Barbari (13.39%) and Siroshi (11.60%). It was maximum in those animals which were kept in intensive housing system (46.43%), open (28.57%) and semi-intensive housing system (25.00%). In pakka floor (62.50%) and kachha floor (37.50%). It was maximum in high concentrate diet (43.75%) schedule followed by green leaves (33.92%) and concentrate along with green leaves (22.33%). Mild lameness was (46.43) followed by moderate (30.36%) and severe lameness (23.21%).

Fresh leaves of Neem with and without systemic antibiotic (streptopenclillin) showed significant healing on 20th post operative day followed by conventional dressing with zinc ointment and povidone iodine along with systemic antibiotic. Fresh Custard apple leaves with systemic antibiotic also showed wound healing in all the cases.
6.2 Conclusions

- Overall incidence of hoof lesions observed in the present study was 15.68%.

- Maximum hoof affections were observed in middle age jamnapari followed by nondescript goats, maintained at intensive housing system.

- Hoof overgrowth was observed 06.44% followed by traumatic lesions 03.78%. In both the disorders most of the animals showed moderate to severe lameness.

- Fresh leaves of Neem with and without systemic antibiotic (streptopencillin) showed significant healing on 20th post operative day followed by conventional dressing with Zinc ointment and Povidone iodine along with systemic antibiotic. Fresh Custard apple leaves with systemic antibiotic also showed wound healing in all the cases.
6.3 Suggestions for Further Work

- Healing properties of other medicinal plants such as turmeric, garlic, castor oil etc. can tried.
REFFERENCES


Shaw, J. and Bell, P. M. (2012). Wound measurement in diabetic foot ulceration. *Regional Centre for Endocrinology and Diabetes, Royal Victoria Hospital, Belfast United Kingdom, 5*: 71-82.


