Morphological, Physio-biochemical Properties and Antiibiogram of the Clostridium chauvoei

Rubina Rais¹, Kanwar Kumar Malhi¹*, Rahmatullah Rind¹, Shahid Hussain Abro¹, Asghar Ali Kamboh¹, Chandar Kumar², Rani Abro³, Muhammad Rafique Rind⁴, Faiza Habib¹

ABSTRACT

Clostridium chauvoei is one of the deadly micro-organism that causes disease in cattle and sheep. We tested Clostridium chauvoei on different culture media, physio-biochemical agents and antibiotics. The best growth of organism was observed on blood and nutrient agar at pH 7.2-7.5, and temperature in between 37-40°C. No effect of centrifugation was observed. Fourteen different antibiotics were tested against the Clostridium chauvoei. Highly effective antibiotics were chloramphenicol, tetracycline, baquiloprim/sulphadimidine, erythromycin, gentamicin, compound sulphonamides, penicillin with 100, 93.7, 93.7, 93.5, 87.5, 87.7, and 75 % respectively. The less active drugs recorded against the species were neomycin, kanamycin, and ampicillin with 55.2, 43.7, and 62.5% respectively. The species showed resistant to lincomycin, metronidazole and bacitracin.

Keywords: Black leg, antibiotics, Pakistan, resistance, sensitive

BACKGROUND

Clostridium chauvoei is known as anaerobic, motile, Gram positive bacterium that causes black leg in cattle and sheep and which belongs to histotoxic clostria group [1]. It is known as one of the most prevalent bacteria with high mortality in cattle and sheep due to severe toxemia [2]. Organisms normally exist in the gastrointestinal tract of many ruminants [3]. The bacterial spores are present in high numbers in soil where cattle graze. The infection initiates after the ingestion of endospores by susceptible animals. The spores then pass the intestinal epithelium and enter the bloodstream to be lodged in tissues of the animal body especially in skeletal muscles. In the tissues, organisms lie latent till they become triggered and produce the disease. Certain circumstances like over exercise or injury of muscles offers optimum environment for the germination of endospores. After germination, the vegetative organisms begin to multiply, ferment muscle glycogen, digest protein and produce gas and toxins [4]. Conditions supporting germination of endospores, bacterial multiplication, and production of toxins cause development of local lesions such as hemorrhage, edema and myofibrillar necrosis. The efficiency of treatment trials on two broad spectrum antibiotics e.g. amoxicillin and oxytetracycline against black leg under field conditions reported to be proved 95% effective [5].

Keeping in view the above fact, the present study was designed to determine the morphological, physio-biochemical properties and antiibiogram sensitivity of the Clostridium chauvoei.

METHODOLOGY

Clostridium chauvoei strain

Clostridium chauvoei strain was obtained from Veterinary Research Institute, Quetta, Baluchistan and brought to the laboratory of the Department of Veterinary Microbiology, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam, Central Veterinary Diagnostic Laboratory Tandojam.

Preparation of culture media

The following Agar and Broth media were prepared and used for detailed investigation of the species of Clostridium chauvoei manufactured according to [6].

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Blood agar, Nutrient agar, MacConkey’s agar, Nitrate blood agar, Reinforced Clostridial medium broth, Nutrient broth, Brain heart infusion broth.

Isolation of Clostridium Chauvoei

The complete process of microbial analysis was performed under a sterile condition in a laminar flow to avoid contamination from environment. The collected samples were cultured on general and selective media for isolation of Clostridium Chauvoei. The blood sample was inoculated in Reinforced Clostridial Medium (RCM) broth and incubated anaerobically for 48 hours in gas pack anaerobic jar with oxyrase anaerobic sachet. Tubes containing growth of bacteria were picked and streaked by wire loop on RCM agar in sterilized petri dishes and incubated in anaerobiosis as done before. The suspected colonies were selected and picked using sterilized wire loop and sub cultured on RCM agar in order to purify the organism.

Identification of Clostridium Chauvoei

Identification and characterization of the isolates was made through the colony characteristics, hemolysis test, motility test, Gram’s staining test to observe morphological characteristics of the bacteria under microscope and various biochemical tests including Catalase, Oxidase,Indole, Methyl red, Voges-Proskauer (VP), Aesculine, Hydrogen sulphide (H₂S), Oxidation fermentation (OF), Gelatin liquefication, Urease, Nitrate reduction and Triple sugar iron (TSI) tests were performed. After identification, isolates were analyzed for in vitro antimicrobial susceptibility. [7]

Effect of physical agent on the growth of the Clostridium Chauvoei

The cells of Clostridium Chauvoei were inoculated in broth medium and incubated at temperature 37, 40, 45, 50 °C to record their survival after that, the organisms kept at higher temperatures were again cultured on nutrient agar for their growth. The organisms were grown at various pH ranges from 2-11 in nutrient broth for 24 hours and the growth of organism was analysed as a tool for the survival of the medium. The species was grown in nutrient broth, Brain heart infusion broth, Blood agar, Nutrient agar, MacConkey’s agar, Nitrate blood agar, Reinforced Clostridial medium broth, Nutrient broth, Brain heart infusion broth.

The sensitivity of Clostridium Chauvoei to various antibiotics

Antibiotic sensitivity of the organism was performed using the disk diffusion method as described by [8]. For this purpose, Muller Hinton agar plates were prepared and dried by incubating at 37°C for 30 minutes. Following antimicrobials were used: gentamicin (30ug), ampicillin (10ug), penicillin (5ug), erythromycin (10ug), chloramphenicol (30ug), tetracycline (10ug), kanamycin (5ug), neomycin (10ug), bacitracin (10ug), nitrofurantoin (300ug), baquilocrime/ sulphadimidine (25ug), metronidazole (5ug), lincomycin (5ug) and compound sulphonamides (300ug). Discs were placed over the surface of agar plate with the help of disc dispenser and slightly pressed with sterile forceps to make it adhere to the surface of the medium. The plates were closed, wrapped in aluminum foil, inverted (medium up and disc downward) and incubated for 24h at 37°C. The zones of inhibition for antimicrobial discs were observed and recorded with annotations.

RESULTS

Morphologica Properties of Clostridium chauvoei

Physio-Physio-biochemical and growth characteristics of Clostridium Chauvoei are presented in (Table 1). The cells of the species of Clostridium Chauvoei were found spindle shaped with long and short rods and arranged in single, pairs. Sometimes the species manifested as a pleomorphic in structure. The organism produced large, low convex, whitish-grey and β haemolytic with entire margin colonies on blood agar medium.

Biochemical properties of Clostridium Chauvoei

The biochemical tests were designed to record very specific nature of the species because many species of the same genus or family are morphologically very similar to differentiate them from each other. The biochemical reactions e.g. oxidase, catalase, methyl blue, methyl red, indole, Vogas proskauer, aesculine, hydrogen sulfide production, oxidation fermentation, gelatin liquefication, nitrate reduction, urease and TSI results are summarized in (Table 2).

Effect of various pH on Clostridium chauvoei

The species was grown in nutrient broth at pH that range 2-11. The organisms did not grow at pH 2-3 but slight growth was observed at pH 4. The best growth was seen at pH that ranged from 7.2-7.5. It was observed that organisms can grow at very wide range of pH (4-11). It is clear from the present investigation that organism best grow at slightly alkaline pH.
Effect of temperatures on Clostridium Chauvoei

During present study the organism of *Clostridium chauvoei* was tested for different temperatures to record its stability and viability. The bacterial cells were examined for their growth, the species grew very well at temperatures ranges from 37–45°C but failed to produce colonies on the medium at temperature 50°C and above. However, the organisms did tolerate the temperature upto 45°C.

Effect of centrifugation on Clostridium Chauvoei

The organisms of *Clostridium chauvoei* were centrifuged at rotation 1000, 2000, 3000, 4000, 4500 and 5000 rpm for 30 minutes in nutrient broth with density of 1.4g/cm³ at 4°C. No any effect of different rpm with different time periods on the cells of *Clostridium chauvoei* was observed.

Sensitivity of *Clostridium chauvoei* to different antibiotics

During this study, the susceptibility of *Clostridium chauvoei* to various antibiotics was demonstrated. Results indicated that highly effective antibiotics against the species *Clostridium chauvoei* were chloramphenicol, tetracycline, baquoloprim/sulphadimidine, erythromycin, gentamicin, compound sulphonamides, penicillin, 100, 93.7, 93.7, 93.5, 87.5, 87.7, and 75 % respectively.

The quite active drugs recorded against the species were neomycin, kanamycin, and ampicillin, and their action against *Clostridium chauvoei* demonstrated were 55.2, 43.7, and 62.5% respectively. While the species did resist to the drugs were lincomycin, metronidazole and bacitracin. (Figure-1)

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**Table 1. The morphological, cultural and staining properties of *Clostridium chauvoei***

<table>
<thead>
<tr>
<th>Shape</th>
<th>Arrangement</th>
<th>Gram reaction</th>
<th>Colony characteristics</th>
<th>Spore staining</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spindle shape with long/short rods</td>
<td>Single/pair or pleomorphic rods</td>
<td>Gram +ve but G–ve on old culture</td>
<td>Large, low convex, whitish-grew,β- haemolytic with entire margin colonies</td>
<td>Spores were not clear, they were sometimes what swollen at the centre where spore were located</td>
</tr>
</tbody>
</table>

**Table 2. Biochemical properties of *Clostridium chauvoei***

<table>
<thead>
<tr>
<th>Biochemical Test</th>
<th>CL</th>
<th>OD</th>
<th>ID</th>
<th>MR</th>
<th>VP</th>
<th>AS</th>
<th>H₂S</th>
<th>OF</th>
<th>GL</th>
<th>US</th>
<th>NR</th>
<th>TSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reaction</td>
<td>+ve</td>
<td>+ve</td>
<td>-ve</td>
<td>-ve</td>
<td>-ve</td>
<td>+ve</td>
<td>+ve</td>
<td>+ve</td>
<td>+ve</td>
<td>-ve</td>
<td>+ve</td>
<td>K/A</td>
</tr>
</tbody>
</table>

CL=Catalase, OD=Oxidase, ID=Indole, MR=Methyl Red, VP=Vogus proskauer, AS=Aesculine, H₂S=Hydrogen Sulphide, OF=Oxidation Fermentation, GL=Gelatin Liquefication, US=Urease, NR=Nitrate Reduction, TSI=Triple sugar iron

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**Figure 1: Antibiogram pattern of Clostridium chauvoei**
DISCUSSION

During present study Clostridium chauvoei was cultured on different culture media and all cultural and related behavior were recorded (Table 1) [9]. The similar characteristics was observed in PYG broth medium by Singh KP, 1991 [10]. Also recorded same morphological, staining and cultural characteristics in RCM broth medium as noted in present study. They recoded the cells of Clostridium chauvoei as pleomorphic, motile, spores, in centre and sub terminal locations. They also recorded different forms of colonies produced in different broth media.

The results regarding the various pH on the growth of Clostridium chauvoei depends on the wide range of pH. Therefore Clostridium chauvoei showed its behavior from slightly acidic to alkaline. The effect of various pH suggested that appropriate pH has major role in the normal physiological activities of bacterial organisms [11] while the physiological activity of the clostiridium chauvoei was reported at pH 8.5 [13]. The species showed abundant growth in broth and agar media at 37°C but grew poorly at 40 and 45°C, when no growth was observed at 50°C during present study. It is obvious that temperatures above 37°C slightly inhibited the growth activities of the organisms but complete inhibition of the growth of the bacterial organism could take place above 45°C.

Clostridium Chauvoei centrifuged 40000g for 20 hours mixed the CsCl to give a density 1.3g/cm³ centrifuged at 40000 for 20 hours in preparative ultracentrifuge [11]. Again it very difficult to compare present results regarding the effect of centrifugation on bacterial cell because we adopted maximum 5000 rpm for 30 minutes but they adopted higher for 20 hours. We can say that no damage to the cells was recorded during present study.

numbers of biochemical test were carried out to record the biochemical properties of Clostridium chauvoei. Merchant IA also demonstrated the same results about biochemical properties except catalase negative. Some environment factors can also play role to modify its behavioral activities.

Present study indicated that highly effective antibiotics against the species Clostridium chauvoei were chloramphenicol, tetracycline, baquilorpin/sulphadimidine, erythromycin, gentamicin, compound sulphonamides and penicillin, 100, 93.7, 93.7, 93.5, 87.5, 87.7, and 75 % respectively. The quite active drugs recorded against the species were neomycin, kananycin, and ampicillin, and their action against Clostridium chauvoei demonstrated were 55.2, 43.7, and 62.5% respectively while the species did resist to the drugs were lincomycin, metronidazole and bacitracin. It has been reported that Clostridium chauvoei was highly susceptible to chloramphenicol, clindamycin, erythromycin, penicillin G and tetracycline but they did not mention in their study about the degree of sensitivity against the species [11]. The organism responded very well to tetracycline and penicillin only [12]. The similar findings regarding Clostridium chauvoei was observed that sensitivity to penicillin, chlorotetraycline and oxytetracycline [15]. The blackleg caused by Clostridium chauvoei could be treated with penicillin and recoded highly effective against blackleg when administrated through systemically and locally into the lesions in the early stage [16].

CONCLUSION

In conclusion, Clostridium chauvoei was found spindle shaped with long and short rods and arranged in single, pairs. The organisms showed negative catalase reaction and can grow at very wide range of pH (7.6-11). The highly effective antibiotics against the species Clostridium chauvoei were are chloramphenicol, tetracycline, baquilorpin/sulphadimidine, erythromycin, gentamicin, compound sulphonamides and penicillin.

COMPETING INTERESTS

The authors declare that they have no competing interest.

AUTHORS’ CONTRIBUTION

Rubina Rais conducted the research work, Rahmatullah Rind, Rubina Rais and Kanwar Kumar Malhi designed study. Kanwar Kumar Malhi, Asghar Ali Kamboh, Shahid Hussain Abro, Rani Abro helped during research and written manuscript. Shahid Hussain Abro, Muhammad Rafique Rind, Chandar Kumar and Faiza Habib analyzed data and proofreading of manuscript.

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