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Muthukumar Subramaniyan

Department of Livestock
Production Management,
Madras Veterinary College,
Tamil Nadu Veterinary and
Animal Sciences University,
Chennai, Tamil Nadu, India

Thamilvannan Thanga

Department of Livestock
Production Management,
Madras Veterinary College,
Tamil Nadu Veterinary and
Animal Sciences University,
Chennai, Tamil Nadu, India

Meenakshisundaram**Subramanian**

Department of Livestock
Production Management,
Madras Veterinary College,
Tamil Nadu Veterinary and
Animal Sciences University,
Chennai, Tamil Nadu, India

Hemalatha Sentilnayagam

Department of Veterinary
Pathology, Madras Veterinary
College, Tamil Nadu Veterinary
and Animal Sciences University,
Chennai, Tamil Nadu, India

Samuel Masilamoni Ronald B

Department of Veterinary
Microbiology, Madras Veterinary
College, Tamil Nadu Veterinary
and Animal Sciences University,
Chennai, Tamil Nadu, India

Correspondence**Muthukumar Subramaniyan**

Department of Livestock
Production Management,
Madras Veterinary College,
Tamil Nadu Veterinary and
Animal Sciences University,
Chennai, Tamil Nadu, India

Optimization of managemental strategies to control kid mortality due to neonatal enterotoxaemia in an organized goat farm (drunken kid syndrome)

Muthukumar Subramaniyan, Thamilvannan Thanga, Meenakshisundaram Subramanian, Hemalatha Sentilnayagam and Samuel Masilamoni Ronald B

Abstract

Goat production system in India has started slowly moving from traditional low input extensive to high input intensive commercial production system. One of the important limiting factors of intensive goat rearing is the high level of mortality among kids, which can affect the economic viability of commercial goat farming. A study was carried out to find the various causes of kid mortality and to optimize the management strategies to improve kid survivability in an organized goat farm under intensive system of rearing with more than 500 breedable Tellicherry does at Kancheepuram district, Tamil Nadu, India. During the study period (2014 - 2015) 52 kid mortality was recorded out of 551 live kids born and detailed necropsy was carried out. On detailed laboratory examination *Clostridium perfringens* type D was found to be the single major cause of kid mortality (65.38%) in this farm, while low birth weight, pneumonia, navel ill, cystic calculi, intussusception, round worm infestation and brain suppurative encephalitis were other causes for kid mortality. Among the different management interventions tried vaccination of ewes during last month of pregnancy and controlled nursing provided significant protection to kids from neonatal enterotoxaemia. Maximum survivability was observed in kids born to vaccinated does (98.21%) followed by control group (89.70%). In conclusion, kid mortality due to neonatal enterotoxaemia can be significantly reduced by vaccination and controlled nursing.

Keywords: kid, survivability, mortality, *Clostridium perfringens* type D, neonatal enterotoxaemia

1. Introduction

Goats (*Capra hircus*) are an important species of livestock in India, which contribute greatly to the agricultural economy, especially in areas where the crop and dairy farming are not feasible. Their role in the livelihood of a large proportion of small and marginal farmers and landless labourers are remarkable. Goat rearing has been promoted by various governmental and non-governmental organizations all over the world to mitigate rural poverty, especially in the regions of arid/semi-arid tropical environments, due to their drought-tolerant ability, browsing of wild grasses, tree buds and leaves etc. They require moderate care and reproduce quickly and start to bear kids from the age of one year old (Sundaram *et al.*, 2012) [13].

According to the 19th Livestock census (CSO 2012), the goat population in India is 135.17 million which forms 26.40% of the total livestock population. In Tamil Nadu there are 8.14 million goats which shares about 6.02% of total goat population. Goat rearing is an important enterprise not only for livelihood of weaker sections of the society but also helps in meeting nutritional requirement of farm families. Goat rearing as a micro enterprise in animal husbandry sector has considerable potential as sustainable income generating activity for the rural women since the management of goats are less labour and input intensive.

Goats provide a dependable source of income to 40% of the rural population below poverty line in India and to many who do not possess any land. At present due to scarcity of land for animal husbandry practices necessitates the farmers to adopt alternative management practices and to intensify their goat production to meet the increasing demand for chevon in the domestic as well as international markets (Elangovan, 2004) [3]. Apart from labour and cost involved in intensive farming, factors like kid mortality, feed, disease, management etc. reduce the sustainability of this farming system.

The kid mortality before weaning is the single major cause of economic loss to goat farmers, which need to be reduced by making improvements in the management strategies. The aim of the present study is to identify the causes of kid mortality and to evolve suitable management strategies to control kid mortality in commercial goat farms.

Materials and Methods

The study was carried out in a commercial goat farm with more than 500 breedable Tellicherry does. The total number of births recorded during the study period was 551 kids. The aetiology of mortality among kids that occurred during neonatal, pre-weaning and post-weaning periods was identified through detailed post-mortem examinations. The influence of several management interventions on control kid mortality were studied by grouping the does' in advance stage of pregnancy by different group viz, kidding pen, concentrate supplementation, disinfection of floor, vaccination of dam, suckling mode for which kids from another fifteen animals were taken as trail (controlled nursing) Group and studied with control (continuous) group.

Post mortem Examination

The dead kids were immediately subjected to detailed post mortem examination and samples were collected (Heart blood, liver, brain, abomasal content, fecal swab). The collected samples were subjected for isolation and identification procedure (Quinn *et al*, 2004) [11]. Apart from this for histopathological examinations samples were collected in 10% formalin. The etiological agents were isolated and identified as per standard protocol (John *et al*, 1993) [5]. For confirmatory diagnosis of *Clostridium perfringens type D* specific toxin genes are targeted by Polymerase chain reaction (PCR) as in previous studies (Miserez *et al*, 1998) [10].

Influence of specific management interventions in reducing kid mortality

To study the influence of specific management interventions in reducing kid mortality, seventy five Tellicherry does in advanced stages of pregnancy were randomly selected & allotted to four groups and subjected to various management practices. Each group consisted of fifteen does and all animals were reared under standard management conditions. The influence of different management interventions viz, kidding pen, extra concentrate feeding, disinfection of shed floor, vaccination of dam and suckling mode were also studied in relation to reducing kid mortality.

Treatment-I (Kidding pen)

The kidding pens were designed as per the ISI recommendations (1.5 X1.2 m) in which animals nearing kidding i.e. one week prior to kidding were housed individually. The pregnant does in the kidding pen were provided with ad libidum water, concentrate feed, dry and green fodder.

Treatment-II (Concentrate feeding)

The pregnant does in this group were provided with concentrate @ 500g/day during last month of gestation with 15% DCP, 70% TDN in addition to standard diet.

Treatment-III (Floor disinfection)

Commercially available glutaraldehyde based disinfectants were sprayed on the floor after dissolving 250 ml in 50 litres of water as suggested by manufacturer and applied at weekly

intervals in the pens by using compressor motor based spray machine.

Treatment- IV (Dam vaccination)

Influence of ET vaccination of dam during the last month of gestation was studied by immunizing 25 does' in advance stage of pregnancy against *Clostridium perfringens type D* vaccination.

Treatment-V (Suckling mode)

The influence of suckling mode (continuous vs controlled nursing) were also studied, for which kids from another fifteen animals were taken as trial group and studied with control group. Trial animals were allowed with dam only trice for nursing where as in continuous mode kids are always with its dam at foot.

Data analysis

The other data regarding cause of mortality & production such as birth weight, dam's weigh at kidding, milk yield (Miah *et al*, 2003) [9], litter size, age, sex and parity were also recorded. The data collected were subjected to standard statistical analysis namely Chi square analysis using Microsoft excel 2010.

Results

Identification of different factors responsible for mortality in kids

The various causes of kid mortality were tabulated in Table.1. The main contributing factor to the kid mortality (65.38%) was *Clostridium perfringens type D*. This maximum incidence of neonatal enterotoxaemia mainly depends on dam's milk yield. The Influence of dam's milk yield on kid survivability was highly significant ($\chi^2 = 13.95^{**}$). The highest kid survivability was observed in dams that produced 300 - 500 ml of milk /day (93.75%) followed by dams yielding less than 300 ml (60.61%) and those yielding more than 500 ml /day (57.95%). Increase of milk yield directly correlated with the outbreak of *Clostridial sp.* infection in the kids.

In the present study the kids affected with neonatal enterotoxaemia showed the following clinical signs viz, abomasal distension, abdominal pain, anorexia, dull and depressed, diarrhoea, ataxia and recumbency which looked like drunken stance in the early stage of the disease.

Grossly, the abomasum was extensively distended with severe serosal congestion with foul smelling and blackish contents with the presence of large chunks of curdled milk. The mucosa showed diffuse multifocal areas of black discoloration. Abomasal smear stained with Gram's stain revealed presence of abundant Gram positive rods. The intestine was ballooned empty and the mucosa was mildly congested. Kidney appeared pale and pulpy in a few cases with scattered petechial on the cortical surface. Brain showed severe congestion of meningeal blood vessels, which was a consistent finding in all cases and in one animal multifocal petechiae were seen on the base of the cerebral hemispheres (As shown in Figure 1,2,3,4).

Histologically, abomasum revealed denudation of mucosal epithelium in few areas, focal areas of haemorrhages and numerous neutrophilic and lymphocytic infiltrations in the mucosa and submucosa. Brown to black pigmentation of contents admixed with numerous clumps of rod shaped bacteria were seen in lumen. Brain showed diffuse neurophilic vacuolation with focal gliosis, perivascular

oedema and mild neuronal degeneration. Kidneys revealed diffuse cloudy swelling and vacuolar degenerative changes in tubular epithelium. The black discoloration of abomasal mucosa was due to hemosiderin pigmentation indicating haemolysis of erythrocytes caused by the action of toxin released by *Clostridium sp.* This was also evident histologically (As shown in Figure 5, 6, 7, 8, 9). Laboratory investigation was carried out from the samples acquired from abomasal contents of dead neonates and *Clostridium perfringens type D* was isolated, identified and confirmed by PCR (As shown in Figure 10). The losses due to *Clostridial sp.* infection were attributed to over consumption of milk.

Influence of specific management interventions in reducing kid mortality

The results of different treatment trials attempted were tabulated in Table-2. Maximum survivability was seen in control group followed by kids kept in the kidding pen. Similar kind of survivability was observed in the control group followed by does fed extra concentrate feed. No significant difference in survivability was observed between the sheds disinfected at weekly and monthly intervals. Treatment 4&5 revealed there was a significant influence on kid survivability.

Table 1: Causes of kid mortality

Cause of death	Number of kids died	Percentage
Low birth weight	6	11.54
Navel ill	2	3.8
Suppurative encephalitis	1	1.9
Neonatal Enterotoxemia	34	65.38
Intussusceptions	2	3.8
Round worm infestation	1	1.9
Pneumonia	3	5.8
Cystic calliculi	2	3.8
Joint ill	1	1.9
Total	52	100.00

Table 2: Specific Managerial interventions to reduce kid mortality

Parameter	χ^2 values
Kidding pen	5.36*
Extra concentrate group	6.64**
Disinfection at weekly interval	0.76 ^{NS}
Vaccination of dam	4.89*
Suckling mode	5.26*

Goat kid – 7days - Neonatal enterotoxemia



Fig 1: PM - Blackish discoloration abomasum contents

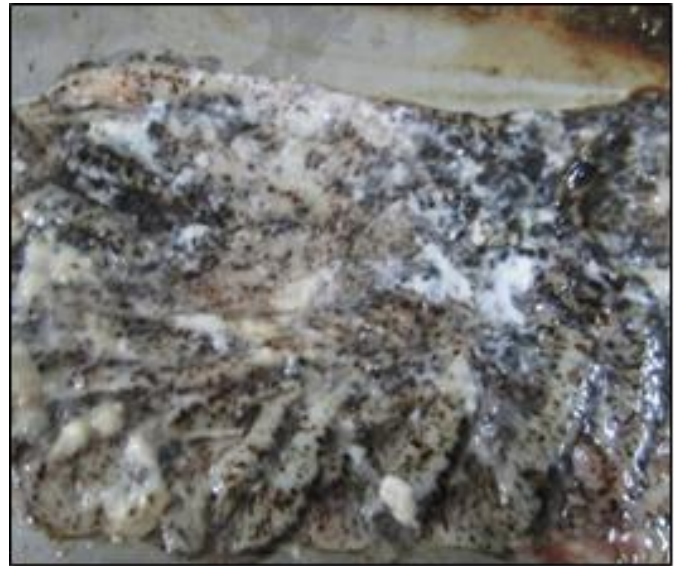


Fig 2: PM – Blackish discoloration - abomasal mucosa



Fig 3: PM - Brain –Congested blood vessels



Fig 4: PM - Kidney - diffused haemorrhage

Goat kid - 7 days - Neonatal enterotoxemia

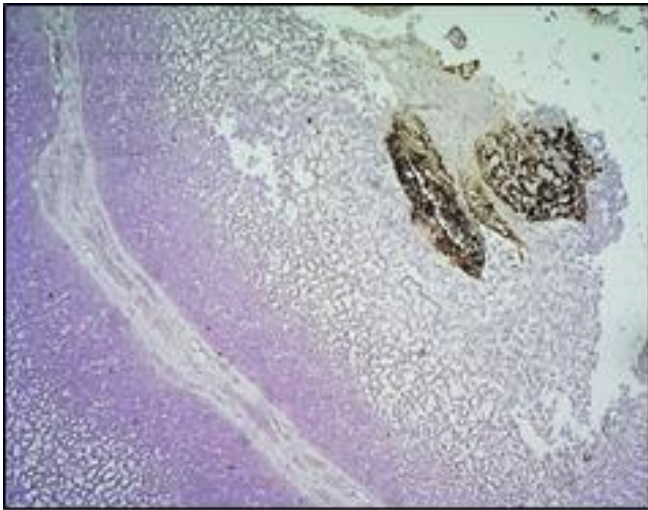


Fig 5: HP- Abomasum - black pigmentation in lumen admixed with contents - HEX100x



Fig 8: Gram's staining - G + bacilli - - Abomasal smear

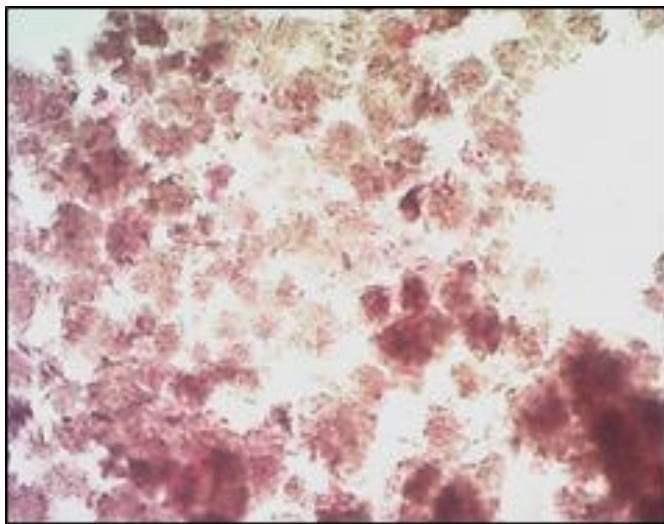


Fig 6: HP-Abomasum - bacterial clumps - brown - HEX400x

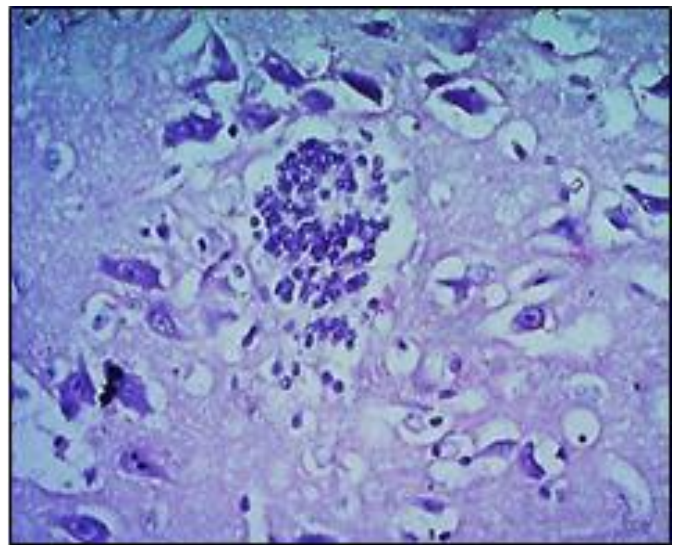


Fig 9: HP - Brain - focal gliosis - HEX400x

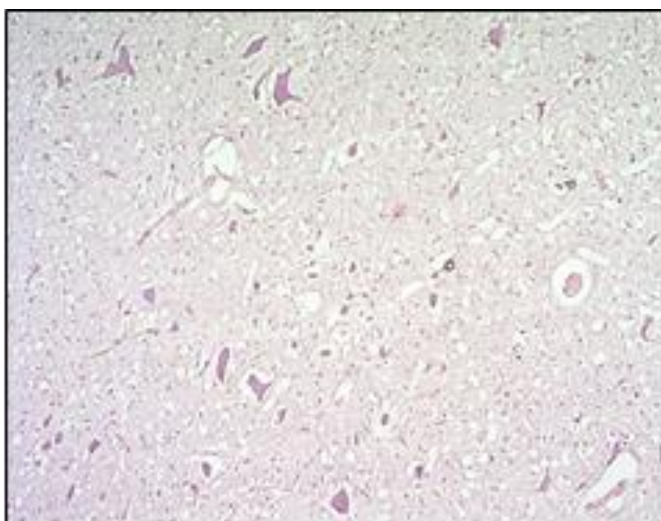
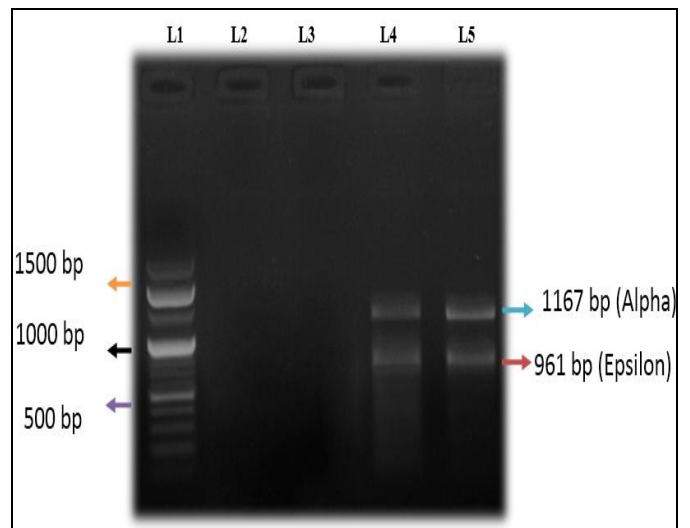


Fig 7: HP - Cerebrum - Neurophilic degeneration - & Perivascular edema - HEX100x



L1 - Ladder - 100bp, L1& L2 – Negative samples
L4 & L5 - *Cl. Perfringen*stye D positive sample (Toxin - Alpha and Epsilon)

Fig 10: PCR for Alpha & epsilon toxin - *Clostridium perfringens* type D

Discussion

Identification of different factors responsible for mortality in kids

In the present study, the major reason for the kid mortality was identified as neonatal enterotoxaemia which showed the following clinical signs viz, abomasal distension, abdominal pain, anorexia, dull and depressed, diarrhoea, ataxia and recumbency which looked like drunken stance in the early stage of the disease similar to the findings of previous studies (Correa *et al*, 2004). The clinical signs in kids affected with enterotoxaemia were observed between 4 - 28 days of age (Angell *et al*, 2013, Gulfler, 2012, and Mathew *et al*, 2014)^[1, 7]. This could be attributed to over consumption of milk combined with proliferation of *Clostridium sp.* in the abomasum. The excess amount of milk consumed favoured the growth of intestinal microbes due to milk stasis thus reducing abomasal pH, predisposing the release of toxin which resulted in toxemia and manifestation of clinical signs. The *Clostridium perfringens* type D was found to be the main contributing factor to the kid mortality (65.38%) in this farm which was also termed as floppy kid disease (Lorenz, 2009)^[6]. The reason for such high incidence of kid mortality could be due to the endemic nature of the disease in the particular flock. Intensive method of rearing would have lead to excretion and concentration of the spores in the bedding and sheds which could have been ingested by the kids leading to the enterotoxaemia.

Histologically, abomasum revealed denudation of mucosal epithelium in few areas, focal areas of haemorrhages and numerous neutrophilic and lymphocytic infiltrations in the mucosa and submucosa. Brown to black pigmentation of contents admixed with numerous clumps of rod shaped bacteria were seen in lumen. Brain showed diffuse neurophilic vacuolation with focal gliosis, perivascular oedema and mild neuronal degeneration. Kidneys revealed diffuse cloudy swelling and vacuolar degenerative changes in tubular epithelium. Similar findings as in the present study were observed in previous study (Gulfler, 2012 and Smith *et al*, 2009)^[4, 12]. This was attributed to the toxemic influence of *Clostridium perfringens* type D in the abomasum, brain and kidney. Scanty or no literatures were available in this regards. Neonatal enterotoxaemia was recorded as an important contributing factor to neonatal losses. However, some authors describe kids with similar kind of clinical signs as floppy kid disease with unknown aetiology. The second major cause of mortality is due to lower birth weight (11.54%). The reason could be attributed to the first parity. The other reasons for kid mortality include pneumonia (5.8%) of which *E.coli* was isolated which could be due to kidding during rainy season.

Influence of specific managerial interventions in reducing kid mortality

The kids kept under kidding pen showed negative pattern of survivability. This might be due to restricted physical movement and more chances to consume high quantum of milk than the other kids. The kids born to does' with extra concentrate supplemented group had negative pattern of survivability. This might be due to high milk yield by does' with supplemented concentration and consumption of more quantum of milk by kids resulted in the death. Scanty or no literatures were available in this regards. The influence of shed disinfection on kid survivability revealed no significant effect between the one disinfected on weekly basis and the one disinfected on monthly basis this might be due to deactivation of disinfectant by presence of organic matter. The other managerial packages like controlled nursing and

vaccination of dam during last month of gestation were found to improve the kid survivability; this might be due to controlled consumption of milk which was documented in the previous studies (Medeiros *et al*, 2014)^[8] and passive transfer of colostral antibodies to the neonates. This might be the first report in this kind of neonatal mortality studies.

Conclusion

Based on the findings of the present study, *Clostridium perfringens* type D was found to be the single major cause of kid mortality, due to over consumption of milk and restricted physical movements of kids because of confinement rearing. Controlled nursing of kids @ 3 times a day for 5 minutes and vaccination of dam with enterotoxaemia vaccine during last month of gestation with adequate space for physical activity for the kids is recommended for farms endemic with enterotoxaemia. Further customized managerial interventions need to be developed for each farm to control kid mortality.

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