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Therapeutic management of contagious ecthyma in goat

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Abstract
This study investigated the therapeutic management of contagious ecthyma (CE) in young goats. Clinical symptoms, prevalence rates, and treatment outcomes were analyzed. Fifty goats from different regions exhibited symptoms of CE, including scab lesions, elevated body temperatures, anorexia, weakness, and dehydration. The overall prevalence of CE was 36%, with the highest prevalence in the Beed region (62.5%). PCR analysis confirmed 18 positive cases out of 50 samples collected. CE was found to be more prevalent in kids under 4 months and bucks, with a peak during the rainy season. Hematological and biochemical analyses revealed specific changes in affected goats. Treatment trials using Amoxicillin, Aciclovir, or a combination of both showed zero mortality rates and varying recovery rates. The group treated with Aciclovir at a dose rate of 10 mg/kg in combination with Amoxicillin demonstrated the highest recovery rate. The study concluded that Aciclovir was the most effective treatment for CE in goats.

Keywords: Contagious ecthyma, goat, aciclovir, PCR

1. Introduction
In India, goats are a crucial source of income for small and marginal farmers because of their superior quality meat, milk, and leather, as well as their usefulness in weed control and land management. Maharashtra is one of the leading states in India for goat meat production and India ranks second globally for goat meat exports. Additionally, goat milk contributes 3% to the total milk production in India.

Contagious diseases of livestock are the major causes of heavy economic losses to Indian farmers amounting to billions of rupees annually. One of them is contagious ecthyma (CE). It is an acute, highly contagious, zoonotic, and economically important viral disease that affects the skin of sheep, goats and some other domesticated and wild ruminants (Nandi *et al.*, 2011) [1]. The contagious ecthyma virus is the prototype of the Parapox virus causing contagious pustular dermatitis in small ruminants (ICTV, 2022). Contagious ecthyma virus (CEV) is classified under the genus Parapox virus and family Poxviridae.

CE infects all age groups (Bouznach *et al.*, 2013; Bora *et al.*, 2016) [3, 4], irrespective of the breed and sex of the animals (Kumar *et al.*, 1974; Dar *et al.*, 2015) [5, 6]. Outbreaks of contagious ecthyma occurred mainly among lambs and kids and the prevalence is lower in older animals (Robinson *et al.*, 1981; Kandemir *et al.*, 2011) [7, 8]. It was commonly observed in young animals at the age of 3-6 months and occurs at any time of the year but is more common in summer and winter seasons (Radostits *et al.*, 2006) [9]. The morbidity rate of contagious ecthyma can vary across different age groups of animals, ranging from 8.57% to 41.43%, with some cases leading to 100% morbidity. Animals under one year of age are generally more susceptible to the disease than those aged 2-3 years or older. (Azad *et al.*, 2016) [10]

The transmission of viruses often occurs during favorable weather conditions through direct contact between infected and susceptible animals, virus can enter an animal's body through abrasions that develop around the mouth while grazing on dry hay or hard fodder (Nandi *et al.*, 2011) [1], contaminated gavage feeding tube, ear tagging and feeding raw meat carcasses of infected sheep and goats to other species of animal (Kumar *et al.*, 2015) [11]. Individuals who are at high risk of contracting the disease are those who work with animals, such as veterinarians, farmers, caregivers, and slaughterhouse employees. The condition has zoonotic implications, and it leads to the development of localized ulcerative lesions or nodules on the hands of these individuals, as stated by (Bayindir *et al.*, 2011; Bergqvist *et al.*, 2017) [12, 13].

Contagious ecthyma is identified by excessive growths on the muzzle and lips, which is commonly known as a scabby mouth. Young lambs may also be affected in the gums and tongue. There are instances where the eyelids, feet, and teats are also affected, and it could rarely spread into the respiratory tract, intestines, stomach or esophagus. The illness has a duration of 3-4 weeks and typically subsides in 1-2 months. (Chan *et al.*, 2007) [14]. Lesions were observed on the gingiva, tongue, and dental pad/hard palate, starting as small erythematous papules and progressing into larger papules that often merged together and became ulcerated in some cases. (McElroy *et al.*, 2007) [15].

Therapeutic management of sick animals with Terramycin at a dosage of 0.5mg/kg body weight l/M or oxytetracycline at a dosage of 10 ml/day J, N for five consecutive days to prevent bacterial infection. recurrence of Capri pox lesions on the udder of pregnant goats can be treated by applying Zovirax cream (5% aci clovir) topically (Carrington *et al.*, 1986) [16], use of aciclovir in CE cases (Buttner *et al.*, 2002) [17]. The eyes and nostrils of the sick animals should be washed with a 2% boric acid solution and a 1:10,000 potassium permanganate solution, respectively.

The aim of the present study is to conduct a comprehensive investigation into the clinical and epidemiological aspects of this uncommon manifestation of the disease and also determine the prevalence of the CE disease by collecting data from random cases based on geographical area, sex, age, and season from the Maharashtra state. The diagnosis of the disease was done by observing the gross lesion shown by goats during the investigation and the scab samples were collected for further confirmation of the disease by polymerase chain reaction by amplifying B2L using a specific primer. The present study also brings the complete picture of haematological and biochemical alterations in the body of infected animals. The treatment protocols were developed by using various drugs in different goats by dividing them into various groups. As CE was a neglected disease by the owners and also globally and it leads to heavy economic losses for farmers. Our study was carried out by taking into consideration making the owner aware of that and also the development of the treatment protocol which was cost-effective and also helpful to cure the CE within a short period as soon as possible.

2. Material and Methods

The present investigation was carried out in the Department of Veterinary Epidemiology and Preventive Medicine, Dept of Veterinary Microbiology and Department of Veterinary Pathology of Krantisinh Nana Patil College of Veterinary Science, Shirwal, District-Satara & College of Veterinary and Animal Science Parbhani to document the occurrence of contagious ecthyma.

The current study on contagious ecthyma (CE) outbreaks in and around Maharashtra state included determining the prevalence of CE in goats, performing haematological and biochemical analyses on blood and serum samples, confirming CE infection using polymerase chain reaction (PCR) on scab samples for the B2L gene of CE virus and therapeutic management of CE Infection in goat. A total of 190 animals were screened for characteristic CE lesions at 7 outbreaks of CE in goats in different regions of Maharashtra during 2021–22. In the present study, the 7 outbreaks taken into account took place in the talukas and villages of the districts of Beed, Satara, and Parbhani. 50 animals out of the 190 had contagious ecthyma based on lesions in and around the mouth region.

2.1 Haematological estimation

Blood was aseptically drawn into vacutainers containing EDTA, and the blood was then subjected to haematological examination using an automated haematology analyzer Abacus Junior Vet.5 (Diatron, Hungary).

2.2 Serum biochemistry

Blood was collected from 18 animals into vacutainers without anticoagulants for biochemical examination. Using an automatic biochemical analyzer (M/S Thermo Fisher Scientific Ltd., manufacturer of Konelab 20) biochemical parameters such as total protein (TP) and albumin were estimated. Globulin and A: G ratio were estimated using the values of total protein and albumin.

2.3 Viral DNA extraction

The DNA was extracted from scab materials by using Phenol: Chloroform: Iso-amyl alcohol method as described by Ramesh *et al*., (2008) with slight modifications.

2.4 PCR assay for major envelope glycoprotein B2L gene

The PCR assay was standardized using B2L gene-specific primers as per the method of Zeedan *et al.*, (2015) [18]. Protocol involves B2LF: GTCGTCCACGATGAGCAGCT, B2LR: TACGTGGGAAGCGCCTCGCT. This primer pair generates an amplicon size of 592bp. For this PCR following parameters were used Initial denaturation at 95°C for 5 min, annealing 54°for 1min and extension 72°for 7min.

2.5 Treatment of animals

Eighteen (PCR positive) goats suffering from contagious ecthyma were divided into three groups of 6 each (Group I, Group II, and Group III) Treatment protocol for three groups as Amoxicillin @5mg/kg BW I/M or S/C for group I, Aciclovir @5mg/kg BW I/V + Amoxicilline @5mg/kg BW I/M or S/C for group II and Aciclovir @10mg/kg BW I/V + Amoxicillin @5mg/kg BW I/M or S/C for group III.

3. Results and Discussion

3.1 Prevalence

The highest prevalence of contagious ecthyma was observed in the Savleshwar region at 62.5%, followed by the Shirwal region at 50% and the COVAS Parbhani goat farm region at 35.71%. The lowest prevalence was observed in the Neknoor region with 16.66%. The Awasgaon and Koregaon regions had the nearly same prevalence of 28.57% and 30%, respectively and the Wadgaon region had a somewhat higher that is 33.33%. the highest prevalence was recorded in animals below 4 months of age (44.44%) and the Pearson Chi-Square test value (X^2) revealed that a statistically significant association was observed ($p<0.05$) the highest prevalence was found in the rainy season (78.3%) as shown X^2 value statistically highly significant association was observed ($p<0.01$).

3.2 Clinical signs

In clinical manifestation, it was found that the lips, oral commissures, muzzle, and mouth all had the characteristic contagious ecthyma lesions. Some animals also exhibited

lesions in the oral mucosa, gums, dental pad, skin of the head, ears, and mucosa of the nostrils. In some animals, the lips and muzzle were almost entirely covered by a 1-2 cm thick, crust of malodorous masses. In some animals sloughing of scabs was observed leaving ulcerated haemorrhagic areas. The lesions in the oral mucosa involving gum appeared as thick proliferative growths.

3.3 Polymerase Chain Reaction

In the present study, out of 50 scab samples of a goat suspected of CE infection in the Maharashtra region, 18 samples were found to be positive by PCR. The results were strongly confirmed through the presence of CEV fragments (592 bp) as shown in below figure.

3.4 Haematological and biochemical parameters in Goats

The mean ± S.E. values of the three groups were compared with normal values of Hb in goats, it was observed that the values were decreased than normal values. The values of total erythrocyte count were decreased as compared with normal reference values, mean ± S.E. value of total erythrocyte count of group I, II and III were 9.93±0.6, 10.03±0.45 and 11.94±1.03 respectively. The findings were not significant $p<0.05$ statistically. As compared to normal values the leukocyte count was increased in our investigation (values were statistically non-significant to $p<0.05$). There was (significant $p<0.05$) neutrophilia, lymphocytopenia and eosinophilia (statistically highly significant $p<0.01$).

3.5 Biochemical alterations in contagious ecthyma-infected goats: A statistically significant association was observed ($p<0.05$). In the present investigation, the globulin value was not significantly decreased ($p<0.05$). In the present study of goats with CE infection, the A: G ratio was decreased due to a decrease in the albumin level. The value of the A: G ratio normally in the goat's body was 0.82 which was no statistically significantly changed observed ($p<0.05$).

3.6 Therapeutic management of goats positive for contagious ecthyma by PCR: The clinical trial results revealed that administering Aciclovir @10 mg/kg along with Amoxicillin @5mg/kg produced statistically highly significant at ($p<0.01$) showed better results than other treatment regimens tested, when the number of days required for resolution of clinical signs, no mortality observed and complications developed during the trial were considered.

Group I: All the goats in the study group I, goat number 1 to 6 continued to exhibit anorexia initially up to the 10^{th} days there was no new development of scab on the mouth and another part of the body after the 8^{th} day there was an animal shows starting recovery from scab lesion at the end of 17 ± 0.57 days animals were fully recovered but two animal shows diarrhoea and respiratory difficulty (33.33%). The remaining animals fully recovered without showing any clinical signs (66.66%).

Group II: All the trial group of goats displayed reduced rectal temperature, scab lesion, diarrhoea, anorexia and weakness on the 8^{th} day after treatment started, at the end of 13.41 ± 0.416 days animals fully recovered and when the clinical response was assessed the 0% mortality and 100% recovery rates, respectively, were noted.

Group III: After the course of therapy, the clinical response was assessed, and it was found that all of the research group of goats had a lower rectal temperature (102-103°F), reduced dehydration, weakness, no scab lesion was observed and diarrhoea. At the end of 10.16 ± 0.75 days, animals were fully recovered. All of the goats responded favorably to the therapy, and healing was seen. In this group, mortality and recovery rates were 0% and 100%, respectively. Chauhan *et al.* (2021) [19], stated that the kids received antibiotics (specifically Cephalosporin) to avoid any possible bacterial infections that could arise, as well as anti-inflammatory medication (Meloxicam) and an antihistamine (Pheniramine maleate) for symptom relief. Additionally, supportive therapy was administered through the provision of Vitamins B complex and Vitamin C. Iqbal *et al.* (2020) [20], observed a scabby mouth which is caused by the contagious ecthyma virus. Group A has been treated with Trisym having trimethoprim 8% w/v and sulphadiazine 14% w/v and Melonac having meloxicam 7.5mg/ml intramuscular for 5 days depicts better results than Group B has been treated with Trisym having Trimethoprim 8% w/v and Sulphadiazine 14% w/v and Phlogen having Flunixin meglumine 1mg/ml intramuscular for 5 days. Topically Somogel having Lignocaine, Eucalyptus, Alcohol, and Menthol was applied in both groups over the lesions for 10 days after washing with potassium permanganate solution as an astringent. After 10 days of topical and 5 days of systemic therapy, all goats recovered. Glutaraldehyde results in a better disinfectant as compared to Virkon, 1% Acetic acid and 2% Sodium hypochlorite. The goats with Ceftriaxone and treated with Tazobactam Injection (525mg) for five days to prevent bacterial infection with Chlorpheniramine maleate (10 mg), Meloxicam (5mg) and Inj. AD_3E (1 ml) was injected. Furthermore, a homemade topical ointment made of ghee and turmeric was recommended to manage skin lesions in goats by Choudhary *et al.* 2022) [21]. The clinical trial results showed that injectable administration of Aciclovir 10mg/kg and Amoxicillin 5mg/kg body weight produced noticeably better outcomes when compared to other treatment regimens tested. When compared to using these chemotherapeutic drugs separately, the treatment protocols given to three different treatment groups were highly significant at $p<0.01$ out of these the third treatment protocol showed early recovery within 10.16±0.75 days. The combination of Aciclovir @ 10 mg/kg and Amoxicillin@ 5mg/kg body weight was beneficial for clinical sign improvement.

Table 1: Sequence and amplicons size of the oligonucleotide (Primers)

Primer	Sequence (5'-3')	Amplicon Size
B2LF	GTCGTCCACGATGAGCAGCT	592BP
B2LR	TACGTGGGAAGCGCCTCGCT	

Table 2: PCR conditions for partial length amplification of B2L gene for 592bp product

Steps	Temperature	Time
Initial denaturation	95 °C	5 min
First 35 cycles		
Denaturation	94 °C	1 min.
Annealing	54 °C	1 min.
Extension	72 °C	1 min.
Final extension	72 °C	7 min.
End of the PCR cycling	4 °C	∞

Table 3: Overall prevalence of contagious ecthyma in goats

Total Number of Goats Tested.	Positive Samples (By PCR)	Negative Samples	Prevalence (%)
50	18	32	36%

Table 4: Treatment Protocol

Group no.	Therapeutic Protocol	Number of Cases	Duration
Group I	Amoxicillin @5mg/kg BW I/M or S/C.	6	Till Recovery
Group II	Aciclovir @5mg/kg BW I/V + Amoxicilline @5mg/kg BW I/M or S/C.	6	Till Recovery
Group III	Aciclovir @10mg/kg BW I/V + Amoxicillin @5mg/kg BW I/M or S/C.	6	Till Recovery

Table 5: Area-wise prevalence of contagious ecthyma in goats

Geographic Area	Total Number of Goats Tested (n=50)	Total Number of Positive Cases (n=18)	Prevalence %	X^2
Awasgaon	7	2	28.57	
Savleshwar	8	5	62.5	
Koregaon	10	3	30	
Neknoor	6	1	16.66	3.916^{NS}
Wadgaon	3	1	33.33	
Shirwal	2	1	50	
Parnhani farm	14	5	35.71	

NS – Non-significant, * -Significant value (p<0.05), ** - Highly significant value (p<0.01)

Table 6: Age-wise prevalence of contagious ecthyma in goats

Sr. no.	Age groups	Total samples (n=50)	No. of Positive samples (n=18)	Prevalence (%)	X^2
1	< 4 Month	36	16	44.44	3.979*
2	≥ 4 Month	14	2	14.28	

Table 7: Sex-wise prevalence of contagious ecthyma in goats.

Sr. no.	Sex	Total number of samples (n=50)	No. of Positive Samples (n=18)	Prevalence %	X^2
1	Male (bucks)	28	11	39.28	0.298^{NS}
2	Female (does)	22	7	31.81	

Table 8: Season-wise prevalence of contagious ecthyma in goats

Sr. no.	Seasons of samples collected	Total samples (n=50)	Total positive samples (n=18)	Prevalence (%)	X^2
1	Summer	10	0	0	
2	Rainy	23	18	78.3	33.01**
3	Winter	17	0	0	

Table 9: Mean ± SE values for haematology in goats having PCR-positive results for contagious ecthyma

Haematological parameter	Group I	Group II	Group III	Reference	P value
Hb (g/dl)	3.93±0.15	4.18±0.3	5.18±0.89	8-12	0.271^{NS}
Platelet(10^5/µL)	3.87±0.32	4.96±0.32	4.54±0.28	3-6	0.076^{NS}
TEC (10^6 /µL)	9.93±0.6	10.03±0.45	11.94±1.03	12-18	0.137^{NS}
TLC (×10^3 /µL)	22.36±1.41	18.11±2.04	16.25±2.61	4-13	0.137^{NS}
N (%)	$56.5±2.61^{a}$	$54±1.87^{b}$	$56.66±2.29^{b}$	30-48	0.018*
L (%)	$33.16±2.58^{b}$	$41±1.98^{ab}$	$36.66±2.04^{a}$	50-70	0.011*
E (%)	$5.83±0.75^{b}$	$1.33±0.33^{a}$	$1.33±0.42^{a}$	0-5	0.000**
M (%)	4±0.44	3±0.36	3.5±0.56	0-4	0.342^{NS}

NS – Non-significant, * -Significant value (p<0.05), ** - Highly significant value (p<0.01). References (Merck's Veterinary Manual 10th edition), platelet and TEC (references from clinical biochemistry of domestic animal, 5th edition by Kaneko

Table 10: Mean ± SE values for serum protein profile in goats with PCR-positive contagious ecthyma results

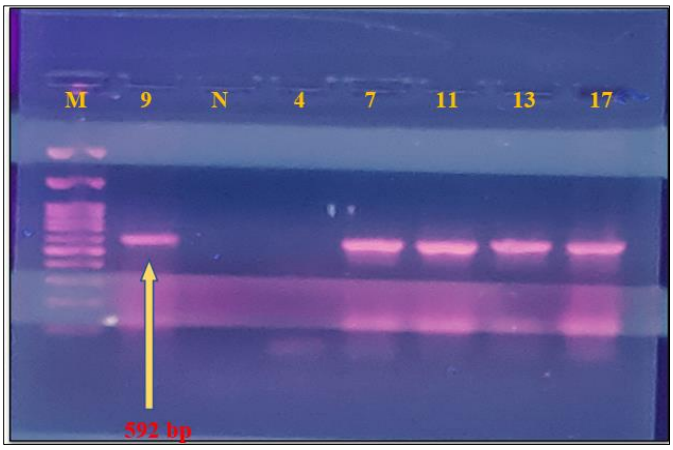
Serum protein	Group I	Group II	Group III	Reference	P value
TP	5.47±0.27	4.92±0.29	5.25±0.34	6.4-7.0	0.462^{NS}
Alb	$2.59±0.12^{b}$	$2.04±0.14^{a}$	$1.96±0.1^{a}$	2.7-3.9	0.007*
Glb	2.88±0.25	2.88±0.22	3.29±0.43	2.7-4.1	0.579^{NS}
A: G Ratio	0.93±0.09	0.72±0.06	0.66±0.12	0.63-1.26	0.174^{NS}

NS – Non-significant, * -Significant value (p<0.05), ** - Highly significant value (p<0.01). (References from clinical biochemistry of domestic animal, 6th edition by Kaneko.)

Table 11: Evaluation of the various therapeutic regimens.

Group (N=6)	Group I	Group II	Group III
Recovery (in days)	$17 ± 0.57^{c}$	$13.41 ± 0.41^{b}$	$10.16±0.75^{a}$
Complications developed	Diarrhoea and Respiratory difficulty	Nil	Nil
P value	0.000**		

NS – Non-significant, * -Significant value (p<0.05), ** - Highly significant value (p<0.01)



M Marker (100 bp), N: Negative control, Lane: 9,7,11,13 and 17 show positive samples, Lane: 4 shows negative sample

Plate 1: Positive result obtained at 592bp in PCR.

Plate 2: CE in kids with severe instances.

Plate 3: A typical case of contagious ecthyma: Before treatment and after treatment.

4. Conclusions

Goats had a 36% overall prevalence for contagious ecthyma. The age group of up to 4 months had a greater age-wise prevalence (44.44%) and bucks had a higher sex-based prevalence than does. Goats infected with contagious ecthyma showed clinical signs like scab lesions around their muzzles, lips, and nostrils as well as elevated body temperatures, anorexia, weakness and dehydration. Haemato-biochemical examination revealed that the cases confirmed by PCR showed anaemia, leucocytosis and hypoproteinaemia. Out of 50 samples processed, 18 samples tested positive for contagious ecthyma virus by PCR technique, whereas 32 were negative. Group I, II, and III each had a death rate of 0% and a recovery rate of 66.66%, 100%, and 100%, respectively. When compared to other dose rates, Aciclovir @10 mg/kg with Amoxicillin@ 5mg/kg body weight was superior and more successful in treating CE in goat

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