Diarrhoeagenic *Escherichia coli* and salmonellae in calves and lambs in Kashmir: absence, prevalence and antibiogram

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**Summary**
Polymerase chain reaction assays and culture were used to investigate 728 faecal samples from 404 calves (286 diarrhoeic, 118 healthy) and 324 lambs (230 diarrhoeic, 94 healthy) in Kashmir, India, for the presence of enterotoxigenic *Escherichia coli* (ETEC), enteroaggregative *E. coli* (EAEC), diffusely adherent *E. coli* (DAEC) and salmonellae. Antimicrobial sensitivity patterns were also investigated. In total, 23 ETEC isolates were obtained from the diarrhoeic calves and 12 from diarrhoeic lambs. Most (74%) of the isolates from calves harboured the gene encoding heat-labile enterotoxin I, whereas 75% of the isolates from lambs possessed only the gene encoding for heat-stable enterotoxin a. The ETEC isolates belonged to 20 serogroups, among which serogroups O15 (five isolates) and O8 (four isolates) were the most frequent. *Salmonella Typhimurium* or *S. Enteritidis* was identified in three samples from diarrhoeic lambs. The ETEC isolates and the salmonellae showed multidrug resistance. No EAEC or DAEC was detected in any of the samples.

**Keywords**

**Introduction**

*Escherichia coli* (*E. coli*) and salmonellae are among the most important causes of diarrhoea in both animals and humans. To date, diarrhoeagenic *E. coli* strains have been divided into six pathotypes, based on the mechanisms by which they produce disease (1):

- enterotoxigenic (ETEC)
- enteropathogenic
- entero-invasive
- Shiga toxin-producing/enterohaemorrhagic
- enteroaggregative (EAEC), and
- diffusely adherent (DAEC).

Among diarrhoeagenic strains of *E. coli*, ETEC is most commonly associated with diarrhoea in calves and lambs (2, 3). These strains produce plasmid-mediated enterotoxins, namely heat-labile and heat-stable enterotoxins, encoded by the genes *elt* and *est*, respectively. There are two major subtypes of heat-labile enterotoxin, designated as LT-I and LT-II, with no cross-reactivity. Strains that express LT-I are pathogenic to both humans and animals, whereas LT-II is found primarily in animal isolates (4). Similarly, heat-stable enterotoxin has two subtypes: STa and STb. Bovine and ovine ETEC isolates usually produce STa toxin (5).

The EAEC and DAEC are increasingly recognised as emerging pathotypes responsible for acute and persistent diarrhoea in humans (6), but their reservoirs are unknown. A fragment of a 60–65 MDa virulence plasmid, referred to as DNA probe pCVD432, has been used to identify EAEC in polymerase chain reaction (PCR) assays (7). Similarly, DAEC strains can be identified in PCR, based on their afimbrial adhesive sheaths (AfAs), which are encoded by gene clusters comprising *afaA*, *afaB*, *afaC*, *afaD* and *afaE*.
(8). Whether or not animals serve as reservoirs of EAEC and DAEC remains to be determined.

The virulence of salmonellae depends upon an array of factors. For example, the chromosomally located invasion gene invA is thought to trigger the invasion of salmonellae into cultured epithelial cells (9), and the genes for Salmonella Enteritidis fimbiae (sefA) and enterotoxin of salmonellae (stin) are responsible for colonisation and secretory diarrhoea, respectively (10).

At present, antimicrobial therapy is one of the primary control measures for reducing morbidity and mortality in animals infected with diarrhoeagenic bacteria. However, prescription of antimicrobials precedes the antimicrobial sensitivity test and the indiscriminate and widespread use of these drugs, in Kashmir as elsewhere, leads to the development of resistance. It is therefore necessary to monitor the drug resistance pattern of these bacteria, both for effective treatment and to prevent the emergence of drug resistance.

Shiga toxin-producing and enteropathogenic E. coli in calves and lambs in Kashmir, India, have been isolated and characterised (11). The present study was undertaken to investigate the prevalence of ETEC and salmonellae serotypes in calves and lambs in Kashmir and to find out whether these animals serve as reservoirs for EAEC and DAEC. The antimicrobial sensitivity patterns of the isolates were also investigated.

Materials and methods

Samples

A total of 728 faecal samples from 286 calves and 230 lambs with diarrhoea and 118 calves and 94 lambs that were apparently healthy were collected between 2006 and 2009. The age of the animals ranged from newborn to three months. The calf samples came from the Cattle Research Station at Manasbal, the Veterinary Clinical Complex, Faculty of Veterinary Sciences and Animal Husbandry, at Shuhama, the Military Dairy Farm at Qamarwari and the Central Veterinary Hospital in Srinagar. The lamb samples came from the Sheep Research Station at Shuhama and two government sheep breeding farms at Goabal (Ganderbal district) and Dachigam (Srinagar district). The samples were collected in sterile, screw-capped vials and transported to the laboratory on ice.

The farms from which the samples were collected are the organised farms in Kashmir. However, the sheep migrate to highland pastures for grazing during the summer and, during migration, they come into contact with other sheep flocks in the valley, including those from the Jammu region. Furthermore, these farms supply rams to other farmers who hold 20 to 50 animals for breeding.

Isolation of *Escherichia coli* and salmonellae

Strains of *E. coli* were isolated from the faecal samples and identified as described (12). Briefly, samples were immediately inoculated into EC broth (HiMedia, Mumbai, India). After overnight incubation at 37°C, 1 ml of each culture was processed for extraction of DNA to detect the genes *elt*, *est*, *pCVD432* and *afaBC* in PCR assay. All broth cultures that tested positive by PCR for at least one virulence gene were inoculated onto MacConkey agar (HiMedia) to isolate *E. coli*. After overnight incubation at 37°C, at least five *E. coli*-like colonies were randomly picked and subcultured on eosin methylene blue agar to observe the characteristic metallic sheen of the *E. coli*. Well-separated colonies were transferred onto nutrient agar slants as pure cultures and subjected to standard morphological and biochemical tests. All *E. coli* isolates were confirmed for the presence of corresponding virulence gene/s using the PCR protocols described below.

To isolate salmonellae, 1 g to 2 g of faecal material was inoculated into 10 ml of tetrathionate broth (HiMedia) for selective enrichment of salmonellae and incubated at 42°C for 48 h before being subcultured on brilliant green agar and Salmonella Shigella agar (HiMedia). Suspected colonies of salmonellae were purified by subculture. The isolates were then subjected to standard morphological and biochemical tests to confirm their identity as salmonellae.

**Polymerase chain reaction**

The procedure for extracting bacterial DNA was as described previously (12). The PCR assays were carried out in 25 μl reaction volumes containing 1 U of Taq polymerase, 200 μmol of each dNTP and 2.5 μl of 10× PCR buffer. Reactions were performed in a GeneAmp® PCR System 2400 Thermal Cycler (Applied Biosystems, Foster City, California) and a FlexiGene® thermal cycler (Techne Inc., Princeton, New Jersey). Oligonucleotide primers were obtained from M/S Sigma Genosys (Ishikari, Hokkaido, Japan), and details of the primer sequences are given in Table I. The DNA extracted from ETEC strain V27, EAEC strain JM042 and DAEC strain V64 served as positive controls for their respective genes. Sterile distilled water was used as the negative control.

**Detection of the *Escherichia coli* genes *elt*, *est*, *pCVD432* and *afaBC**

All *E. coli* isolates were subjected to PCR assay to detect the genes *elt* (LT-I) and *est* (STa), as described previously (13). The pCVD432 probe was detected using specific primers...
(7). Each faecal sample was also screened for the gene afaBC (8) using a specific primer pair, namely, afa1 and afa2. Positive control DNA samples were incorporated into each reaction, as above.

**Molecular characterisation of salmonellae**

All salmonellae isolates were tested by genus-specific PCR assay, as described previously (14), with 16S rRNA primers, as shown in Table I. The serotype-specific PCR assay for S. Typhimurium was similar to the protocol described by Alveraz et al. (15), whereas, for S. Enteritidis, the protocol (15) was used with minor modifications to the PCR conditions as follows: initial denaturation at 94°C for 2 min, followed by 35 cycles of 95°C for 1 min, 57°C for 1 min and 72°C for 2 min. The final extension was at 72°C for 5 min.

To detect the virulence genes invA, sefA and stn, different PCR protocols were followed, as described (16, 17). The strains S. Typhimurium S-B-10829 and S. Enteritidis S-AV-11 were used as positive controls.

**Table I**

<table>
<thead>
<tr>
<th>Primer</th>
<th>Primer sequence (5’→3’)</th>
<th>Target</th>
<th>Primer concentration (μM)</th>
<th>Product size (base pair)</th>
<th>Reference</th>
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</thead>
<tbody>
<tr>
<td>LT-f</td>
<td>AGCAGGTTTCCACCGGATCACA</td>
<td>elt(LT-I)</td>
<td>0.5 each</td>
<td>132</td>
<td>(13)</td>
</tr>
<tr>
<td>LT-r</td>
<td>GTCGTCAGATCTGGTCGTC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST-f</td>
<td>TTTATTCGTTATGCTTTT</td>
<td>est(STa)</td>
<td>1.0 each</td>
<td>171</td>
<td>(13)</td>
</tr>
<tr>
<td>ST-r</td>
<td>AATACAAAGACTTCGAGCAG</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAEC-f</td>
<td>CTGGCGAAGACTGATATCTTC</td>
<td>pCVD432</td>
<td>0.125 each</td>
<td>630</td>
<td>(7)</td>
</tr>
<tr>
<td>EAEC-r</td>
<td>CAATGTATAGAAACTCCGGTTT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>afa1</td>
<td>GCTG86GACCAAAGACTGATAC</td>
<td>afaBC</td>
<td>0.5 each</td>
<td>750</td>
<td>(8)</td>
</tr>
<tr>
<td>afa2</td>
<td>CATCAGGCTTGGTCGTCGCGG</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sal-f</td>
<td>TGTTGTGTTATAAACCAGCA</td>
<td>16S rRNA</td>
<td>1.0 each</td>
<td>574</td>
<td>(14)</td>
</tr>
<tr>
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<td>CACAAATCGATCTGGAA</td>
<td></td>
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<tr>
<td>Ent-f</td>
<td>TGTGTTCTGAGCAAGAG</td>
<td>S. Enteritidis</td>
<td>0.075 0.1</td>
<td>304</td>
<td>(15)</td>
</tr>
<tr>
<td>Ent-r</td>
<td>TGAAATCGCTGTCGTTCTTCTG</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typh-f</td>
<td>GTGTACCTTTTTACCCTGAA</td>
<td>S. Typhimurium</td>
<td>0.1 each</td>
<td>401</td>
<td>(15)</td>
</tr>
<tr>
<td>Typh-r</td>
<td>CCTGAGACGGCTTAGATATT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inv-f</td>
<td>TGTTACGCTTATTTTGACCA</td>
<td>invA</td>
<td>0.2 each</td>
<td>521</td>
<td>(16)</td>
</tr>
<tr>
<td>Inv-r</td>
<td>CTGACTGCTACCTGCTGATG</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Sef-f</td>
<td>GCAGGCGTACATTTGCGAC</td>
<td>sefA</td>
<td>0.2 each</td>
<td>330</td>
<td>(16)</td>
</tr>
<tr>
<td>Sef-r</td>
<td>TGCAACGGAGATTGACC</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Stn-f</td>
<td>TTGTGCTCCTATACGTGCAACC</td>
<td>stn</td>
<td>1.0 each</td>
<td>617</td>
<td>(17)</td>
</tr>
<tr>
<td>Stn-r</td>
<td>ATT CGT AAC CGG CTC TCG TCC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Serogrouping/serotyping and antibacterial sensitivity of *Escherichia coli* and salmonellae isolates**

Three isolates of salmonellae and all the isolates of *E. coli* (one to three isolates per sample) that carried at least one virulence gene were referred to the National Salmonella and Escherichia Centre, Kasauli-173204, Himachal Pradesh, India for serogrouping (*E. coli*) or serotyping (salmonellae).

The disc diffusion technique was used to test all the ETEC and salmonellae isolates for susceptibility to 14 antimicrobial agents (HiMedia) (18). The results were recorded as ‘sensitive’ or ‘resistant’, in accordance with the Performance Standards for Antimicrobial Disk Susceptibility Tests, Clinical and Laboratory Standard Institute Guidelines. *Escherichia coli* strain ATCC 25922 and *Staphylococcus aureus* strain ATCC 25923 were used as controls.
Results

From a total of 286 samples from calves with diarrhoea, 23 ETEC isolates were obtained from 23 animals. Seventeen isolates carried the gene for LT-I alone, four carried the gene for STa, and the remaining two isolates carried genes for both LT-I and STa (Table II). The ETEC isolates belonged to 16 serogroups, two isolates were rough and one was untypeable (Table II). Serogroup O8 was predominant, with four isolates.

Similarly, 12 ETEC isolates were recovered from 12 lambs with diarrhoea. Ten isolates belonged to serogroups O15, O33, O49 and O78 and the remaining two were untypeable (Table II). Serogroup O15 was the most common with five isolates, followed by O78 with three. Two isolates carried only the gene elt for LT-I, nine carried only the gene est for STa, and the remaining O15 isolate carried both genes (Table II).

No ETEC was detected in the samples from healthy calves and lambs. Similarly, none of the samples screened in this investigation revealed the presence of EAEC or DAEC.

Three isolates of salmonellae were recovered from three other diarrhoeic lambs: two isolates were S. Typhimurium (4,12:i:1,2), the third was S. Enteritidis (9,12:g,m). None of the calf samples yielded any salmonellae.

The antibacterial sensitivity patterns of the ETEC isolates are shown in Table III. All the ETEC isolates from calves were sensitive to amikacin (100%), followed by gentamicin (83%), enrofloxacin and ciprofloxacin (74%), norfloxacin (70%), streptomycin (61%), chloramphenicol and oxytetracycline (57%), and cefotaxime and ceftriaxone (56%). Most (91%) of the isolates were resistant to co-trimoxazole, followed by ampicillin (78%), cefalexin and co-amoxiclav (amoxicillin + clavulanic acid) (74%).

Similarly, all 12 ETEC isolates from the diarrhoeic lambs were sensitive to amikacin. The majority (83%) were sensitive to gentamicin, followed by enrofloxacin and ciprofloxacin (75%), norfloxacin and ceftriaxone (67%), chloramphenicol and streptomycin (58%) and cefotaxime and oxytetracycline (50%). Most (83%) of the isolates were resistant to ampicillin and cefalexin, followed by co-trimoxazole (75%) and co-amoxiclav (67%).

The salmonellae isolates were sensitive to all antibacterials tested except ampicillin, co-trimoxazole, oxytetracycline and streptomycin. One isolate of S. Enteritidis was also sensitive to streptomycin.

Discussion

In the present study, ETEC was isolated from 8% of the diarrhoeic calves. The presence of the gene for LT-I in most (74%) of the bovine ETEC isolates is in contrast to the findings of other investigators (19), who observed that such isolates mostly produced the STa toxin. Similarly, among 25 ETEC isolates from diarrhoeic calves in Brazil, eight (32%) carried the gene encoding STa and 17 (68%) the gene
E. coli found to carry the gene for STa (26). Furthermore, only 21.73% of ETEC isolates from diarrhoeic lambs were in agreement with other reports (5), although there is very little information on the isolation of ETEC from diarrhoeic lambs in India. In contrast, in a recent report from Arunachal Pradesh, the majority (75%) of the lamb isolates is in agreement with other reports (22, 25).

The observed predominance of serogroup O8 among calf isolates (5), and strains belonging to serogroups O5 and O9 have been isolated from humans with diarrhoea (24). Strains of ETEC belonging to serogroups O8, O20 and O25 have also been isolated from humans with diarrhoea (5), and strains belonging to serogroups O5 and O9 have been isolated from children with diarrhoea in Kashmir (12). The observed predominance of serogroup O8 among calf ETEC is in agreement with other reports (22, 25).

In the present study, ETEC were also isolated from 5% of diarrhoeic calves and lambs in Kashmir, India. The presence of the gene encoding STa in diarrhoeic calves and lambs in Kashmir, India (12) and strains isolated from diarrhoeic lambs in Spain were usually non-toxigenic and belonged to a broad range of serogroups (27). The lamb ETEC isolates in the present investigation belonged to serogroups O15, O33, O49 and O78, of which serogroup O15 was the most common. Isolates of ETEC from diarrhoeic lambs in India have been reported as belonging to 14 different serogroups (26); however, none of them matched the serogroups detected in the present study. Thus, it seems that a wide range of ETEC serogroups are prevalent in lambs in India. Serogroups O15 and O78 have been reported as the most common among ETEC isolates from humans in India (28).

In the present study, the failure to isolate Salmonellae from calves indicates that the incidence of Salmonellae-induced diarrhoea in calves may be very rare in this region. This agrees with other reports from India and Mozambique (22, 31). In contrast, three isolates of Salmonellae, which have a broad host range, were obtained from the diarrhoeic lambs, apparently the first finding in lambs with diarrhoea in India.

Resistance against frequently used antibacterials, such as fluoroquinolones (norfloxacin, ciprofloxacin, enrofloxacin), oxytetracycline and streptomycin, was evident, although fluoroquinolone resistance was low compared with oxytetracycline and streptomycin, was evident, although fluoroquinolone resistance was low compared with oxytetracycline and streptomycin, perhaps reflecting their recent introduction into animal practice. The resistance of most of the calf and lamb isolates to ampicillin, co-amoxiclav, co-trimoxazole and the cephalosporins may be due to enterobacterial beta-lactamases. All the isolates were found to be sensitive to amikacin, which is seldom used in bovine and ovine practice in Kashmir.

In the present study, ETEC isolates with the gene encoding STa were detected in 16% of diarrhoeic calves in Turkey (21).

The multidrug resistance of the isolates in the present study was alarming and could be the consequence of indiscriminate use of antibacterials in clinical practice. Resistance against frequently used antibacterials, such as fluoroquinolones (norfloxacin, ciprofloxacin, enrofloxacin), oxytetracycline and streptomycin, was evident, although fluoroquinolone resistance was low compared with oxytetracycline and streptomycin, perhaps reflecting their recent introduction into animal practice. The resistance of most of the calf and lamb isolates to ampicillin, co-amoxiclav, co-trimoxazole and the cephalosporins may be due to enterobacterial beta-lactamases. All the isolates were found to be sensitive to amikacin, which is seldom used in bovine and ovine practice in Kashmir.

<table>
<thead>
<tr>
<th>Antibacterial</th>
<th>No. (%) of sensitive calf isolates</th>
<th>No. (%) of sensitive lamb isolates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampicillin</td>
<td>5 (22)</td>
<td>2 (17)</td>
</tr>
<tr>
<td>Co-amoxiclav</td>
<td>6 (26)</td>
<td>4 (33)</td>
</tr>
<tr>
<td>Cefalexin</td>
<td>6 (26)</td>
<td>2 (17)</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>13 (57)</td>
<td>8 (67)</td>
</tr>
<tr>
<td>Cefotaxime</td>
<td>13 (56)</td>
<td>6 (50)</td>
</tr>
<tr>
<td>Chloramphenicol</td>
<td>13 (57)</td>
<td>7 (58)</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>17 (74)</td>
<td>9 (75)</td>
</tr>
<tr>
<td>Enrofloxacin</td>
<td>17 (74)</td>
<td>9 (75)</td>
</tr>
<tr>
<td>Norfloxacin</td>
<td>16 (70)</td>
<td>8 (67)</td>
</tr>
<tr>
<td>Amikacin</td>
<td>23 (100)</td>
<td>12 (100)</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>19 (83)</td>
<td>10 (83)</td>
</tr>
<tr>
<td>Streptomycin</td>
<td>14 (61)</td>
<td>7 (58)</td>
</tr>
<tr>
<td>Oxytetracycline</td>
<td>13 (57)</td>
<td>6 (50)</td>
</tr>
<tr>
<td>Co-trimoxazole</td>
<td>2 (9)</td>
<td>3 (25)</td>
</tr>
</tbody>
</table>

The isolation of ETEC of serogroups O1, O8, O18, O21, O55, O101, O117 and O119 is in agreement with another report from India, in which these serogroups were isolated from diarrhoeic calves in Assam (22). The ETEC isolates belonging to serogroups O26 and O55 were also isolated from diarrhoeic mithun calves (the domesticated form of wild Gaur, Bos frontalis) in India (23). More recently, E. coli serogroups O5, O8, O20, O25 and O76 were detected in cow and buffalo calves with diarrhoea in Gujarat, India (24). Strains of ETEC belonging to serogroups O8, O20 and O25 have also been isolated from humans with diarrhoea (5), and strains belonging to serogroups O5 and O9 have been isolated from children with diarrhoea in Kashmir (12).
Conclusion

Diarrhoeic calves and lambs in Kashmir carry multidrug-resistant ETEC strains, mostly harbouring the genes encoding LT-I and STa. These animals do not serve as reservoirs for EAEC and DAEC. The study underlines the importance of emerging multidrug-resistant strains. There is considerable need for the judicious use of antimicrobials to effectively control diarrhoea in calves and lambs.

Acknowledgements

This work was supported by Grant BT/PR3886/ MED/14/492/2003 from the Department of Biotechnology, Government of India. Thanks are due to the Director of the National Escherichia and Salmonella Centre, Kasauli, India, for the serogrouping and serotyping of the isolates. Thanks also go to Dr T. Ramamurthy of the National Institute of Cholera and Enteric Diseases, Kolkata, for supplying EAEC strain O42.

Étude sur les *Escherichia coli* et les salmonelles responsables de diarrhée chez les veaux et les agneaux au Cachemire : détections, prévalences et antibiogrammes

S.A. Wani, I. Hussain, S.A. Beg, M.A. Rather, Z.A. Kabli, M.A. Mir & Y. Nishikawa

Résumé

Les auteurs décrivent une étude conduite au Cachemire (Inde) afin de déceler la présence d’*Escherichia coli* entérotoxinogènes (ETEC), d’*E. coli* entéroaggrégatives (ECEAgg), d’*E. coli* à adhésion diffuse (ECAD) et de salmonelles ; pour ce faire, 728 prélèvements fécaux provenant de 404 veaux (dont 286 atteints de diarrhée et 118 sains) et de 324 agneaux (dont 286 atteints de diarrhée et 94 sains) ont été soumis à l’épreuve d’amplification en chaîne par polymérase et à des méthodes de culture. La sensibilité à plusieurs agents antimicrobiens des bactéries identifiées a également été étudiée. Au total, 23 isolats d’ETEC ont été obtenus à partir de veaux atteints de diarrhée et 12 autres à partir d’agneaux atteints de diarrhée. La plupart des isolats issus des veaux (64 %) possédaient le gène codant pour l’entérotoxine thermolabile I, tandis que 75 % des isolats provenant d’agneaux ne possédaient que le gène codant pour l’entérotoxine thermostable a. Les isolats d’ETEC appartaient à 20 sérogroupes, parmi lesquels les plus fréquents étaient les sérogroupes O15 (cinq isolats) et O8 (quatre isolats). La présence de *Salmonella Typhimurium* ou de *S. Enteritidis* a été décelée dans trois prélèvements issus d’agneaux atteints de diarrhée. Les isolats d’ETEC ainsi que les salmonelles présentaient une pluri-résistance aux antibiotiques. Aucun échantillon ne contenait d’ECEAgg ni d’ECAD.

Mots-clés

Escherichia coli diarrogénicas y salmonelas en terneros y corderos de Cachemira: ausencia, prevalencia y antibiograma

S.A. Wani, I. Hussain, S.A. Beg, M.A. Rather, Z.A. Kabli, M.A. Mir & Y. Nishikawa

Resumen
Los autores describen un estudio en el que se analizaron por cultivo y por reacción en cadena de la polimerasa (PCR) 728 muestras fecales de 404 terneros (286 diarreicos, 118 sanos) y 324 corderos (230 diarreicos, 94 sanos) de Cachemira (India) para detectar en ellas Escherichia coli enterotoxigénica (ECET), E. coli enteroagregativa (ECEA), E. coli de adherencia difusa (ECAD) y salmonelas. También se investigaron los patrones de sensibilidad a los antimicrobianos. En total se aislaron 23 ECET en terneros diarreicos y 12 en corderos diarreicos. La mayoría (el 74%) de los microorganismos aislados en terneros contenía el gen que codifica la enterotoxina I termolábil, mientras que un 75% de los aislados en corderos poseía solo el gen de la enterotoxina a, que es termoestable. Los ECET pertenecían a 20 serogrupos, entre los que predominaban el O15 (cinco microorganismos) y el O8 (cuatro microorganismos). En tres muestras de corderos diarreicos se observó la presencia de Salmonella Typhimurium o S. Enteritidis. Los microorganismos ECET y las salmonelas presentaban múltiples farmacorresistencias. En ninguna de las muestras se detectó ECEA ni ECAD.

Palabras clave

References


