Studies On Occurrence And Pathology Of Colibacillosis In Sheep (*Ovis aries*) In Jaipur Division

जयपुर संभाग में भेड़ो (*ओवीस एरीज*) में कॉलिबैसिलोसिस का आपात एवं व्याधिकी का अध्ययन

Sandeep Marodia

Thesis

Master of Veterinary Science

(Veterinary Pathology)

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Department of Veterinary Pathology
Post Graduate Institute of Veterinary Education and Research (PGIVER), Jaipur
(Rajasthan University of Veterinary and Animal Sciences, Bikaner)

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the degree of

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(Veterinary Pathology)

Faculty of Veterinary & Animal Sciences

By

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2017

Rajasthan University of Veterinary and Animal Sciences, Bikaner
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Date:
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Abbreviations

&	:	And
A/E	:	Attaching and effacing
BASH	:	Basic Animal Husbandry Statistics
°C	:	Degree Centigrade
DAEC	:	Diffusely adherents *Escherichia coli*
e.g.	:	*exampli gratia* (for example)
et.al.	:	*et alii/ Alia* (and other people)
etc.	:	*et cetera* (and other things)
E. coli	:	*Escherichia coli*
EAEC	:	Enteroaggregative*Escherichia coli*
EHEC	:	Enterohaemorrhagic *E. coli*
EIEC	:	Enteroinvasive *E. coli*
EMB	:	Eosin methylene blue
ETEC	:	Enterotoxigenic *E. coli*
EPEC	:	Enteropathogenic *E. coli*
Fig.	:	Figure
GDP	:	Gross Domestic Product
GIT	:	Gastrointestinal Tract
H&E	:	Haematoxylin and Eosin
HUS	:	Heamolytic uraemic syndrome
IHC	:	Immunohistochemistry
No.	:	Number
O	:	Somatic antigen
%	:	Per cent
PMNLs	:	Polymorphonuclear Leukocyte
Spp.	:	Species
STEC	:	Shiga toxin- producing Escherichia coli.
Stx	:	Shiga toxin
VTEC	:	Verotoxinproducing *Escherichia coli*
TNF	:	Tumor Necrosis Factor
UT	:	Untypable

1. INTRODUCTION

Animal Husbandry sector plays a crucial role in ensuring the welfare of rural population. A majority of farmers depend on Animal Husbandry for their livelihood. Livestock have been an integral component of Indian agricultural and rural economy science time immemorial, supplying energy for crop production in terms of draught power and organic manure. India livestock sector is one of the largest in the world. Livestock contributed 4% of National GDP and 26% of Agriculture GDP (BAHS 2014).

As per 19th Livestock Census, total livestock population consisting of cattle, buffalo, sheep, goat, pig, horses & ponies, mules, donkeys, camels, mithun and yak in the country is 512.05 millions. In India sheep population is estimated to be 65.06 millions that constitutes 12.71% of total livestock population in the country. Andhra Pradesh possesses maximum 40.57% of sheep population and Rajasthan stands third with 9 millions sheep (13.95%) according to19th Livestock Census (2012).

Small ruminants provide much needed livelihood support to the land less and weaker sections and hold considerable potential for commercialization. Sheep husbandry contributes significantly not only to livestock population but also for sustainable livelihood option in the country. Sheep is the life line in the arid and semiarid region of Rajasthan where crop failure is common due to drought conditions. Sheep is such an animal which in true sense act as security option and remain always ready for cash option with the farmer that's why sheep is commonly known as "Mobile Bank of farmer". Sheep have the ability to convert and diversify different types of forages into valuable products for mankind, such as mutton, milk and wool (Galal *et al.*, 2005).

In Rajasthan sheep is mainly reared for mutton and wool purpose. With a share of 30% in total wool output, Rajasthan is the leading state in wool production, followed by Karnataka, Jammu & Kashmir (17%) and Andhra Pradesh (11%) according to 12th Five Year Plan (2012-2017). Rajasthan also

ranks third in mutton production with annual production of 35000 tones (BAHS, 2014).

The importance of sheep to the socioeconomic wellbeing of people in developing countries cannot be emphasized hence it is necessary to study the diseases and syndromes that affect this species in order to enhance and sustain their productivity to meet the demand of the human population places upon them (Baker and Grey, 2004).

To obtain the maximum gain from sheep industry, it is vitally important that sheep should be reared in healthy and productive environment. Sheep may suffer from infectious and non-infectious diseases. So, diagnosis of diseases and their control will definitely improve the potential of sheep to better the national economy.

Epidemiological studies on diarrhoea in sheep have shown that colibacillosis is one of the most important causes of neonatal lamb diarrhoea that is followed by mortality and is responsible for 14-30 per cent of lamb deaths (Ahmed, 2009 and Hassan *et al.* 2017) occurring during first few days to few week of life. The disease is caused by pathogenic serotype of *Escherichia coli* (Gyles, 1992). *Escherichia coli* is a member of family *Enterobacteriaceae,* a short gram negative, rod shape, facultative anaerobic, non-spore forming motile bacillus that is commonly found in the intestine of humans and animals. According to modified Kauffman scheme, the organism is serotyped on the basis of it's somatic (O), flagellar (H) and capsular (K) surface antigens (Lior, 1996). The distribution of different serotypes of *E. coli* varies with the geographical regions and their prevalence in man and animals in a particular area. Over 700 antigenic types or serotypes of *E. coli* have been recognized based on these three antigens (Nataro and Kaper, 1998). The detection and accurate identification of *E. coli* is enormously important as the distribution of different serotypes and the prevalence in animals varies with the geographical regions (Hassan and Sheikh, 2013). Although, antibiotics are frequently used for both treatment and prevention of *E. coli* scours in lambs and calves to minimize losses (Novotna *et al*., 2005) but in recent years, the emergence of drug resistant strains following extensive and indiscriminate use

of antimicrobial agents for therapy and prophylaxis has led to loss of their efficacy (Schoenian, 2006). Resistance to almost all front line antimicrobials is demonstrated by *E. coli* isolates from lambs (Ahmed, 2010).

Thus, *Escherichia coli* can be the causative agent of several intestinal and extra-intestinal infections such as urinary tract infections, meningitis, peritonitis, mastitis, septicemia and Gram-negative pneumonia. Some *Escherichia coli* strains such as shiga toxin-producing *E. coli* (STEC) enterotoxigenic *E. coli* (ETEC), enteropathogenic *E. coli* (EPEC), enteroaggregative *E. coli* (EAEC), enteroinvasive *E. coli* (EIEC) and diffusely adherents *E. coli* (DAEC) are pathogenic and cause diarrhoea in the host (Clark, 2009, Wani *et al*., 2013).

Escherichia coli has been associated with two forms of enteric and septicemic infections. The Enteric collibacillosis may occur in animals of any age due to *E. coli* infection (Jesse *et al.*, 2016) being more commonly observed in 2 to 8 days old lambs, characterized by varying degree of diarrhoea (scours), dehydration, acidosis and death in few days. The *E. coli* scours also called “watery mouth” (Schoenian, 2007). Nonetheless, by colonization of enterotoxigenic strain of *E. coli* in the small intestine (Kahn and Line, 2005) and enteropathogenic *E. coli* (EPEC), which also known as adhering and effacing *E. coli* (AEEC) are usually the causative agent for severe diarrhoea in both kids/ Lambs and adult sheep and goat (Wani *et al.*, 2013). The septicemic form in lambs at 2 to 6 weeks of age is characterized by severe illness and rapid death (Hassan *et al.*, 2014). The septicaemic strains of *E. coli* were found to be invasive and commonly cause rapid death due to the effects of septicaemia involving multiple body systems (Sonawane *et al.*, 2012). Less severe symptoms include meningitis and arthritis (Gillespie and Timoney, 1981). Abortion attributed to *E.coli* infection was reported by Howarth (1932). This pathogen is of zoonotic importance and has potential economic implications worldwide. Mortality in sheep/lambs causes a great deal of concern to sheep breeders, leading to poor economic returns (Kumar *et al*., 2015).

Escherichia coli O157:H7 and other enterohemorrhagic *E. coli* (EHEC) are important food and water-borne zoonotic pathogens that cause diarrhoea, hemorrhagic colitis, and hemolytic uremic syndrome in humans (Karmali *et al*., 1983, Riley *et al*., 1983) and animals (Garcia, 2010, Saeed and Ibrahim, 2013).

Economic importance of colibacillosis is due to severe losses that it produces in different sectors of animal production. Therefore, there is need to study the colibacillosis, so as to gain a better understanding of this disease in Rajasthan.

In Jaipur Division of Rajasthan, few efforts have been made to study the occurrence and pathology of colibacillosis in sheep. Therefore, it becomes pertinent to analyse the colibacillosis through its gross and histopathological examination in the Jaipur Division of Rajasthan state.

The present study was carried out with the following objectives:

1. To isolate the *Escherichia coli* organism from the lesions of affected sheep.

2. To study the gross and histopathology of various types of lesions of colibacillosis in sheep.

3. To find out the occurrence of colibacillosis in sheep (*Ovis aries*) in Jaipur Division (Rajasthan).

2. REVIEW OF LITERATURE

2.1 OCCURRENCE

Chapman *et al.* (2000) reported occurrence of two cases of *Escherichia coli* O157 infection in children after visiting open farm situated in an inner city area of Sheffield, United Kingdom. Subsequently faecal samples collected from animal pens and samples of composted mixed animal manure and vegetable waste were examined. They isolated verocytotoxin-producing *E. coli* O157 strains from faecal samples from a cow, a horse, 3 breeds of pigs and 2 breeds of sheep (20).

Chapman *et al.* (2000) examined 5093 samples of raw beef and lamb products for the presence of *E. coli* O157 in south Yorkshire. The highest occurrence was found in lamb sausages and lamb burgers where *E. coli* O157 was isolated from 3 (4.1%) of 73 and 18 (3.7%) of 484 samples respectively.

Naaber *et al*. (2000) experimentally studied wister rates (n= 51) challenged with an *E.coli* isolate from the blood of a septic patient in Estonia. They concluded that bacterial translocation is the passage of variable indigenous bacteria to sterile body sites. Several factors such as bacterial overgrowth, alteration of mucosal barriers and immunosuppression promote bacterial translocation from the intestinal tract.

Kelleher and Lonnerdal (2001) reported that for young animals, colostrum deprivation is a risk factor for increased susceptibility to gastrointestinal pathogens such as *Escherichia coli.*

Payne *et al*. (2003) reported that orphan lambs which deprived of colostrum and bottle fed with milk replacer on petting farms are a known source of human infection.

Kaper *et al.* (2004) studied the pathogen whose incidences in human diseases has increased significantly over the last decade is *Escherichia coli* O157:H7.

Nagy and Fakete (2005) reported entrotoxigenic *Escherichia coli* (ETEC) infection was the most common type and significant cause of colibacillosis in young animals. Almost all ETEC bacteria were known to adhere to receptors on the small intestinal epithelium and secrete enterotoxins to reduce absorption and to increase fluid and electrolyte secretion of small intestinal epithelial cells.

Oruc (2006) concluded that pneumonia continues to be one of the most important causes of lamb morbidity and mortality in Turkey. He determined *Mannheimia haemolytica* (56.14%), *Escherichia coli* (24.56%), and *Pasteurella multocida* (10.52%) as the most important bacterial agents of lamb pneumonia, and these organisms caused different pneumonic lesion.

Radostits *et al.* (2007) showed septicemia caused by *Escherichia coli* has been the most frequently reported in lambs.

La Ragione *et al*. (2008) cleared that *Escherichia coli* O157:H7 is prevalent in small ruminants (sheep and goats) and that groups of these animals may act as effective reservoirs for this important zoonotic pathogen.

Ahmed *et al*. (2010) examined 127 faecal samples from diarrhoeic lambs in Nigeria to determine the prevalence of pathogenic bacteria causing diarrhoea and found 36.84 % samples were positive for *E. coli.*

Lamy *et al.* (2012) found that gastrointestinal tract (GIT) disorders play an important role in causing high mortality and morbidity in sheep affecting the profits in sheep production programmes.

Rahimi *et al.* (2012) examined 295 raw meat samples from beef (n= 85), camel, (n= 50), sheep (n= 62), goat (n= 60), and water buffalo (n=38) from two provinces of Iran. They found fourteen (4.7%) of the 295 samples positive for *E. coli* O157. The highest occurrence of *E. coli* O157 was found in beef samples (8.2%), followed by water buffalo (5.3%), sheep (4.8%), camel (2.0%), and goat (1.7%).

Sonawane *et al.* (2012) reported a disease outbreak in lambs caused by *Escherichia coli* O95 at an organized farm (Bikaner) in arid region of Rajasthan. 89 lambs were affected, out of which 17 (19%) died in a week with history of clinical signs such as sudden death, frothy mouth, fever, shivering, unable to walk and lying prostrate.

Ghoneim *et al.* (2014) screened a total of 461 faecal samples collected from sheep (192) goats (76) and human (93) buffalo (40), dairy cattle (86), feedlot (beef) cattle (67), in Egypt using Enzyme-linked Immunosorbent Assay (ELISA) to detect shiga toxins and then positive samples were cultured on selective chromogenic media for STEC, after that positive isolates were subjected to biochemical tests to be proved as *E. coli*. The occurrence of STEC in both sheep and goat were 2.6% and 5.4% in human samples.

Rosilawati *et al.* (2016) studied high mortality of young lambs in two sheep farms in Pekan, Malaysia over a period of 3 years. They collected samples of five vital organs (heart, lung, spleen, liver and kidney) from postmortem of 1,451 lambs below one year of age and observed *Escherichia coli* was the most commonly recorded bacteria. They reported 161 (11.09%), 120 (8.27%), and 75 (5.16%) lambs mortality in 2013, 2014 and 2015 respectively.

2.2 ISOLATION AND SEROGROUPING

Kapur *et al*. (1974) reported that gastroenteritis and pneumonia were the most important causes of mortality in 98 lambs and 14 kids over a two years period and *Escherichia coli* was the most important agent involved.

Broadbent *et al.* (1975) studied infections associated with ovine perinatal mortality and examined carcasses from 94 flocks located in Victoria. *Escherichia coli* was isolated from a majority of carcasses and in pure culture from the liver of 26 cases.

Beutin *et al.* (1993) examined 720 healthy domestic animals representing 7 different species (cattle, sheep, goats, pigs, chicken, dogs, and cats) for verotoxin (VT/ shiga like toxin) producing *E.coli* (VTEC) in Berlin,

Germany. VTEC were isolated from 208 animals (28.9 per cent), most frequently from sheep (66.6 per cent), goat (56.1 per cent) and cattle (21.1 per cent).

Munoz *et al*. (1996) investigated faecal sample from diarrhoea and non-diarrhoeic lambs and kids aged 1-45 days for enteric pathogen. *Escherichia coli* strains were isolated from 26 per cent and 22 per cent of the diarrhoeic lambs and kids, respectively.

Heuvelink *et al.* (1998) examined 52 ewes, 49 lambs at slaughter houses of the Netherland and the faecal samples were processed for the presence of verocytotoxin (VT) producing *Escherichia coli* (VTEC) of serogroup O157. They reported that *Escherichia coli* O157 strains are potentially pathogenic for humans.

Elfaki *et al.* (2000) isolated strains of enterotoxigenic *Escherichia coli* from faecal and mucosal scrapings of the large intestine of lambs with signs of the haemorrhagic diarrhoea.

Raji *et al.* (2000) isolated *Escherichia coli* 24.7 per cent in ovine, and 26.6 per cent in caprine in Zaira, Nigeria. The major bacterial agents for sheep and goats were *Escherichia coli* 72 (25.4%). Gross pathologic lesion associated with ovine pneumonia, congestion in 58 cases (33.0%) and other pathological lesions *viz.* consolidated lungs in 48 cases (27%) and the frothy exudation/oedematious lungs were lowest.

Obasi *et al.* (2001) studied 283 sheep and goats with pneumonia, the main bacteria isolated from affected ovine lungs were *Escherichia coli* (24.7%), and (26.6%) in caprine in Zaira, Nigeria.

Horii and Kobayashi (2002) Studied *E. coli* infected groups, and observed gastritis with infiltration of polymorphonuclear leukocytes (PMNLs) into the lamina propria, mucoepithelial erosions and mucoepithelial cell necrosis from 1.5 hour to 6 hour after inoculation and at 24 hour, observations included infiltration of lymphocytes into the lamina propria, extensive

mucoepithelial cell necrosis, and vasodilation and haemorrhage in the mucoepithelium.

Novotna *et al*. (2005) examined 93 rectal swabs of lambs and kids for Shiga toxin-producing *Escherichia coli* (STEC) in Jorden. They isolated in 8 of 32 diarrhoeic lambs and one sheep herd with intensive milk production.

Sharif *et al.* (2005) conducted a study to identify the risk factors that were associated with neonatal mortality in lamb and kids in Jordan. The results indicated that neonatal mortality rate within 4 weeks of age, in lamb and kids was 3.2 per cent. Diarrhoea is found to be major cause of neonatal mortality (59.75 per cent) in lamb and kids. They reported that *Escherichia coli* were the most frequent bacterial species responsible for neonatal mortality and represented 63.4 per cent of all bacterial isolates.

Sharma *et al.* (2007) analyzed a total of 100 faecal samples from 100 diarrhoeic sheep for bacteriological studies in Hisar, India. They reported *E. coli* as most predominant bacterial organism and O88 was the most prominent serotype followed by O172, O44, O2, O153, O91, O80, O25, O132, O158, O1, O3, O5, O42, O73, O101, O109, O128, O147 and O156.

Sharma and Pruthi (2008) examined 142 sheep carcasses. On postmortem examination 112 sheep revealed gastroenteritis and 24 hepatitis in Hisar. On bacteriological examination of different organs of sheep carcasses, they found *Escherichia coli* as most predominant bacterial organism in gastrointestinal tract. The *Escherichia coli* strains belonged to 14 different serotypes, of these 52.3% were of 7 serotypes O172 (7), O158 (14), O88 (17), O44 (7), O153 (17), O22 (11) and O25 (10). Other serotypes were O32 (1), O132 (2), O64 (1), O42 (5), O156 (5), O70 (1), O91 (3).

Wani *et al*. (2008) screened 338 lambs with (n = 230) and without (n = 108) diarrhoea and recovered 75 (seventy five) *Escherichia coli* isolates with at least one targeted virulence gene. Isolates belonged to 36 different serogroups. Shiga toxin-producing *E. coli* (STEC) was isolated from 9.6% of

lambs with and 24.1% of lambs without diarrhoea. Enteropathogenic *E. coli* (EPEC) was isolated from 6.1% of lambs with and 11.1% of lambs without diarrhoea.

Kiranmayi and Krishnaiah (2010) collected a total of 150 different meat samples (50 samples each of beef, mutton and chicken) and 100 meat surface swabs (50 each of beef swabs and mutton swabs) from freshly dressed and washed animal carcasses at slaughter houses and markets in Hyderabad. *Escherichia coli* O157: H7 was isolated from 12 out of 50 mutton swabs by cultural method as 24 per cent.

Purkayastha *et al.* (2010) examined 90 faecal samples, 36 from diarrhoeic and 54 from apparently healthy sheep collected from different areas in and around Bangladesh Agricultural University (BAU) campus, Bangladesh and 15 (41.67%) and 21 (38.38%) were found to be positive for *E. coli*.

Bahobail *et al.* (2012) studied a total of 153 animals (55 diseased sheep, 22 dead lambs) at Taif governorate in Saudi Arabia. Bacteriological examination revealed that *Escherichia coli* was isolated from diarrhoeic sheep in percentage of 36.36%. They isolated *E. coli* from lung, liver, spleen and intestine of dead lambs as 12 (54.55%), 15 (68.18%), 16 (72.73%), 18 (81.82%), respectively.

Kumar *et al.* (2012) collected 72 tissue samples from 30 sheep showed the gross pathological lesions of gastrointestinal tract disorders in Hisar. *Escherichia coli* was isolated from 48 samples. They reported, that the most prevalent serotype was O168 (5) followed by O60 (4), O1 (1), O91 (1), O102 (1) and O116 (1).

Omer *et al.* (2012) collected a total number of 142 specimens (74 healthy and 68 clinically sick sheep) for bacteriological examination in Gondar, Ethiopia. The isolation rate of *Escherichia coli* was 14.3% (11) and 6.7% (5) recovered from healthy and sick sheep respectively.

Tijjani *et al.* (2012) examined 500 pneumonic lungs samples from slaughtered goats in Maiduguri, North-Eastern Nigeria. The results showed that *Escherichia coli* (86.6%), was the most frequently bacterial isolate.

Arumugam *et al.* (2014) isolated colicinogenic 112 *Escherichia coli* from sheep and cow dung samples out of which 63 isolates from cow dung and 49 isolates from sheep dung samples.

Aklilu *et al.* (2013) assessed the prevalence of *E. coli* in diarrhoeal lambs in Ethiopia. They collected and processed samples from diarrhoeal lambs of different age group, result revealed 84 % of cases were positive for *E. coli*.

Shahzad *et al.* (2013) analysed faecal samples of sheep, goat, cattle, buffalo, chicken, and faeces of monkey as well as aseptically collected samples of milk and beef in Pakistan. Sorbitol-non fermenting (SNF) biotype was detected in faeces of sheep (52 %), goat (56 %), buffalo (92 %) and cattle (84 %). However, *E. coli* (SNF) was not detected in droppings of rural chickens, faeces of monkeys and fresh aseptically collected milk and beef samples.

Wani *et al.* (2013) recovered 12 ETEC isolates from 12 lambs with diarrhoea in Kashmir, India. Out of them, ten isolates belonged to serogroups O15, O33, O49 and O78 and the remaining two were untypeable.

Nasar *et al.* (2014) examined 650 fecal samples of lambs Behra Province. Examination revealed that 190 samples (29%) were positive for pathogenic bacterial culture. The isolated bacteria were *Escherichia coli* pathogenic form from 65 cases (34.20%) which was the most predominant bacterial isolate. They detected serotypes of *Escherichia coli* as O22, O55, O77, O110 and O125.

Ali (2015) screened 50 faecal samples of sheep suffering from diarrhoea in Diwanyia province and 32 isolates (64%) of *Escherichia coli*

were detected and diagnosed by routine laboratory tests. The results showed only 13 positive isolates out of 32 in PCR technique proved to carry haemolysin toxin gene (40.62%), which were characterized as Enterohemorrhagic *Escherichia coli*.

Mahouz *et al.* (2015) studied 450 sheep at Tiaret abattoir, (Algeria). Seventy (70) urine samples were taken directly from bladder for the bacteriological study while histopathologically kidney samples were taken to determine the prevalence and type of renal lesions. Bacteriological examination of urine revealed that 23 (32.8%) of urine samples show positive results in bacterial isolation including 13 (56.5%) *Escherichia coli*, 7 (30.4%) *Staphylococcus aureus* and 3 (13.1%) *Pseudomonas aeruginosa*. Prevalence rate of kidney lesions were interstitial nephritis 39 (8.6%) and glomerulonephritis 28 (6.2%), acute tubular necrosis 5 (1.1%) and renal cyst 1 (0.2%).

Akloul and Menoueri (2016) performed bacteriological analysis on 150 samples from 75 sheep in Algeria. The samples were 75 fragments of lung and 75 bronchial swabs of the same lungs with lesions. The family of *Enterobacteriaceae* represents nearly 43 per cent of the isolates included *Escherichia coli* (17.7%).

Al –Anbagi (2016) examined 42 lungs from died (10) and slaughtered sheep (32) in farm of Al Najaf province. The result of bacterial isolation appeared as *Staphylococcus aureus* 15 (46.8%), *Escherichia coli* 9 (28.1%), *Klebsiella pneumonia* 5 (15.6%) and *Staphylococcus saprophyticus* 3 (9.3%) from lung abscesses.

Tarabees *et al.* (2016) collected 19 tissue samples of liver and lung from diarrhoeic and dead lambs and goat kids in Egypt. Bacteriological examination revealed that the highest percentage of isolated bacteria was *Escherichia coli* and showed 10 of 19 (52.63%) and 6 of 19 (31.58%) positive in lung and liver samples respectively.

Ibrahim *et al.* (2016) examined 140 sheep and goat suffering from a variety of respiratory manifestations in Talkha city in Dakahilia Governorate. They collected 35 nasal swabs from diseased sheep and tissue samples from 7 emergency slaughtered sheep (7 lung and 2 liver samples). Bacteriological examination revealed that highest isolation rate was *Escherichia coli* spp. 12 isolates (23.07%).

Oscar (2016) done sampling of faeces, wool, and meat from sheep of at least six months of age, in the Kharas Region of Namibia. Sheep feces (n = 40), brisket wool (n = 40), and 150 meat samples of slaughter-age sheep were collected and tested for STEC using a combination of culture and real-time polymerase chain reaction techniques. *E. coli* O103 (5/40) and O145 (5/40) strains were isolated from the feces and *E. coli* O157:H7 was isolated from brisket wool (10/40) and flank meat (5/35).

Hassan *et al.* (2017) isolated the different strains of *Escherichia coli* from diarrhoeic lambs in Kashmir. They recovered principal serotypes of *E. coli as* O20 (10.09%), O11 (8.25%), O123, O84 and O22 (7.33% each), O107 (5.50%), O89 and O92 (3.66% each), O69 and O5 (2.75% each), O157, O15, O36, O159 and O60 (1.83% each).

2.3 PATHOLOGICAL CHANGES

Dubourguier *et al.* (1977) observed atrophy of villi, oedema and loss of epithelium as the characteristic histopathological features in the germ free lamb, which were infected by oral inoculation *Escherichia coli* from bovine.

Tzipori *et al.* (1981) observed hyperemia of mucosal vessels, distension of lacteals and infiltration of neutrophils as the characteristic pathological changes in the ileum in the gnotobiotic calves, which were inoculated orally with enterotoxigenic *Escherichia coli*.

Golovko *et al.* (1984) studied histopathological changes in experimental colibacillosis infected lamb and they found that there was depression of the functions of intestine, pancreas and the liver (blocking of

bile secretion). The toxin acted on blood vessels, resulting in oedema and petechial haemorrages.

Rao *et al.* (1985) isolated *E. coli* from heart blood, lungs and intestinal contents of cross bred lambs showing severe diarrohea in sheep breeding farm. After post-mortem examination of lambs, he observed diffuse congestion of all internal organs. Heart and spleen were oedematous and swollen. Lungs showed pneumonic lesions. The mesenteric lymph nodes were enlarged, oedematous and haemorrhagic.

Azmi and Jha (1994) conducted experimental study on pathology of induced *Escherichia coli* infection in kids. Grossly, mesenteric lymph nodes were enlarged with severely congested intestinal mucosa, petechial haemorrhage over the pericardium and lungs. Microscopically, intestine reveled desquamation of mucosal lining with infiltration of lymphocytes and macrophages in lamina propria. Liver showed focal areas of coagulative necrosis and congestion of hepatic vein. Serous and erythrocytic exudation of the alveoli with polymorphonuclear and mononuclear cells infiltration was seen in the lungs. Heart showed congestion and oedema. The kidneys showed vacuolar degeneration of convoluted tubules and intertubular blood vessels in the cortical region were highly engorged with erythrocytes.

Abou-Zaid *et al.* (2000) observed sudden death after a short period of illness in 153 of 376 newborn lambs and goat kids. Nacrotoxigenic *Escherichia coli* was detected in rectal swabs of diseased animals. Post-mortem examination showed petechial haemorrages in the epicardium, mucoid or haemorrhagic enteritis, enlarged liver and distended/engorged blood vessels on the wall of the gall bladder.

Sharma *et al.* (2003) reported the Pathomorphological changes due to colibacillosis in neonatal kids. Post mortem examination of infected kids revealed general congestion of visceral organs with or without petechiae haemorrhage over the epicardium and liver. Liver enlarged and congestion with multiple necrotic foci. Histopathologically, hepatic parenchyma showed varying degree of degenerative changes *viz.* cloudy swelling, fatty changes and necrosis of hepatocytes. Heart showed marked congestion and haemorrhages with separation and degeneration of myofibers and purkienje fibers.

La Ragione *et al*. (2006) hypothesized that colostrum deprivation and pre-infection with *Cryptosporidium parvum* predisposed young ruminants to colonization and increased shedding of *E. coli* O157 : H7. To test this, 21 lambs 5 weeks of age were divided into four groups as - (A) colostrum-deprived and inoculated with *E. coli* O157 : H7, (B) colostrum-deprived and inoculated with *C. parvum* and then *E. coli* O157 : H7, (C) conventionally reared and inoculated with *E. coli* O157 : H7, (D) conventionally reared and inoculated with *C. parvum* and then *E. coli* O157 : H7. At 24 h post-inoculation with *E. coli* O157 : H7, all lambs were shedding *E. coli* O157 :H7 in the faeces. *E. coli* O157: H7 was shed in higher numbers in the groups pre-inoculated with *C. parvum*, whether conventionally reared or colostrum-deprived. Interestingly, for the colostrum-deprived lambs on day 3, a significant difference in shedding of *E. coli* O157 :H7 was observed with the lambs inoculated with *E. coli* alone yielding higher counts than those pre-inoculated with *C. parvum*. All animals euthanized and on examination of tissues, multifocal attaching and effacing lesions were observed in the caecum, colon, rectum and at the recto-anal junction, and were confirmed by immunohistochemistry to be associated with *E. coli* O157 : H7.

Oruc (2006) detected pneumonia in 262 (35.41%) of 740 diseased or dead lambs. Pathogenic bacteria were isolated in 114 cases (14.96%) of all lamb deaths and 43.51% of all pneumonia). *Escherichia coli* isolated from lung lesions histopathologically described as acute-catarrhal bronchopneumonia (28.57%), catarrhal purulent bronchopneumonia (17.86%), purulent necrotic bronchopneumonia (3.57%), fibrinous pneumonia (25.00%) and interstitial pneumonia (25.00%).

Aldomy and Abu-zeid (2007) recorded neonatal mortality occurring within 14 days of birth in 104 sheep in Jordan. They reported that 6 (3.8%) lambs were died due to *E. coli* infection. Post-mortem signs of *Escherichia coli* septicaemia were diarrhoea, scanty amount of food in the intestine with presence of gas, patchy congestion of the lungs, enlarged liver and serofibrinous material, particularly in the synovial joint fluid from where *Escherichia coli* was isolated. They also diagnosed *Escherichia coli* toxaemia in one lamb, post-mortem examination revealed pale kidneys and pale liver, congested lungs, bloated gut with green-yellowish semifluid, enlarged greenish mesenteric lymph nodes.

Jubb *et al.* (2007) observed significant villous atrophy in *E. coli* infection. They observed mild neutrophilic infiltration in lamina propria and between bases of villi. Grossly, there were characteristic fluid content in the lumen of flaccid, small and large bowel and erosive fibrinohaemorhagic enterocolitis. Microscopically, mild patchy congestion of mucosa and blunt, atrophied and fused villi were seen in intestine. In severely bowel, the mucosa and submucosa were congested, oedematous and micro vascular thrombi might be present. In septicemic colibacillosis, congestion, thrombosis and oedema in lungs were noticed. They also found thickening of alveolar septa by mononuclear cells and neutrophils and effusion of lightly fibrinous exudate and a few neutrophils into the alveoli. In spleen, corona of neutrophils around white pulp was seen. In liver neutrophils and prominent kupffer cells were present in hepatic sinusoids. In kidneys, acute interstitial nephritis with foci of neutrophilic accumulation were present. Heart showed serosal haemorrages with serosanguinous pericardial fluid.

Mc Donald *et al.* (2007) observed, that in *Escherichia coli* infection, the small intestine is dilated, flaccid and filled with translucent yellow fluid and sometime gas, grossly. Microscopically, enteritis, serositis and cortical abscess in kidney and disrupted brush border of entrocytes were reported.

Abd El-Mottaleb and Zaki (2008) collected a total of 20 faecal samples as well as tissue specimens of 16 dead lambs suffered from haemorrhagic diarrhoea. They isolated *Escherichia coli* O157:H7 from 12 diarrhoeic lambs out of 20 (60%). In dead lambs *E. coli* O157:H7 isolated from lung, liver, kidneys, spleen, and intestine in a percentage of 9 (56.25%), 12 (75%), 15 (93.75%), 14 (87.5%), and 15 (93.75%) respectively. The post-mortem examination of infected lamb showed, congested and enlarged lungs, liver, kidneys, spleen and intestine with haemorrhagic diarrhoea in its lumen. The histopathological examination of lungs showed haemorrhage filled alveoli accompanied with lymphocytic infiltration (Haemorrhagic pneumonia) as well as destruction and sloughing of the epithelial cells lining the bronchioles, complete destruction of the endothelial cells lining the blood vessels with thrombus formation. Liver showed haemorrhage, infiltration of mononuclear inflammatory cells, fibrin deposition especially around the portal area with necrosis of some hepatocytes. Kidneys showed haemorrhage, necrosis of

epithelial cells of renal tubules, infiltration of mononuclear inflammatory cells as well as vacuolation and necrosis of the endothelial cells lining the blood vessels of the glomeruli accompanied with infiltration of mononuclear inflammatory cells inside the Bowman's capsule. Spleen was suffered from severe depletion of the lymphocytes of the white as well as accumulation of hemosidrin pigments scattered in the red bulb (indication of haemorrhage). Intestine especially the right colon was the most severely affected part which showed severe haemorrhage, oedema, atrophied villi, fibrinous to fibrinohaemorrhagic exudates were fill the intestinal lumen (Fibrinohaemorrhagic colitis), necrosis of the epithelial cells lining the intestinal glands with severe infiltration of mononuclear inflammatory cells.

Gomez *et al.* (2008) observed the lambs suffering from diarrohea attributed to non-enterotoxigenic *Escherichia coli*. They found inflammation of the intestine and ischemic injury to the digestive mucous barrier. Pathological finding were catarrhal gastroenteritis, enlargement and hyperplasia of lymphoid organs, congestion, emphysema and interstitial pneumonia in lungs, congestion and degenerative changes in hepatocytes and perivascular hepatitis in liver.

Vegad and Katiyar (2012) examined colonization of *Escherichia coli* on the surface of *E. coli* intestine. In septicemic form of colibacillosis, the lesions were polyserositis (pericarditis pleuritis, and peritonitis), meningitis, opthalmitis, and pyelonephritis, with bacterial emboli and necrotizing, purulent and fibrinous exudates.

Sastry and Rao (2012) reported that in enteric form of colibacillosis, inflammation of mucosa with loss of epithelium of small intestine occurred. Lesion were petechiae on all serous membrane, swelling of payer's patches, solitary follicles in mesenteric lymph nodes, degeneration of parenchymatous organs, catarrhal pneumonia and haemorrhages on the epicardium and endocardium. In systemic form of colibacillosis, abscesses were found in liver, lung, kidney, mesenteric, bronchial lymph gland and brain.

Sonawane *et al.* (2012) grossly observed congested and haemorrhagic lungs, blood-tinged frothy exudates in the bronchi. Liver was slightly enlarged

and congested. Kidneys were highly congested, small intestinal mucosa was congested and had mucus mixed yellowish contents. In the heart and spleen, petechial haemorrhages were observed. Histopathologically, they noted blood vessels were severely engorged with erythrocytes and inter alveolar septae were mildly thickened with fibrinous exudates and infiltration of mononuclear cells in lungs. In the liver, hydropic degeneration of hepatocytes, sinusoidal engorgement with erythrocytes and perivascular haemorrhages were seen. Kidneys showed degeneration of tubules, oedema in the pelvis and congestion in the cortical area. Intestine revealed acute enteritis characterized by infiltration of inflammatory cells predominantly neutrophils in the mucosa and congestion of blood vessels. Epicardial muscles and spleen showed extravasation of erythrocytes and engorged blood vessels.

Tehrani *et al.* (2012) grossly observed 230 liver abscesses (4.6%) in sheep. Most of the abscesses were found in diaphragmatic surface, visceral surface and right lobes of the livers. *Escherichia coli* was isolated from 25 cases (11.1%). Histologically, these lesions had a core of caseous necrosis, encircled by a zone of necrotic phagocytic cells and bacterial cells and a connective tissue capsule with calcification.

Borai *et al.* (2013) *Escherichia coli* was isolated from liver abscesses in sheep and the frequency was 24% in pure state. Grossly, abscesses up to one centimeter in diameter containing creamy viscid pus were found. Microscopically, abscesses represented by necrotic areas, infiltrated with neutrophils and surrounded with connective tissue capsule and mononuclear cells.

Kumar *et al.* (2015) isolated *E. coli* from different tissues of carcasses of sheep/lambs. Grossly, they found congestion and haemorrhages in intestine, necrotic foci in liver, hard and indurated mesenteric lymph nodes, hemorrhages and consolidation of lungs, congestion and soft kidneys as the major changes. Histopathological changes in the liver were congestion, degenerative changes in hepatocytes including cloudy swelling and fatty changes. In Lungs evidenced edema, congestion, emphysema, serous

inflammation, thickening of interlobular septa, fibrinous pleuritis and peribronchiolar lymphoid follicle formation. In kidneys, congestion, focal interstitial nephritis, hyaline degeneration and coagulative necrosis and depletion of lymphocytes in germinal center in cortex of lymph node were seen.

Madhav *et al.* (2015) grossly found single to multiple and minute to large creamy-yellow coloured abscesses of varying sizes on both parietal and visceral surfaces of liver. Histologically, the abscesses consisted of central areas of liquefactive necrosis surrounded by numerous polymorphonuclear neutrophils, few mononuclear cells, calcified centers and colonies of bacteria.

Mahouz *et al.* (2015) examined 70 kidney samples out of 450 slaughtered sheep. They observed the most common lesions such as interstitial nephritis (8.6%), glomerulonephritis (6.2%) and acute tubular necrosis (1.1%). Macroscopically kidneys were pale and hypertrophied and the cut surface was shiny. Microscopic findings revealed interstitial nephritis characterized by the edematous and an inflammatory infiltrate of lymphocytes and eosinophils in the interstitium. In glomerulonephritis lesions consisted of inflammed glomeruli characteristically very fine, small, red, dense, and uniformly distributed in the renal cortex (acute form). Endothelial cell proliferation with neutrophils in the renal glomerulus.

Vaged and Swamy (2015) reported enterotoxic colibacillosis septicemic colibacillosis in new born calves, lambs, and sometimes foals that have not received sufficient colostral immunity. Although, the lesions produced are generally those of septicemia, infection can localize in the intestine causing enteritis, fibrinous arthritis, opthalmitis, serositis, meningitis and white spotted kidney (cortical abscesses) characterize the septicemia.

Giri *et al.* (2015) detected pyogenic *Escherichia coli* from multiple hepatic abscesses in a Muzzaffarnagari sheep. Necropsy revealed multiple grayish-white, round to oval spherical nodules (2–4 cm in diameter) over the diaphragmatic, right and left lobes of liver and spleen yielding thick creamy

yellow pus upon incision. Histopathologically, severe hepatic destruction and hepatocytes as icebergs in the sea of inflammatory cells and bile duct hyperplasia were recorded.

Jesse *et al.* (2016) grossly observed thin wall indicative of necrosis and petechial haemorrhages in the mucosa of both the small and large intestine. Histopathological findings revealed infiltrations of inflammatory cells in the submucosa, loss of architecture in the Crypt of Lieberkuhn and necrosis of the Brunner's glands.

Tarabees *et al.* (2016) examined 19 tissue samples from diarroheic and dead lambs and goat kids. Histopathologically, the lungs revealed catarrhal bronchitis with hyperplasia of the epithelial lining as well as goblet cells. The surrounding pulmonary parenchyma suffered alveolar emphysema and other were filled with mucous exudates while the liver showed granuloma and sinusoidal congestion.

Ibrahim *et al.* (2016) examined 140 head of sheep and goat suffering from a variety of respiratory manifestations. They collected 35 nasal swabs from diseased sheep and tissue samples from 7 emergency slaughtered sheep (7 lung and 2 liver samples). Bacteriological examination revealed that highest isolation rate was *Escherichia coli* 12 isolates (23.07%). Grossly the lung had soft consistency, dark red with green areas on its surface and whitish to greenish pus was present while liver showed scattered whitish foci variable in diameter on its surface and deeply on its parenchyma. Cut sections revealed creamy purulent exudate and necrosed area. Microscopically, lung showed fibrinopurulent pneumonia where pulmonary alveoli filled with esinophilic fibrinous exudate obliterating it (rose shape) with neutrophilic recruitment into pulmonary tissue and necrosis of hepatic tissue.

3. MATERIALS AND METHODS

This study was conducted from November 2016 to April 2017. During this period, a total 503 sheep irrespective of age, sex, and breeds were examined. Out of these, tissue specimens from 56 sheep showing frank macroscopic lesions were used for further study.

3.1 SOURCE OF SAMPLE

The tissue specimens for proposed investigation were collected from various slaughter houses of Jaipur Division of Rajasthan. The tissue samples were also collected from the carcasses of sheep submitted to the Department of Veterinary Pathology, Post Graduate Institute of Veterinary Education and Research, Jaipur for routine post-mortem examinations. The tissues samples collected from the field veterinarians were also included in this study.

For Bacteriological study, various tissue samples were collected aseptically and then the isolation of *Escherichia coli* organism was carried out in the Department of Veterinary Microbiology and Biotechnology, Post Graduate Institute of Veterinary Education and Research, Jaipur.

3.2 METHOD OF BACTERIOLOGY

3.2.1 Isolation and Identification of *Escherichia Coli* from Sheep

Escherichia coli isolation was carried out as on the method described by Cown and Steel (1975), the samples were collected aseptically and streaked on Mac-Conkey agar incubated at 37°C for 24 hours as early as possible for selective isolation of *E. coli*. Further, all suspected single lactose fermenting pink colony were picked up and pure on nutrient agar. After purification, each suspected isolate were be checked for metallic sheen on Eosin Methylene Blue agar to confirm as *E. coli*.

The phenotypically confirmed isolates were characterise for primary and secondary identification tests such as oxidase test, catalase test, IMViC (Indole production, Methyl Red, Voges Proskauer and Citrate utilization test) pattern as per the method described by Quinn *et al.* (1994).

3.2.2 Serotyping

Out of 149 confirmed *Escherichia coli* isolates, random 35 isolates were sent to National Salmonella and Escherichia Centre, Central Research Institute, Kasouli- 173204, Himachal Pradesh, India for serotyping on the basis of their "O" antigen.

3.3 METHOD OF HISTOPATHOLOGY

3.3.1 Collection of Tissue Sample for Histopathology

The various tissue samples of sheep showing frank macroscopic lesions were collected and preserved in the 10 per cent formal saline after recording gross observation.

3.3.2 Histopathology

The tissue samples were be processed mechanically for paraffin embedding by Acetone and Benzene technique (Lillie, 1965 and Bancroft *et al.,* 1996). The sections of 4-6 micron thickness were cut and stain with haematoxylin and eosin method of staining as routine**.**

The entire works were carried out in the Post Graduate Institute of Veterinary Education and Research, Jamdoli, Jaipur (Rajasthan).

4. RESULTS AND DISCUSSION

Cases of natural and experimental enteric colibacillosis have been reported frequently in small ruminants. *Escherichia coli* has been recognized as a major cause of large scale epidemics of gastrointestinal illness in animals and man (Deshmukh and Karpe, 2006). Sheep and goats are known to harbour not only strains pathogenic to animals but also strains which cause asymptomatic infections in animals and which can pass through the food chain to cause clinical disease in man (Arshad *et al.*, 2006).

In the present study, a total number of 503 sheep were examined. Different organs of 56 sheep showed frank macroscopic lesions were processed for bacteriological examination *viz* isolation, identification, characterization and serotyping and histopathological examination. The results recorded were as follows:

4.1 OCCURRENCE OF COLIBACILLOSIS

In the present investigation, a total number of 503 sheep were examined. Out of these, 56 cases were positive for colibacillosis. Thus, an overall occurrence of colibacillosis was recorded as 11.13 per cent. Nearly similar results have also been reported by Rosilawati *et al.* (2016) as 11.09 per cent in lambs in sheep farms in Pekan, Malaysia. A lower occurrence was observed by Aldomy and Abu Zeid (2007) as 3.8 per cent in lambs in Jorden, Rosilawati *et al.* (2015) as 5.16 per cent and 8.27 per cent (2014) in lambs. However, higher occurrence was recorded by Sonawane *et al.* (2012) as 19 per cent in lambs at an organized farm (Bikaner) in arid region of Rajasthan, Munoz *et al*. (1996) as 26 per cent in lambs in Castillaleon (North West Spain) and Bahobail *et al.* (2012) as 36.36 per cent in sheep/lambs in Saudi Arabia.

Whatever differences exists in the occurrence of colibacillosis in sheep/lambs in Rajasthan and other parts of India/world may be influenced by many factors. It can be attributed to possible variation in the nutritional status, stress factor, management practices (Sonawane *et al.*, 2012 and Tehrani *et al.*, 2012) immune system status (Omer *et al.*, 2012 and Aklilu *et al.*, 2013) hormonal changes (Kumar *et al.*, 2015) and transportation (Al–Anbagi 2016).

Differences in the geography and climate are also supposed to play their role in these variations (Raji *et al.,* 2000 and Sonawane *et al.,* 2012) and even lack of implementation of proper preventive and control measures (Aklilu *et al.*, 2013).

4.2 ISOLATION OF BACTERIA

The isolation and identification of bacteria (*Escherichia coli*) were carried out from various tissue samples of intestine, mesenteric lymph nodes, liver, lung, heart, kidney and spleen. Out of total 149 *E. coli* isolates, 40 were obtained from intestine, 21 from mesenteric lymph nodes, 20 from liver, 21 from lung, 20 from kidney, 15 from heart and 12 were obtained from spleen. These were categorized in below table as follows:

Table-I: Table showing the percentage frequency of occurrence and tissue samples of different organs of sheep affected by *Escherichia coli* infection:

S. No.	Name of Organ	No. of Samples Processed	No. of Isolates Obtained	Percent (%)
1.	Intestine	56	40	71.42
2.	lymph node	56	21	37.50
3.	Liver	56	20	35.71
4.	Lung	56	21	37.50
5.	Heart	56	15	26.78
6.	Kidney	56	20	35.71
7.	Spleen	56	12	21.42
Total			**149**	

Characteristic pink coloured and lactose fermenting colonies on MacConkey agar were contingently considered as *Escherichia coli* (Fig. 1). The bacteria subcultured on Eosine Methylene Blue (EMB) agar plates resulted into colonies exhibiting greenish metallic sheen, a characteristic feature of *Escherichia coli* (Fig. 2). Followed by Catalase and Methyl red reactions positive (Fig. 3 and Fig. 4) and Citrate test negative (Fig. 5).

Table-II: Biochemical tests of *Escherichia coli* isolates:

Biochemical Tests	**Results**
Mac-Conkey Agar	Lactose fermenting pink colonies
Eosine Methylene Blue	Metallic sheen
Gram reaction	Gram negative
Morphology	Bacilli
Catalase	Positive
Indole Test	Positive
Methyl Red Test	Positive
Voges-Proskauer Test	Negative
Citrate Test	Negative
Oxidase Test	Negative

In present investigation, tissue samples of different organs were collected aseptically from the slaughtered sheep and the organism was isolated and identified as *Escherichia coli* based on the colony characteristics and primary and secondary identification tests as described by Cowan and Steel (1975) and Quinn *et al.* (1994). The result were in line with those found by Rao *et al*. (1985), Sonawane *et al.* (2012), Omer *et al.* (2012), Wani *et al*. (2013), Borai *et al.* (2013), Nasar *et al.* (2014), Giri *et al.* (2015), Madhav *et al.* (2015), Kumar *et al.* (2015), Akloui and Menoueri (2016) and Roslilawati *et al.* (2016).

4.3 SEROTYPING

In the present study, out of 149 isolates, random 35 isolates got serotyped at National Salmonella and Escherichia Centre, Kasauli. Out of 35 isolates 26 were serotyped for “O” antigen whereas five were rough and remaining four were untypable isolates. The most frequent serotype was O22 (8) followed by O115 (6) O88 (3), O20 (2), O49 (2), O119 (2) O1 (2) and O157 (1). O22 serotype was recovered from lymph node, liver, lung, heart and spleen samples as 30.76 per cent, O115 serotype from intestine, lymph node,

liver, lung and heart as 23.07 per cent, O88 serotype from heart, kidney and spleen as 11.34 per cent, O20 serotype from lymph node and spleen as 7.69 per cent, O49 serotype from liver and kidney as 7.69 per cent, O119 serotype from lung and heart as 7.69 per cent, O1 serotype from intestine and heart as 7.69 per cent and O157 from lung as 3.84 per cent.

Table-III: Organ-wise distribution of *E. coli* serotypes isolated from slaughtered sheep:

Serotypes	Intestine	Mesenteric Lymph Node	Liver	Lung	Heart	Kidney	Spleen
O22	-	1	1	2	2	-	2
O115	1	1	2	1	1	-	-
O88	-	-	-	-	1	1	1
O20	-	1	-	-	-	-	1
O49	-	-	1	-	-	1	-
O119	-	-	-	1	1	-	-
O1	1	-	-	-	1	-	-
O157	-	-	-	1	-	-	-
UT		-	2	1	-	-	1
Rough	1	-	2	1	1	-	-

UT = Untypable

All of the serogroups obtained in present study have earlier been reported elsewhere. Serotypes O115, O88, O20, O49, O119, O1 and O157 have been reported by Clark (2009) from bovines faeces and from humans while Nataro & Kaper (1998) and Scheutz & Strockbine (2001) from humans. Serogroup O157 was earlier reported by Hassan *et al.* (2017) from diarrhoeic lambs in Kashmir, Wani *et al.* (2003) from diarrhoeic lambs in Kashmir, Heuvelink *et al.* (1998) from faecal samples of sheep in Netherland, Chahed *et al.* (2015) from sheep faecal samples in Algeria. Serogroup O22 was reported by Sharma and purthi (2007) from diarrhoeic sheep in Hissar, India, Nasar *et al.* (2014) from diarrhoeic lambs in Bhera province, Egypt, Kumar *et al.* (2015) from diarrhoeic sheep in Hisar, India, and by Hassan *et al.* (2017) from diarrhoeic lambs in Kashmir. Serotype O115 was earlier reported by Wani *et al.* (2003) from diarrhoeic calves and lambs in India and by Clark (2009) from bovines

faeces. Serotype O88 was earlier reported by Kumar *et al.* (2015) from diarrhoeic sheep/lamb in India and by clark (2009) from bovines faeces. Serotype O20 was earlier reported by Wani *et al.* (2003) from diarrhoeic lambs and Hassan *et al.* (2017) from diarrhoeic lambs in Kashmir. Serotypes O1 earlier reported by Wani *et al.* (2013) from diarrhoeic lambs and calves in Kashmir and Kumar *et al.* (2012) from diarrhoeic lambs in Hisar, India. O49 and O119 were earlier reported by Wani *et al.* (2013) from diarrhoeic lambs and calves in Kashmir.

In the present study, possible role of these serotypes in causing pathomorphological effect on various cadaver organs viz intestine, liver, mesenteric lymph nodes along with lesions on lungs, spleen, kidneys, and heart in sheep are in agreement with the finding described by Kumar *et al.* (2012) and Kumar *et al.* (2015). These findings could be because of seasonal variation, diet, different source of sampling, errors in colostrum feeding, inefficient production of antibodies, resistance of *E. coli* for different drugs, different environmental conditions and difference within serovars of *Escherichia coli*. Moreover, it might be due to spontaneously induced genetic mutation or the acquisition of resistance genes from other bacterial species by horizontal gene transfer via conjugation, transduction, or transformation, therefore infection flare up (Kumar *et al.,* 2012 and Kumar *et al.,* 2015).

4.4 PATHOLOGICAL STUDIES

The tissue samples collected for gross and histopathology were examined and the lesions recorded were as follows:

4.4.1 Intestine

Pathological conditions were observed in 40 cases (71.42%) of intestine in the present study. A relatively lower occurrence was reported by Nasar *et al.* (2014) as 20 per cent in lambs and higher occurrence was reported by Aklilu *et al.* (2013) as 84 per cent in sheep and El-Mottaleb and Zaki (2008) as 93.75 per cent.

Grossly, the intestine mucosa was thickened, mucinous and petechiae haemorrhagic (fig. 6) and in few cases, severely congested blood vessels were

observed in intestine (fig. 9). Above findings in intestine were in agreement with Rao *et al*. (1985), El-Mottaleb and Zaki (2008), Sonawane *et al.* (2012) in lambs and Kumar *et al.* (2015) in sheep/lambs, Aldomy and Abou-Zaid *et al.* (2007) in lambs and kids, Azmi and Jha (1994) in kids and Jesse *et al.* (2016) in *E. coli* infected adults doe and Jubb *et al.* (2007) in infected ruminants.

These manifestations reflect that enterotoxigenic *Escherichia coli* bacteria adhere to receptors on the small intestinal epithelium and secrete enterotoxins to reduce absorption and to increase fluid and electrolyte secretion of small intestinal epithelial cells (Nagy and Fakete, 2005) which often leads to diarrhoea, dehydration and death in enteric form and severe illness and rapid death in systemic form (Hassan *et al.,* 2014).

Microscopically, severely haemorrhagic mucosa of intestine and infiltration of erythrocytes and lymphocytes along with few macrophages was seen (fig. 7 and fig. 8). In most of cases, highly congested mucosa with engorged mucosal blood vessels of intestine were observed (fig. 10 and fig. 11). At number of places, there were exfoliated villi with leucocytic infiltration and hyperplastic goblet cells with neutrophilic infiltration in mucosa of intestine (fig. 12 and fig. 13). There was necrosis of the epithelial cells, lining the intestinal glands with sever infiltration of mononuclear cells in mucosa of intestine (fig. 14) and loss of epithelium of villi and intestinal glands with sever infiltration of lymphocytes (fig. 15). In some cases, blunt and fused villi were noticed in intestinal mucosa (fig. 16). In few cases, hyperemia of mucosal vessels, distension of lacteals and infiltration of polymorphonuclear cells and neutrophils in the ileum (fig. 17 and fig. 18). Similar finding have been described by El-Mottaleb and Zaki (2008) in lambs, Gomez *et al.* (2008) in lambs/sheep, Dubourguier *et al.* (1977), Sonawane *et al*. (2012) in lambs/sheep, Jubb *et al.* (2007) and Vaged and swamy (2015) in infected ruminants and Jesse *et al.* (2016) in Adult doe. The intestine revealed hyperemia of mucosal vessels, distension of lacteals and infiltration of neutrophils in the ileum. Similar findings were observed by Tzipori *et al.* (1981) in gnotobiotic calves.

In present study, it can be stated that physiological state and the interaction of Enterotoxigenic *Escherichia coli* (ETEC) with other etiological agents on the mucosal surface of the intestine is of great importance. Rotaviruses are known to infect mature enterocytes and subsequent replacement by immature cells. The emergence of these cells may promote the adherence of ETEC in young ruminants (Tzipori *et al.,* 1981). Proliferation of *Escherichia coli* in the small intestine released enterotoxin which absorbed and act elsewhere and also caused production of fluid in the intestine. By invading the wall of small intestine, *Escherichia coli* destroys the epithelium and causes bacteraemia or localized outside the intestinal tract (Moon, 1974). The inflammatory lesions as observed in colibacillosis might be due to secretion of secretary products like histamine provoking inflammation and damages intestinal mucosa. *Escherichia coli* produces enterotoxins which inhibit protein synthesis as well as causes necrosis of enterocytes of the intestine (Vaged and Swamy, 2012). The desquamation of the mucosal epithelium has been reported due to cytopathic effect of invading *Escherichia coli* on enterocyte or as a natural protective action by the intestine to eliminate the infection as documented by Sharma *et al*. (2003).

4.4.2 Lymph Nodes

Pathological conditions were observed in 21 cases (37.50%) of mesenteric lymph node in the present study. Almost similar occurrence was recorded by Verma and Kalra (1975) as 33.33 per cent and Mehra (2013) as 32.05 per cent and in young ruminants.

Grossly, the mesenteric lymph nodes were hard, enlarged and congested (fig. 19). These findings are in close approximation to the findings described by Rao *et al*. (1985) in lambs, Azmi and Jha (1994) in kids and Kumar *et al.* (2015) in sheep/lambs.

Microscopically, the tissue section showed hyperplasia of lymphocytes and congested blood vessels in mesenteric lymph node (fig.20). In most of the cases, lymph nodes showed depletion of lymphocytes in germinal center in cortex (fig. 21). Similar finding were recorded by Gomez *et al.* (2008) in

lambs, Kumar *et al.* (2015) in sheep/lambs and Sastry and Rao (2012) and Jubb *et al.* (2007) in infected *E.coli* in ruminants.

The depletion of lymphocytes in secondary lymphoid organs was due to decreased immune status of young ruminants because of bacterial infection (Omer *et al.,* 2012 and Aklilu *et al.,* 2013). Arrival of large number of antigen in lymph node result in increased blood supply and recruitment of many lymphocytes. Lymph nodes become enlarged because lymphocytes transform into large cells which undergo cell division, increased numbers of large lymphocytes resulting hyperplastic lymph nodes (Vaged and Swamy, 2015).

4.4.3 Liver

Pathological conditions were observed in 20 cases (35.71%) of liver in the present study. Almost similar occurrence was recorded by Kumar *et al.* (2015) as 31.81 per cent in sheep/lambs and Tarabees *et al.* (2016) as 31.58 per cent in lambs. A relatively lower occurrence was reported by Borai *et al.* (2013) as 24 per cent in sheep and Nasar *et al.* (2014) as 18 per cent in lambs and higher occurrence was reported by El-Mottaleb and Zaki (2008) as 75 per cent in lambs.

Grossly, the liver was enlarged and congested (fig. 22). In few cases, grayish white and round focal abscess on the surface of liver was observed (fig. 24). Similar observations made by Rao *et al*. (1985), El-Mottaleb and Zaki (2008), Sonawane *et al.* (2012) and Aklilu *et al.* (2013) in lambs, Abou-Zaid *et al.* (2000) in lamb/kids, Tehrani *et al.* (2012), Borai *et al.* (2013) in sheep, Madhav *et al.* (2015) and Giri *et al.* (2015) in sheep/lambs, Ibrahim *et al.* (2016) in sheep/goat and Sastry and Rao (2012) in *E. coli* infected ruminants.

Microscopically, tissue section showed congestion and degenerative changes in hepatocytes and perivascular hepatitis in liver (fig. 23). There were abscesses represented by a core of caseous necrosis, encircled by a zone of leucocytic cells and a connective tissue capsule (fig. 25) and necrotic areas, infiltrated with neutrophils and surrounded with connective tissue capsule and

mononuclear cells (fig. 26). In some cases, liver section showed central areas of liquefactive necrosis surrounded by numerous polymorphonuclear cells, few mononuclear cells, calcified centers and colonies of bacteria (fig. 27 and fig. 28). At few places, prominent infiltration of inflammatory cells such as neutrophils and few kupffer cells in hepatic sinusoids of liver were seen (fig. 29 and fig. 30). In some places, hyperplasia of bile duct was observed (fig. 31 and fig. 32). In few cases, sections showed focal areas of coagulative necrosis of hepatocytes (fig. 33 and fig. 34). There were sinusoidal engorgement with erythrocytes and perivascular haemorrhages noticed in liver (fig. 35 and fig. 36). At few places, hydropic degeneration with clear or hazy, large and small vacuoles in hepatocytes were recorded (fig. 37 and fig. 38). In many cases, cloudy swelling characterized by swellen hepatocytes and nuclei with granular cytoplasm and reduced sinusoidal spaces (fig. 39 and fig. 40). In some cases, degenerative changes in hepatocytes and perivascular hepatitis (fig. 41) and infiltration of lymphocytes and few macrophages in and around central vein were noticed (fig. 42). Similar finding observed by Rao *et al*. (1985), El-Mottaleb and Zaki (2008) and Sonawane *et al.* (2012) in lambs, Tehrani *et al.* (2012), Borai *et al.* (2013), Giri *et al.* (2015) in sheep, Madhav *et al.* (2015) in lambs/sheep, Tarabees *et al.* (2016) in lambs/kids, Ibrahim *et al.* (2016) in sheep/goat, Sharma *et al.* (2003) in kids, Azmi and Jha (1994) and Jubb *et al.* (2007) in young ruminants.

Above findings indicate that escaping of causative bacteria and localization in the liver with subsequent serious pathologic effect on hepatic tissue (Ibrahim *et al.*, 2016) may be in accordance to the fact that liver function are depressed due to blocking of bile secretion and pressure on hepatocytes by bacterial emboli in *E.coli* infection. The toxin acted on blood vessels, resulting in oedema, hepatitis and haemorrhages (Golovko *et al.*, 1984). Abscesses are initiated as microabscess, possibly induced by an embolus of bacteria in the hepatic sinusoid which progresses to coagulative necrosis of adjacent hepatocytes with a simultaneous recruitment of neutrophils (Kumar *et al.*, 2014). The neutrophils contain myeloperoxidase leading to liquefaction of dead and degenerated hepatocytes. The lesion gets

encapsulated by fibrous connective tissue. Liver abscesses have been reported and be caused by a variety of bacteria including *Escherichia coli* (Mashhadi *et al.,* 2006). Further, *E. coli* is usually reported in abscesses of biliary or portal origin while *Streptococcus* spp. and *Staphylococcus* spp. are accounted in cases of haematogenous or cryptogenic disease (Lampropoulos *et al.,* 2013). This is also supported our findings of biliary hyperplasia particularly at portal areas (Giri *et al.,* 2015).

4.4.4 Lungs

Frank pathological changes were reported in 21 cases (37.50%) of lungs in this study. Almost similar occurrence was recorded by Verma and Kalra (1975) as 33.33 per cent in young ruminants. A relatively lower occurrence was reported by Al–Anbagi *et al.* (2016) as 28.1 per cent in sheep, Oruc (2006) as 24.56 per cent in lambs and Kumar *et al.* (2015) as 22.72 per cent in sheep/lambs and higher occurrence was reported by Tarabees *et al.* (2016) as 52.63 per cent in lambs and El-Mottaleb and Zaki (2008) as 56.25 per cent in lambs. This variation may be due to geographical area and some factors like stress, immune system status and transportation (Al–Anbagi, 2016).

Grossly, the lungs showed severe congestion in positive case (fig. 43) and at few places, abscesses were observed on lung surface (fig. 55). These finding were in the agreement with finding described by Rao *et al*. (1985), El-Mottaleb and Zaki (2008) and Sonawane *et al.* (2012) in lamb, Kumar *et al.* (2015) in lambs/sheep, Aldomy and Abu-zeid (2007) and Al-Anbagi (2016) in sheep, Jubb *et al.* (2007) and Sastry and Rao (2012) in *E.coli* infected ruminants.

Microscopically, the tissue section showed severely congested blood vessels engorged with erythrocytes (fig. 44 and fig. 45). At few places, lungs showed thickening of alveolar septa and alveoli filled with fibrinous exudate (fig. 46) and effusion of lightly fibrinous exudate and a few neutrophils into the alveoli (fig. 47). While in some cases, distention and rupture of alveolar walls, forming air spaces of various sizes were recorded in lungs (fig. 48). In

some cases, haemorrhagic exudate filled the alveoli accompanied with lymphocytic infiltration (fig. 49 and fig. 50). In most of cases, inflammatory exudate of mononuclear cells and few neutrophils in the alveolar interstitium causing thickening of alveolar septa (fig. 51 and fig. 52). Some tissue section showed purulent-necrotic exudate consisted of necrotic bronchiolar epithelium and alveoli with neutrophilic infiltration (fig. 53 and fig. 54). Some sections showed focal abscesses represented by aggregation of neutrophils (fig. 56 and fig. 57). At few places, sloughing of the epithelial cells lining bronchioles was observed (fig. 58 and fig. 59). In few cases, thickening of alveolar septa was recorded (fig. 60). Similar findings have been described in *E. coli* infected lambs by El-Mottaleb and Zaki (2008), Gomez *et al.* (2008) and Sonawane *et al.* (2012), in sheep by Aldomy and Abu-zeid (2007), in sheep/lambs by Kumar *et al.* (2015), in lambs/kid by Tarabees *et al.* (2016) and in *E.coli* infected ruminants by Sastry and Rao (2012) and Jubb *et al.* (2007).

Above findings may be due to variations in temperature, can promote the development of sheep respiratory diseases (Aklou and Menoueri, 2016). The dusty, dry harmattan wind increases irritation of the respiratory tract, preparing the ground for microbial infection. The condition may be aggrevated by stress due to lack of feed or inadequate feed (Raji *et al.,* 2000). Sudden change in environment, cold stress, dew and frost and poor ventilation might have exposed lambs/sheep to *E. coli* septicaemia with major involvement of respiratory system (Sonawane *et al.,* 2012). The acute inflammatory reaction might be due to damage of minute blood vessels *viz.* capillaries which resulted into oedema, congestion and haemorrhages (Sastry and Rao, 2012).

4.4.5 Heart

In the present study, pathological changes were found in 15 cases (26.78%) of heart. Almost similar occurrence was recorded by Kumar *et al.* (2015) as 27.27 per cent in sheep/lambs. A lower occurrence was reported by Nasar *et al.* (2014) as 4.00 per cent in lambs.

Grossly, at most of cases heart was congested, oedematous and enlarged (fig. 61). Similar findings were observed by Rao *et al*. (1985) in lambs, Abou-

Zaid *et al.* (2000) in lambs/goats, Sonawane *et al.* (2012) in lambs/sheep, Azmi and Jha (1994) and Sharma *et al.* (2003) in kids.

Microscopically, tissue section showed congestion of blood vessels in heart (fig. 62 and fig. 63). In some places, haemorrhage (fig. 64) with marked infiltration of erythrocytes in myocardium of heart was noticed (fig. 65). At most of cases, separations of myofibrils in heart were observed (fig. 66). The findings of present study resembled with the observation of Sonawane *et al.* (2012) in lambs/sheep, Azmi and Jha (1994) and Sharma *et al.* (2003) in *E. coli* infected kids and Sastry and Rao (2012) and Jubb *et al.* (2007) in *E. coli* infected ruminants.

These changes occurred due to production of endotoxins by *E. coli* and the cellular infiltration might be a defensive reaction of host in an attempt to degrade and kill the pathogen (Sastry and Rao 2015 and Sharma *et al.*, 2003).

4.4.6 Kidney

Pathological conditions were found in 20 cases (35.71%) of kidney samples. Almost similar occurrence was recorded by Verma and Kalra (1975) as 33.33 per cent and Mehra (2013) as 32.05 per cent in young ruminants. A relatively lower occurrence was reported by Kumar *et al.* (2015) as 13.64 per cent in sheep/lambs and Nasar *et al.* (2014) as 10 per cent in lambs and higher occurrence was reported by El-Mottaleb and Zaki (2008) as 93.75 per cent in lambs.

Grossly, in a few cases kidneys were pale and hypertrophied with the shiny cut surface and in most of the cases, congested and soft (fig. 67 and fig. 74). Similar findings were observed by El-Mottaleb and Zaki (2008) and Sonawane *et al.* (2012) in lambs, Kumar *et al.* (2015) in sheep/lambs, Aldomy and Abu-zeid (2007) and Mahouz *et al.* (2015) in infected sheep.

Microscopically, some cases showed glomerulonephritis with infiltration of mononuclear cells in the glomerulous (fig. 68 and fig. 69). In most cases, focal interstitial nephritis and mild infiltration of mononuclear cells in the renal interstitium were observed (fig. 70 and fig. 71). In a few

cases, pyelonephritis showed interstitial lesion in pelvis of kidney along with infiltration of neutrophils and few lymphocytes (fig. 72 and fig. 73). At most of cases, congestion, degeneration and coagulative necrosis were observed (fig. 75 and fig. 76). Some section showed hyaline degeneration in glomeruli of kidney (fig. 77) and translucent, glossy, amorphous structureless material which stained pink in and around glomeruli was observed (fig. 78). Many tissue section showed tubular necrosis with necrosed tubular epithelium in kidneys (fig. 79 and fig. 80). At few places, tissue sections showed vacuolation and necrosis of the endothelial cells lining of blood vessels of the glomeruli (fig. 81 and fig. 82). Similar finding were recorded by Azmi and Jha (1994) in infected kids, El-Mottaleb and Zaki (2008) and Sonawane *et al.* (2012) in lambs, Kumar *et al.* (2015) in sheep/lambs, Mahouz *et al.* (2015) in sheep, Jubb *et al.* (2007) and Vegad and Katiyar (2012) in infected ruminants. The vascular alterations in kidney might be the reflection of endotoxin mediated damage as reported by Smith (1986).

4.4.7 Spleen

Total 12 cases (21.42%) of spleen showed pathological alterations in this study. Almost similar occurrence was recorded by Mehra (2013) as 20.51 per cent in young ruminants. A relatively lower occurrence was reported by Kumar *et al.* (2015) as 4.5 per cent in sheep/lambs and Nasar *et al.* (2014) as 8 per cent in lambs and higher occurrence was reported by El-Mottaleb and Zaki (2008) as 87.5 per cent in lambs.

Grossly, in most of the cases, oedematous, swollen and petechial haemorrhagic spleen were observed (fig. 83 and fig. 88). These finding are in close approximation to the findings described by Rao *et al*. (1985) and Sonawane *et al.* (2012) in lambs.

Microscopically, tissue section showed hyperplasia of lymphocytes in red and white pulp of spleen (fig. 84). In few cases, corona of polymorphonuclear cells around white pulp (fig. 85) and marked infiltration of neutrophils around lymphatic nodules were noticed (fig. 86). At a number of places, severe depletion of the lymphocytes of the white pulp was recorded (fig. 87). In most of the cases, extravasation of erythrocytes with

hemosiderosis was seen (fig. 89) and golden brown hemosiderin pigments scattered in the red pulp indicates chronic haemorrhage (fig. 90). Similar findings were recorded by Gomez *et al.* (2008), El-Mottaleb and Zaki (2008) and Sonawane *et al.* (2012) in lambs and Jubb *et al.* (2007) in *E.coli* infected ruminants.

The pathogenic strains of *E. coli* are able to invade extra intestinal tissues, survive and multiply there, releases cytotoxins and induce tissue damage (Sonawane *et al*., 2012 and Radostits, 2007) especially towards endothelial and epithelial cells of different organs, producing the pathologic changes (Isogai *et al.,* 1998). The vascular changes might be due to damage of capillaries which resulted into oedema, congestion and haemorrhages (Sastry and Rao, 2012) depletion of the lymphocytes of the white pulp, hyperplasia of lymphocytes, extravasation of erythrocytes with hemosiderosis (El-Mottaleb and Zaki, 2008). The above changes occur due to poor immune status of young/adult ruminants and the ability of certain *E. coli* strains to lyse erythrocytes of different species via hemolysins which are responsible for necrotic and lethal activities (Blanco *et al.,* 1996).

5. SUMMARY

The present study was undertaken to elucidate the occurrence and pathology of colibacillosis in sheep in Jaipur Division of Rajasthan. This investigation was carried out from November 2016 to April 2017.

During the course of study, a total 503 sheep irrespective of age, sex, and breeds were examined. Out of these, tissue samples from 56 sheep/lambs, showing frank macroscopic lesions in terms of shape, size, colour, consistency, odour, location and type for colibacillosis were examined grossly for alteration in morphology of individual organ and collected for isolation of bacteria and histopathological study. The *Escherichia coli* micro-organisms were isolated and identified on the basis of cultural, morphological and biochemical characteristics. Tissue samples were further processed for histopathology and examined microscopically.

An overall occurrence of colibacillosis in sheep was recorded as 11.13 per cent, in intestine 40 cases (71.42%), in mesenteric lymph node 21 cases (37.50%), in liver 20 cases (35.71%), in lungs 21 cases (37.50%), in heart 15 cases (26.78%), in kidney 20 cases (35.71%) and spleen 12 cases (21.42%) out of a total of 56 cases of each organ were recorded.

The gross and histopathological changes recorded in present study as circulatory disturbances, various kinds of inflammatory changes, degenerative changes, different types of necrosis and other regressive changes were the main leading pathological conditions.

During this period a total 149 isolates of *Escherichia coli* isolated from different organs of slaughtered sheep. Out of 149 isolates, random 35 isolates were sent to National Salmonella and Escherichia Centre, Kasauli. Among them 26 were serotyped and all were belong to “O” serogroups whereas remaining five strains were rough and four untypable. The most prevalent serotype were O22 (8) and O115 (6) followed by O88 (3), O20 (2), O49 (2), O119 (2) O1 (2) and O157 (1).

The present investigation had been concluded that:

1. Colibacillosis is economically important health problem which may occur in sheep of any age and causes high mortality and morbidity predominantly in lambs with the potential role of pathogenic *Escherichia coli* causing diarrhoea and extraintestinal lesions in sheep.

2. Possible variation in the nutritional status, stress factor (transport stress, overcrowding and poor ventilation) management practices, hormonal changes, geography and climate and even lack of implementation of proper preventive and control measures could turn these supposedly harmless commensals into pathogenic bacteria. *Escherichia coli* infections in animals also reflect the diversity of the human *E. coli* pathotypes.

3. In present study *Escherichia coli* belong to a large number of serotypes which cause severe drastic pathological lesions can lead to the death of animals either by naturally or experimentally infection. These serotypes along with O157 have been found associated with certain life-threatening severe diseases in humans in other parts of globe, suggestive zoonotic significance of this microorganism.

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जयपुर संभाग में भेड़ों (*ओविस एरिस*) में कोलाईबेसिलोसिस का आपात एवं व्याधिकी का अध्ययन

स्नातकोत्तर शोध ग्रंथ

पशु व्याधिकी विभाग,

स्नातकोत्तर पशुचिकित्सा शिक्षा एवं अनुसंधान संस्थान (पीजीआईवीईआर), जयपुर
राजस्थान पशु चिकित्सा एवं पशु विज्ञान विश्वविद्यालय, बीकानेर

प्रस्तुतकर्ताः **संदीप मरोड़िया**
उपदेष्टाः **डॉ. सर्जना मीणा**

अनुक्षेपण

कोलाईबेसिलोसिस भेड़ों/भेड़ मेमनों में लगातार पाये जाने वाले अत्यधिक महत्वपूर्ण रोगों में से एक है, इसलिए भेड़ों में कोलाईबेसिलोसिस का आपात एवं व्याधिकी ज्ञात करने हेतु वर्तमान अध्ययन किया गया। वर्तमान अध्ययन नवम्बर 2016 से अप्रेल 2017 तक किया गया। वर्तमान अध्ययन में राजस्थान के जयपुर संभाग में भेड़ों में 11.13 प्रतिशत कोलाईबेसिलोसिस के आपात का गठित होना पाया गया। कुल 56 प्रभावित रोगग्रस्त भेड़ों के विभिन्न अंगों से *एस्चेरिचिया कोलाई* जीवाणुओं को पृथक किया गया, जिनकी संख्या निम्न प्रकार हैंः आंत्र से 40 (71.42 प्रतिशत), लसिका ग्रंथि से 21 (37.50 प्रतिशत), यकृत से 20 (35.71 प्रतिशत), फेंफड़ों से 21 (37.50 प्रतिशत), हृदय से 15 (15.78 प्रतिशत), वृक्क से 20 (35.71 प्रतिशत) और तिल्ली से 12 (21.42 प्रतिशत) आईसोलेट मिले। वर्तमान अध्ययन में सबसे अधिक प्रचलित सीरो प्रकार O22(8), O115(6) पाये गये एवं इनके बाद O88(3), O20(2), O1(2), O49(2), O119(2) और O157(1) थे। सकल परिवर्तनों के विभिन्न स्वरूपों में मुख्य रूप से संकुलता, आंत्र लसिका ग्रंथि, यकृत, फेंफडों, हृदय और वृक्क में पाई गई, जबकि रक्तस्त्राव आंत्र, हृदय और तिल्ली में पाया गया एवं वृक्क की आकारात्मक वृद्धि अंकित की गई। विभिन्न अंगों के सूक्ष्मदर्शी उत्तकीय परिवर्तनों में, आंत्र में रक्तस्त्राव, संकुलता, पतिशयायी आंत्रशोथ, परिगलन, क्षीणता, लेक्टेअल्स का बढ़ाव और रिक्तिकाओं का बनना पाया गया। यकृत में संकुलता, अपक्षयी परिवर्तन, परिगलन, मवादीय यकृत शोथ, परिरक्तनलिका यकृतशोथ एवं पित्त नली उपकला की संख्यात्मक की अतिवृद्धि पाई गई। फेंफड़ों में संकुलता, फुलाव, वायुकोष वातस्फीति, विभिन्न प्रकार के फुफ्फुस प्रदाह एवं फेंफड़ों में उपकला कोशिकाओं का हटना पाया गया। वृक्क में संकुलता, परिगलन, अपक्षयी परिवर्तन और विभिन्न प्रकार के वृक्कशोथ पाये गये। अन्ततः तिल्ली में रक्तस्त्राव, सफेद रक्त कणिकाओं (लिम्फोसाईट्स) का रिक्तिकरण और हीमोसिड्रिन वर्णक पाये गये। कोलिबेसिलोसि आर्थिक रूप से महत्वपूर्ण स्वास्थ्य सम्बंधित समस्या है जो कि किसी भी आयु वर्ग के जानवरों में हो सकती हे और भेड़ो में दस्त और बाह्मआंत्रीय रोगों का कारण हैं।

Studies On Occurrence And Pathology Of Colibacillosis In Sheep (*Ovis aries*) In Jaipur Division

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ABSTRACT

Colibacillosis continues to remain one of the most important disease entities of Sheep/Lambs. The present study was undertaken to elucidate occurrence and pathology of colibacillosis in sheep. This study was carried out from November 2016 to April 2017. An overall occurrence of colibacillosis was recorded as 11.13 per cent in sheep in Jaipur Division of Rajasthan state. The *Escherichia coli* organisms were isolated from different tissue samples of 56 affected sheep and these were categorized as follows: from intestine 40 (71.42%), mesenteric lymph nodes 21 (37.50%), liver 20 (35.71%), lung 21 (37.50%), heart 15 (26.78%), kidney 20 (35.71%), and spleen 12 (21.42%). The most prevalent serotype were O22 (8) and O115 (6) followed by O88 (3), O20 (2), O49 (2), O119 (2) O1 (2) and O157 (1). The gross changes in different affected organs were described as: congestion in intestine, mesenteric lymph node, liver, lung, heart and kidney. Haemorrhage in intestine, heart and spleen and hypertrophied kidney. In intestine, mucosa was thickened and mucinous. Multi focal abscess in lung, grayish white and round focal abscess on surface of liver, oedema and swelling in spleen. Histopathological changes revealed congestion, haemorrhage, catarrhal enteritis, necrosis, atrophy, and distension of lacteals and vacuolation in intestine. Congestion, degenerative changes and necrosis, suppurative hepatitis, perivascular hepatitis and bile duct hyperplasia in liver. Congestion, oedema, alveolar emphysema, different types of pneumonia and sloughing of epithelial cells in lung. Congestion, haemorrhage and separation of myofibrils in heart. Congestion, necrosis, degenerative changes and different types of nephritis in kidney. Haemorrhage, depletion of lymphocytes and haemosiderin pigments in spleen. Colibacillosis is economically important health problem which may occur in animals of any age groups and causes diarrhoea and extraintestinal diseases in sheep.