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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(12): 554-562

www.thepharmajournal.com
Received: 14-09-2022
Accepted: 22-10-2022

Neelesh
Veterinary Officer, Department of AH&VS, Government of Karnataka, Karnataka, India

Ravindra BG
Associate Professor, Department of Veterinary Medicine, Veterinary College, Bidar, Karnataka, India

Baswaraj Nitture
Senior Veterinary Officer, Department of AH&VS, Government of Karnataka, Karnataka, India

NA Patil
Director of Extension, Karnataka Veterinary Animal & Fisheries Sciences University, Bidar, Karnataka, India

Vivek R Kasaralikar
Professor & Head, Department of VCC, Veterinary College, Bidar, Karnataka, India

Shrikant Kulkarni
Professor & Head, Department of VPY, Veterinary College, Bidar, Karnataka, India

Vinay P Tikare
Professor and Head, Department of VPT, Veterinary College, Bidar, Karnataka, India

Corresponding Author:
Neelesh
Veterinary Officer, Department of AH&VS, Government of Karnataka, Karnataka, India

Haematobiochemical and micriobiological diagnosis of bacterial enteritis in calves

Neelesh, Ravindra BG, Baswaraj Nitture, NA Patil, Vivek R Kasaralikar, Shrikant Kulkarni and Vinay P Tikare

Abstract
Diarrhoea in the farm animals, especially in calves is one of the challenging clinical signs noticed in the dairy farm and is leading to economic loss to the dairy farmers. The future endeavour of successful dairy farming depends on the better management of calves. Therefore, the present study was envisaged to evaluate the prevalence, diagnosis and therapeutic management of bacterial enteritis in calves. A total of ten dairy farms in Bidar district were selected and visited to collect faecal samples and blood samples from diarrhoeic calves. The results revealed that nutritional stress due to inadequate colostrum feeding, and unhygienic practices were implicating bacterial enteritis in calves. To confirm, the faecal samples (N=100) were subjected to isolation and identification of underlying cause. The results showed that *E. coli* and *Salmonella* spp. as predominant bacteria in this area. In the prevalence study the early age group calves (0-1 month) were highly susceptible to both *E. coli* and *Salmonella* spp. and as age progresses the susceptibility reduces. Female calves were found to be more susceptible to the male counter parts. On haemato-biochemical examination there was significant difference (≥0.05%) in total leucocyte count, lymphocyte count, monocyte count and granulocyte count in diarrhoeic calves suffering from bacterial enteritis when compared to healthy calves suggesting acute bacterial enteritis. Whereas, significant increase in erythrocyte count and packed cell volume may indicates moderate dehydration. However, serum glucose and total proteins were within normal physiological limit.

Keywords: Diarrhoea, calves, bacterial enteritis, *E. coli* and *Salmonella* spp, dairy farms

Introduction
The future of any dairy production depends on the successful raising of calves and heifers for replacement. Under modern dairy production in the developing countries, the average length of time a cow stays in a milking herd is about four years and therefore, 25.00% of the milking herd must be replaced each year (Bhat *et al*., 2012) [3]. Diarrhoea in new born farm animals, particularly calves under 30 days of age of life, is one of the most common disease complexes. It is a significant cause of economic loss in cattle and continues to be of major importance in livestock production. The impacts of calf diseases could be direct and indirect through increased treatment expenses, decreased lifetime productivity and survivorship (Randhawa *et al*., 2012) [13]. It has been estimated that 75.00% of early calf mortality in dairy herds is commonly caused by acute diarrhea in the pre-weaning period and it is a major cause of economic loss to cattle producers and also a cause of high morbidity and mortality in the cattle industry worldwide (Uhde *et al*., 2008; Bartels *et al*., 2010) [16, 2]. Diarrhea is one of the most common diseases reported in calves up to three months old (Svensson *et al*., 2003) [15]. However, calf diarrhea was perceived as a minor problem by dairy producers, while the beef producers did not consider it a problem at all (Roderick and Hovi, 1999) [14].
The causes of calf diarrhea are complex and usually involve an interaction between enteropathogenic agents (bacteria, viruses, fungal agent's protozoa and parasites) the colostral immunity of the calves and the effects of environment precipitate the occurrence/reoccurence of diarhoeic syndrome in dairy farms. It is characterized clinically by acute profuse watery diarrhoea, progressive dehydration, acidosis and death in a few days, or earlier after onset if treatment is not provided. Based on clinical findings alone, it is not usually possible to differentiate between the common known causes of diarrhoeic syndrome in new born calves, which include enterotoxigenic *E. coli* (ETEC), verocytotoxic *E. coli* (VTEC), necrotoxigenic *E. Coli* (NTEC), *Salmonella* spp, Rotavirus, coronavirus, bovine torovirus (Breda virus), calicivirus, norovirus (Norwalk-like virus), *Cryptosporidium spp*., *Giardia spp and Toxocara spp*. *E. coli and Salmonella* species are known as the most common pathogens identified in diarrhoeic calves (Acha *et al*., 2004) [1].

Usually Diarrhea caused by *E. coli* occurs as part of a mixed infection with Rotavirus and *Cryptosporidium species* and also *E. coli* can invade the bloodstream and cause coli septicaemia (Quinn *et al*., 1994) [11]. Among the path groups of *E. coli*, the most common cause of neonatal diarrhea is ETEC stains of *E. coli* that are producing the K99 (F5) adhesion antigen and also the heat-stable enterotoxin (Nataro and Kaper, 1998) [10]. Neonatal calves are most susceptible to ETEC infection and develop "watery" diarrhea if infected (Foster and Smith, 2009) [7].

There are approximately 2,500 known serovars in the *Salmonella* genus (Davies, 2008) [6] Of these S. *Dublin*, a host specific, and S. *Typhimurium*, non-host-specific, are quoted to be the most common serovars in bovines (Venter *et al*., 1994, Jones *et al*., 2002 and Bhoyar 2009) [20, 9, 4]. Both serotypes affect the calves severely (Bisping and Amtsberg 1988) [4]. Acute diarrheal disease is most commonly recorded with S. *Typhimurium* and systemic disease with S. *Dublin* in cattle. Infected animal can serve as source of zoonosis through food-borne or direct contact routes (Mead *et al*., 1999) [9].

Therefore, infectious diarrhoea in young ones is one of the most common and economically devastating conditions encountered in dairy industry (Wudu, 2008) [17] and80% of diarrheic calves tested were positive for at least one of the target enteric pathogens, suggesting that the infectious factor is still a major cause of calf diarrhea whereas more than 50% of the diarrheic calves tested were concurrently infected with more than one pathogen. Co-infection with two pathogens were the most common finding (31.00%) with up to six pathogens detected in 1.00% of the fecal samples from diarrheic calves (Cho, 2012) [5]. Many of these enteropathogens cause severe intestinal lesions, alterations in enzyme activity, and alterations in nutrient transport mechanisms, or a combination of these effects leading to severe enteritis resulting into diarrhoea in calves.

Many interrelated risk factors have been associated with a high incidence of calf diarrhea and have added to the difficulty of understanding the complexity of the disease and controlling it *viz.,* immaturity of the neonate at birth, age of the neonate, a lack of vigor of the calf at birth, the presence of intrapartum hypoxemia and acidosis from a difficult birth, and failure to acquire sufficient colostral immunity. The failure of the new born calf to ingest an adequate quantity of good-quality colostrum containing a high level of colostralimmunoglobulins within a few hours after birth is a major risk factor contributing to acute undifferentiated diarrhoea (Radostits *et al*., 2010) [12]. Cold, wet, windy weather during the winter months in temperate climates and hot humid weather during the summer months may be associated with an increased incidence of dairy calf mortality due to diarrhea. The managemental risk factors include poor hygiene and overcrowding in the calving facility, contamination of the incoming air, inadequate ventilation, and close proximity to adult cows, mixing of different age groups and poor stockman ship or motivation of the herdsperson responsible for the enteritis in calves (Lance *et al*., 1992) [8].

Keeping in view above facts, the present study was carried out to study the prevalence of Salmonellosis and *E. coli* infection in diarrheic Calves and assess the clinical and laboratory diagnosis of bacterial enteritis.

Materials and Methods

The present study on “Diagnosis of bacterial enteritis in calves” was undertaken to determine the percentage of prevalence of *Salmonella* spp. and *E. coli* in diarrheic calves below 6 months of age, The study also carried out to assess the clinical and laboratory diagnosis of bacterial enteritis in calves in Bidar district covering all five talukas (Bidar, Aurad, Bhalki, Humanabad and Basavakalyan) of Karnataka. The present study on “Diagnosis and therapeutic management of bacterial enteritis in calves” was carried out in the randomly selected cattle farms (10) in Bidar district covering all five taluks. From all the dairy farms, a total of 100 samples (Faecal sample and blood sample) were collected Bagdal (16), Kholar (14), Aurad (08) Bakchoudi (11), Naubad (07), Shaheen (05), Bhalki (09), Hudagi (11) Basavakalyan (10) and Halbarga (09).

On clinical examination of the diarrheic calves, the following parameters were recorded *viz.*, conjunctival mucous membrane, rectal temperature, heart rate, respiratory rate, fecal scoring and to check the percentage of dehydration skin turgor test was performed. Fecal samples in sterile containers, whole bloodline DTA vial and blood for serum were collected from 100 randomly selected diarrhoeic calves. Biochemical Parameters *viz.* serum glucose and total protein were analysed by ARTOS®semi-automatic biochemical analyser. The haematological parameters *viz.* total erythrocyte count, total leukocyte count, haemoglobin, packed cell volume, lymphocyte count, monocyte count and granulocyte count were carried out on fully automated haematology cell counter-Automatic Blood Cell Counter.

In the present study the faecal samples of diarrhoeic calves (N=100) were processed to determine the bacterial origin with special reference to *Escherichia coli* and *Salmonella* spp and attempted to draw percentage of prevalence of *Escherichia coli* and *Salmonella* spp infection in diarrheic calves.

For isolation and identification of *E. coli* all the faecal samples (N=100) were inoculated into nutrient broth for 24hours at 37°C aerobically. After that, swabs streaked onto MacConkey agar. The colonies showing pink colour (Lactose fermented colonies) were randomly selected from each isolates (Plate-2). Selected colonies were later streaked onto Eosin methylene blue agar and incubated at 37°C 24hour for identification of characteristic metallic sheen produced by *E.coli* (Plate-3).Further such isolates were confirmed as *E. coli* by standard biochemical tests following pattern of IMViC: + + -- --(Plate-4)

For Isolation and identification of *Salmonella* from the faecal samples were collected from the diarrheic calves were inoculated in selenite broth at 1:10 ratio and are incubated at 41 °C and then a loopful of culture was streaked onto MacConkey agar. The colonies showing pale (Non-Lactose fermented colonies) were randomly selected from each isolates (Plate-5). Selected colonies were later streaked onto Hektoen enteric agar /*Salmonella* Shigella agar media and incubated at 37 °C for 24 hours. *Salmonella* on these media showed blue green to blue colonies with or without black centre on Hektoen enteric agar (Plate- 6) and black round colonies on SS agar (Plate-7). Further such colonies were confirmed by IMViC tests pattern as - + - +. (Plate-8a), Negative reaction on Urease test (Plate- 8b), and showing red slant with H_2S production on triple sugar iron test (Plate- 8c).

Data collected were subjected to statistical analysis as per procedure described by Snedecor and Cochran (1997) [17]. The clinical, haematological and biochemical parameters obtained on day ‘0’ and day ‘5’ were critically analysed by statistical analysis by one way ANOVA using Statistical Package for Social Sciences (SPSS) version 20. Differences between means were tested using Duncan’s multiple comparison test

and significance was set at 5% (p<0.05) and also at 1% (p<0.01).

Results and Discussion

The result revealed that out of 100 samples 82 faecal samples were found to be positive for *E. coli* alone whereas, *Salmonella* spp was detected in only 3 samples. The co-infection with both *E. coli* and *Salmonella* spp was observed in 6% and rest of the 9%% samples were found to be positive for neither *E. coli* nor *Salmonella* spp (Table-5, 6, 7, and 8) (Fig-1). This indicates that these two enteric pathogens are predominant in bacterial enteritis of diarrhoeic calves in Bidar district. For this a total of 10 different organised dairy farms were screened and results were tabulated and presented in Table-4, 5, 6, 7, 8 and 9.

Farm-wise prevalence of *Escherichia coli* and *Salmonella spp.* in diarrhoeic calves

A total of 10 dairy farms were screened for*E. Coli* and *Salmonella* spp, and their prevalence in different farms were presented in Table 3, 4, 5, and 6. The highest prevalence of *Escherichia coli* alone in diarrhoeic calves was noticed in Bakchoudi and Hudagi farm with the (13.41%)followed by Bagdal (10.98%), Bhalki (10.98%) and Basavakalyan (10.98%), Halbarga (90.76%), Aurad, Naubad (8.54%), Kholar (7.32%) and the least prevalence was noticed in Shaheen farm with 6.17%.Similarly the highest prevalence of *Salmonella*spp. alone in diarrhoeic calves was noticed in Bagdal farm with 66.67% and Kholar farm with 33.33%. However rest of the farms were found to be free from *Salmonella*spp infection. The co-infection study revealed that the highest prevalence of both *Escherichia coli* and *Salmonella* spp. together in diarrhoeic calve was observed in Bagdal farm with 50% followed by Kholar (33.33%) and Aurad (16.67%).However, other bacteria were also recorded in certain farms such as Kholar farm which was recorded 55.55% followed by Bagdal farm, Aurad farm, Basavakalyan farm and Halbarga farm with 11.11% in each farm. This indicates that *Escherichia coli* and *Salmonella* spp were widely spread across different taluks of Bidar district.

Table 3: Prevalence of *Escherichia coli* in diarrhoeic calves in Bidar district

Farms	Place	Faecal Samples	*E. coli*	Percent Prevalence	
				Out of total diarrhoeic calves (%)	Out of *E. coli* positives (%)
1	Bagdal(Bidar)	16	09	09	10.98
2	Kholar(Bidar)	14	06	06	07.32
3	Aurad	08	07	07	08.54
4	Bakchoudi(Bidar)	11	11	11	13.41
5	Naubad(Bidar)	07	07	07	08.54
6	Shaheen(Bidar)	05	05	05	06.17
7	Bhalki	09	09	09	10.98
8	Hudagi (Humanabad)	11	11	11	13.41
9	Basavakalyan	10	09	09	10.98
10	Halbarga (Bhalki)	09	08	08	09.76
	Total	100	82	82	100

Table 4: Prevalence of *Salmonella spp.* in diarrhoeic calves in Bidar district

Farms	Places	Faecal Samples	Salmonella	Percent Prevalence	
				Out of total diarrhoeic calves (%)	Out of Salmonella positives (%)
1	Bagdal(Bidar)	16	02	02	66.67
2	Kholar(Bidar)	14	01	01	33.33
3	Aurad	08	-	-	-
4	Bakchoudi(Bidar)	11	-	-	-
5	Naubad(Bidar)	07	-	-	-
6	Shaheen(Bidar)	05	-	-	-
7	Bhalki	09	-	-	-
8	Hudagi(Humanabad)	11	-	-	--
9	Basavakalyan	10	-	-	-
10	Halbarga (Bhalki)	09	-	-	-
	Total	100	03	03	100

Table 5: Prevalence of co-infection of *Escherichia coli* and *Salmonella* spp in diarrheic calves in Bidar district

	Places	Faecal Samples	Mixed	Percent Prevalence	
				Out of total diarrhoeic calves (%)	Out of mixed positives (%)
1	Bagdal(Bidar)	16	03	03	50
2	Kholar(Bidar)	14	02	02	33.33
3	Aurad	08	01	01	16.67
4	Bakchoudi(Bidar)	11	-	-	-
5	Naubad(Bidar)	07	-	-	-
6	Shaheen(Bidar)	05	-	-	-
7	Bhalki	09	-	-	-
8	Hudagi (Humanabad)	11	-	-	--
9	Basavakalyan	10	-	-	-
10	Halbarga (Bhalki)	09	-	-	-
	Total	100	06	06	100

Table 6: Prevalence of other bacterial origin in Diarrhoeic calves in Bidar district.

Farms	Places	Percent Prevalence			
		Faecal Samples	Others	Out of total diarrhoeic calves (%)	Out of Others positives (%)
1	Bagdal(Bidar)	16	01	01	11.11
2	Kholar(Bidar)	14	05	05	55.55
3	Aurad	08	01	01	11.11
4	Bakchoudi(Bidar)	11	-	-	-
5	Naubad(Bidar)	07	-	-	-
6	Shaheen(Bidar)	05	-	-	-
7	Bhalki	09	-	-	-
8	Hudagi (Humanabad)	11	-	-	--
9	Basavakalyan	10	01	01	11.11
10	Halbarga (Bhalki)	09	01	01	11.11
	Total	100	09	09	100

Age-wise prevalence of *Escherichia coli* and *Salmonella* spp. in diarrheic calves

A total of 100 diarrheic calves screened in the present study were classified in to different groups as per their age such as0-1 month (25 calves), 1-2 month (20 calves),-2-3 month (16 calves), 3-4 month (17 calves), 4-5 month (08 calves), and 5-6 month old (14 calves) to know the age-wise prevalence of *Escherichia coli, Salmonella* spp, *E. coli and Salmonella* spp co-infection and other bacterial origin in calves. The data were and depicted in Fig-2. The study revealed that 0-1 month and 1-2 month aged diarrhoeic calves were found to have highest% prevalence of *E. coli* alone (19.51%)followed by 3-4 month (18.29%), 2-3 month (17.07%) 5-6 month (15.85%) and 09.76% in 4-5 months age group calves. Similarly highest% prevalence of *Salmonella* spp alone was recorded in 0-1 month age group (66.67%) and was followed by 1-2 month (33.33%), however from remaining age groups *Salmonella* spp alone was not isolated. With reference to co-infection highest% prevalence was recorded in 0-1 month (50.00%) followed by 1-2month, 2-3 month, and 3-4 month to the tune of 16.66% whereas, 4-5 month and 5-6 month recorded 00.00%. Other than *E. coli and Salmonella* spp a total of 9 samples were found to harbour other infectious organisms. The result revealed that highest% prevalence was observed in 0-1 month (44.44%) followed by 1-2 month (22.22%), 2-3 month (11.11%), 3-4 month (11.11%), 5-6 month (11.11%) and 4-5 month (00.00%). The results indicated that early age group calves (< 2month) were found to be more susceptible to bacterial enteritis and its prevalence decreased with advancement of the age of the calves.

Sex-wise prevalence of *Escherichia coli* and *Salmonella* spp in diarrheic calves

Sex wise prevalence of *E. coli* infection, *Salmonella* spp infection, co-infection and other infectious origin in both female and male calves in the present study revealed that, percentage of prevalence of *E. coli*, *Salmonella* spp, co-infection and other infections were 65.85%, 66.67%, 66.67% and 77.78% in female calves where as in male calves it was 34.14%, 33.33% 33.33% and 22.22% respectively (Table-8) (Fig-3). The results revealed that female calves were found to be more susceptible to bacterial enteritis than male calves.

Table 7: Sex-wise prevalence of *Escherichia coli* and *Salmonella* spp in diarrheic calves

Sample collected	Causative agent	Female	% Prevalence	Male	% Prevalence
100 Female**:** male 67**:**33	*Escherichia coli* (82%)	54	65.85	28	34.14
	*Salmonella*spp (3%)	02	66.67	01	33.33
	Co-infection (6%)	04	66.67	02	33.33
	Others (09%)	07	77.78	02	22.22

Table 8: Age- wise prevalence of *Escherichia coli* and *Salmonella* spp in diarrheic calves

0	No of animals (n=100)	Prevalence of *E. coli*	Percentage (%)	Prevalence of *Salmonella*	Percentage (%)	Others	Percentage (%)	Co-infection	Percentage (%)
0-1	25	16	19.51	02	66.67	04	44.44	03	50.00
1-2	20	16	19.51	01	33.33	02	22.22	01	16.66
2-3	16	14	17.07	00	00.00	01	11.11	01	16.66
3-4	17	15	18.29	00	00.00	01	11.11	01	16.66
4-5	08	08	09.76	00	00.00	00	00.00	00	00.00
5-6	14	13	15.85	00	00.00	01	11.11	00	00.00
Total	100	82	100	03	100	09	100	06	100

Assessment of clinical and hemato-biochemical changes in bacterial enteritis of diarrhoeic calves

To assess clinical and hemato-biochemical changes in diarrhoeic calves of bacterial enteritis, the clinical parameters like conjunctival mucous membrane, rectal temperature, heart rate, respiration rate, faecal scoring and skin turgor test were recorded. Whereas, blood sample is utilised to know the changes in haematological and biochemical parameters. For this study a total of 100 calves below 6 month age suffering from diarrhoea were screened.

Clinical examination

All the diarrhoeic calves in different dairy farms were clinically examined. The predominant clinical signs recorded in bacterial enteritis in diarrhoeic calves in the present study were as follows. Conjunctival mucous membrane (Pale-24.00%, Pink- 24.00% and Congested- 52%), Rectal temperature (Sub normal-0.00%, Normal-73.00% and High-27.00%), Heart rate (Bradycardia-0.00%, Normal- 77.00%, Tachycardia- 33.00%) and Respiratory rate (Bradypnea-0.00%, Normal- 73.00%, Tachypnea- 27.00%).The results revealed that that higher percentage of congested conjunctival mucous membrane, normal rectal temperature, heart rate and respiratory rate were observed in the diarrhoeic calves suffering from bacterial enteritis in the present study.

Upon examination of diarrhoeic calves, varying degree of faecal consistency was evaluated and scored as 01 to 07 (score- 1: 0.00%, score -2: 0.00%, score- 3: 0.00%, score-5: 36.00%, score-6: 50.00%, score-7: 14.00%) and percentile prevalence were presented in Table-4.The results revealed that the faecal sample collected in the present study were of05 to 07 faecal scoring i.e., moderate severe diarrhoea. Further these faecal samples were evaluated for probable bacterial cause for enteric infection.

Skin turgor test was performed to assess the degree of dehydration based on skin elasticity as presented in Table-2 and scored all the diarrhoeic calves as mild, moderate and severe. The results revealed that mild: 0%, moderate: 100%, and severe: 0% (Table-9). In the present study all the diarrhoeic calves had moderate dehydration.

Table 9: Shows Clinical parameters

Sl. No	Clinical parameters	Scoring	Numbers	Percent (%)
1	Congective mucous membrane	Congested	52	52
		Pale	24	24
		Pink	24	24
2	Rectal Temperature	Subnormal	00	00
		Normal	73	73
		High	27	27
3	Heart Rate	Bradycardia	00	00
		Normal	77	77
		Tachycardia	23	23
4	Respiratory Rate	Bradypnea	00	00
		Normal	59	59
		Tachypnea	41	41
5	Fecal scoring	1	00	00
		2	00	00
		3	00	00
		4	00	00
		5	36	36
		6	50	50
		7	14	14
6	Skin Turgor Test	Mild	00	00
		Modearte	100	100
		Severe	00	00

Hemato-biochemical examination

For assessment of haematological changes in bacterial enteritis of diarrhoeic calves the blood samples were collected and processed in automatic blood cell counter and results were tabulated and analysed statistically by ANOVA (Table - 10) (Fig-4).

The mean ± standard error values of total erythrocyte count in control group was 7.09±0.31 and in the study group (N=100) it was 9.78±0.24. The result revealed that comparison between control group and study group showed significantly higher (P≤0.05) values of total erythrocyte count in study group.

The mean ± standard error value of total leucocyte count in control group was 11.10±0.91 and in the study group (N=100) was 18.04±0.67. The result revealed that comparison between control group and study group showed significantly higher (p≤0.05) values of total leucocyte count in study group.

The mean ± standard error values of haemoglobin count in control group was 10.95±0.25and in the study group (N=100) was 11.06±0.39. The result revealed that comparison between control group and study group showed no significance difference between the values of haemoglobin count in study group.

The mean ± standard error value of packed cell volume in control group was 32.92±0.67and in the study group (N=100) it was 41.28±1.65.The result revealed that comparison between control group and study group showed significantly higher (p≤0.05) values of packed cell volume in study group.

The mean ±standard error value of lymphocyte count in control group was 53.87±2.19and in the study group (N=100) it was 31.58±2.37.The result revealed that comparison between control group and study group showed significantly higher (p≤0.05) values of lymphocyte countin study group.

The mean ±standard error value of monocyte count in control group was 5.67±0.45and in the study group (N=100) it was 9.90±0.77. The result revealed that comparison between control group and study group showed significantly higher (p≤0.05) values of monocyte count in study group.

The mean ± standard error value of granulocyte count in control group was 40.46±1.91and in the study group (N=100) it was 57.75±2.62. The result revealed that comparison between control group and study group showed significantly higher (p≤0.05) values of granulocyte count in study group.

The overall haematological study revealed that, there is a significant difference between TLC, TEC, PCV, Lymphocyte count, Monocyte count and Granulocyte count in diarrhoeic calves suffering from bacterial enteritis when compared to healthy calves. However, there was no significant difference

observed in Hb value of diarrhoeic calves when compared to healthy calves.

For assessment of biochemical changes in bacterial enteritis of diarrhoeic calves the blood samples were collected and processed to separate serum sample. Serum samples were further analysed in automatic biochemical analyser for Glucose and protein concentration and results were tabulated and analysed with ANOVA (Table -10).

In a total of 100 serum samples 60% of samples were found to be hypoglycaemic followed by normal glucose values in 30% and hyperglycaemic in 10% of the samples collected from diarrhoeic calves. Whereas, Hypoproteinemia recorded in 60% of the samples followed by hyperproteinemia in 20% and 20% of the samples showed values within normal range.

The mean ± standard error value of blood glucose in control group was 73.13±1.81 and in the study group (N=100) it was 49.96±6.27. The results revealed that there was a significant difference ($p \leq 0.05$) between the values of blood glucose in the study group when compared to control group, indicating profound hypoglycaemic condition seen in the bacterial enteritis of diarrhoeic calves

The mean ± standard error values of protein in control group was 6.37±0.20and in the study group (N=100) was 6.72±0.65. The result revealed that there was no significant difference ($p \leq 0.05$) between the values of protein in study group when compared to control group.

Table 10: Assessment of hemato-biochemical changes in bacterial enteritis of diarrhoeic calves

Hemato-biochemical Parameters	Control group N=6	Prevalence group N=100
TEC(10^3/µl)	7.09±0.31 [a]	9.78±0.24 [b]
Hb (g %)	10.95±0.25 [a]	11.06±0.39[a]
TLC(10^6/µl)	11.10±0.91[a]	18.04±0.67[b]
PCV (%)	32.92±0.67 [a]	41.28±1.65 [b]
Ly (%)	53.87±2.19 [a]	31.58±2.37[b]
Mo (%)	5.67±0.45 [a]	9.90±0.77[b]
Gr (%)	40.46±1.91 [a]	57.75±2.62[b]
Total protein	6.37±0.20 [a]	6.72±0.65 [a]
Glucose	65.70±2.25 [a]	49.96±6.27 [b]

Note: Means bearing different superscript differs significantly ($p<0.05$)

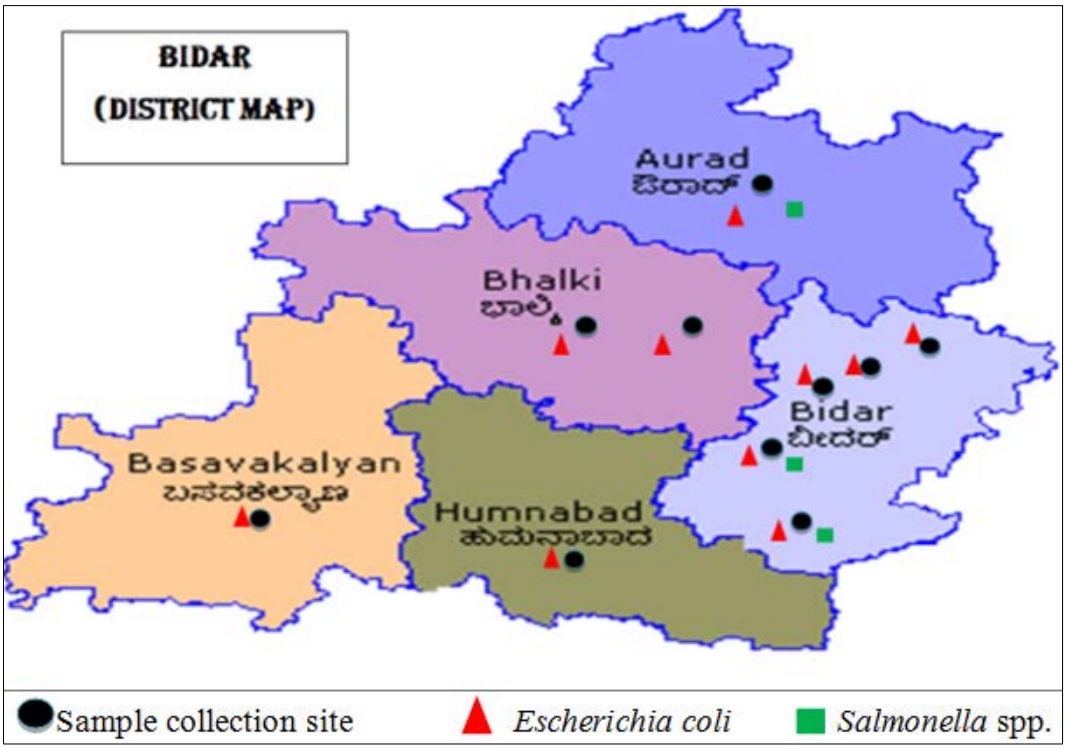

Plate 1: Distribution of *Escherichia coli* and *Salmonella* spp in dairrhoeic calvesofBidar district

Plate 2: Photograph showing pinkcolour colonies of *Escherichia coli*MacConkey agar

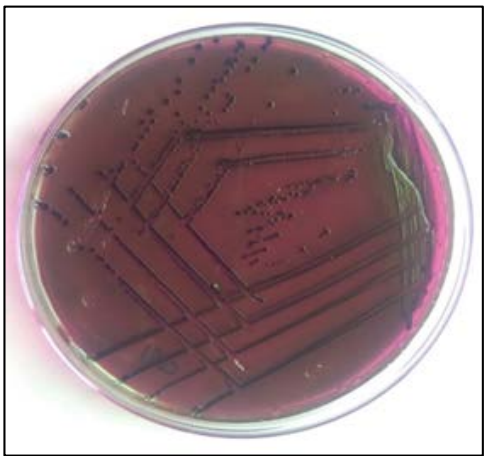

Plate 3: Photograph showing metallic sheen on Eosin methylene blue agar

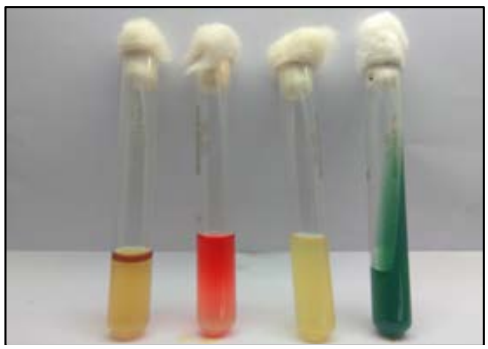

Plate 4: Photograph showing IMViC test (+ + - -) of *Escherichia coli spp.*

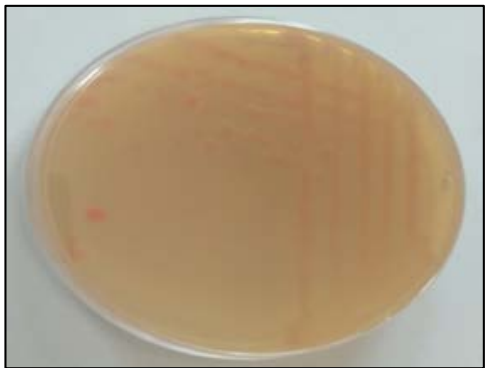

Plate 5: Photograph showing pale on coloured colonies of *Salmonella* on MacConkey agar

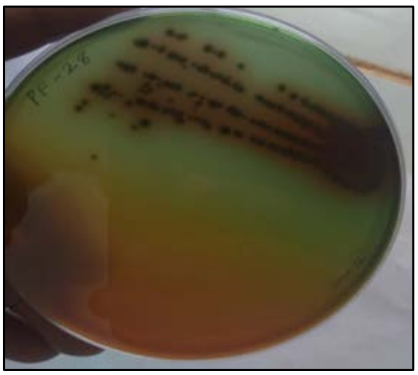

Plate 6: Photograph showing blue green to blue colone with or without black centred colonies by *Salmonella* spp. on hektoen enteric agar

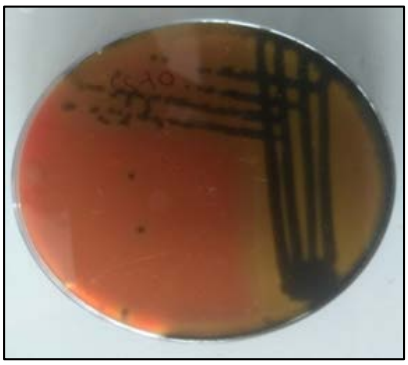

Plate 7: Photograph showing black round colonies by *Salmonella* spp. on italic agar

Plate 8a: Photograph showing IMViC (- + - +) test by *Salmonella spp*

Plate 8b: Photograph showing negative reaction on urease test by *Salmonella spp*

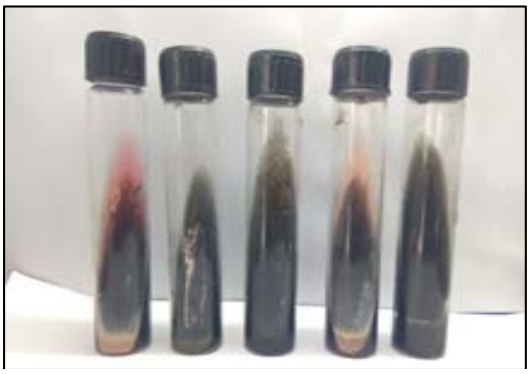

Plate 8c: Photograph showing red slant with H_2S production by *Salmonella* spp. on triple sugar iron test

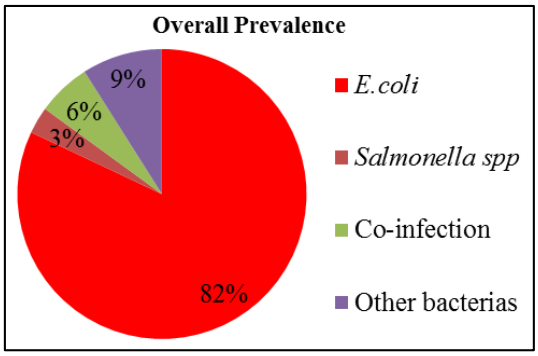

Fig 1: Overall prevalence of diarrhoeic calves suffering from bacterial enteritis.

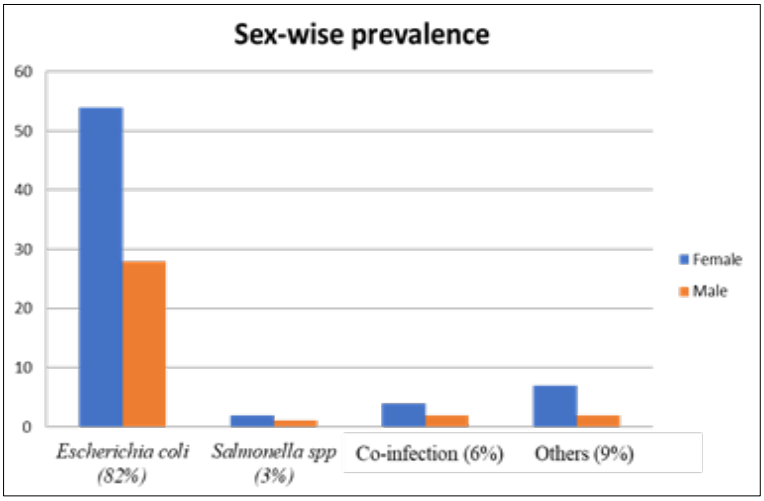

Fig 2: Sex –wise prevalence of diarrhoeic calves suffering from bacterial enteritis.

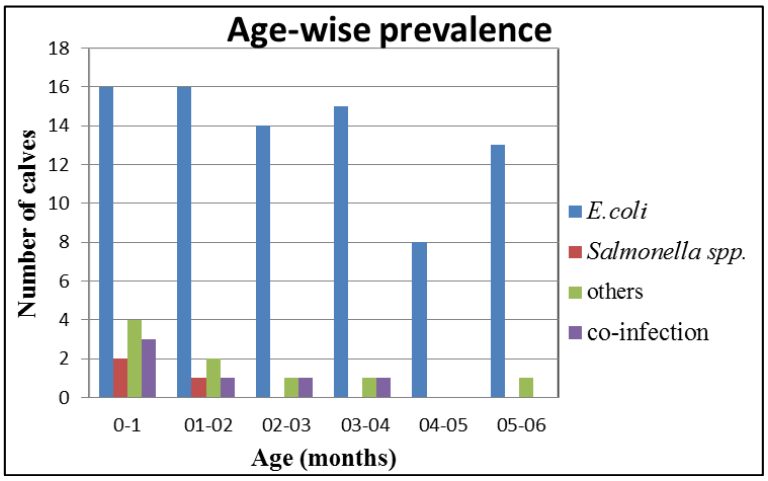

Fig 3: Age –wise prevalence of diarrhoeic calves suffering from bacterial enteritis

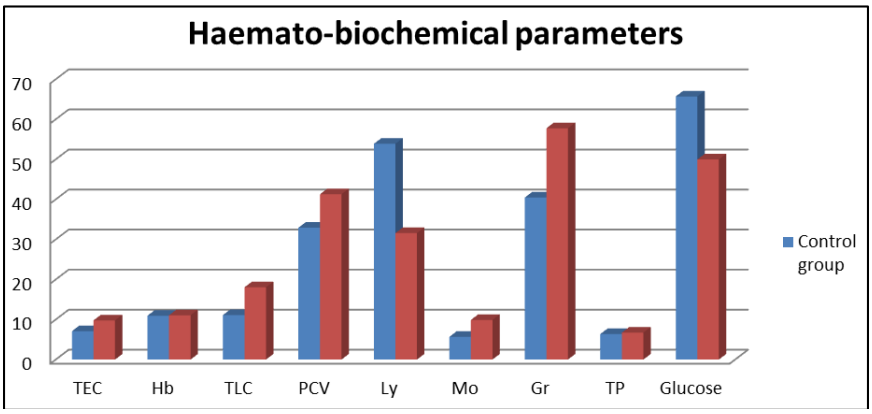

Fig 4: Haemato-biochemical parameters

Conclusion

The prevalence study revealed that 82% fecal samples were found to be positive for *E. coli* alone whereas, *Salmonella* spp was found to be positive in only03%. Co-infection of both *E. coli* and *Salmonella* spp was observed in 06% of the faecal samples and rest of the 09% samples were found to be positive for other bacteria such as Proteus, Shigella, and Pseudomonasetc.

The present study revealed that *E. coli* and *Salmonella* spp are two predominant enteric pathogens in diarrhoeic calves and are widely spread in this area.

Among the calves<1 month old and female calves are more susceptible to bacterial enteritis and The fecal scoring helps in assessment of severity and recovery from bacterial enteritis.

On haematological study, there was significant increase in total leucocyte count, granulocytic count and monocytic count in response to bacterial enteritis and marginal changes in the value of PCV and TEC which may correlated to dehydration in diarrhoeic calves.

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