Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(3): 612-616
Received: 19-03-2019
Accepted: 21-04-2019

Manu Jaiswal
Faculty of Veterinary and Animal Science, Institute of Agricultural Sciences, Rajiv Gandhi South Campus, Banaras Hindu University, Barkachha, Mirzapur, Uttar Pradesh, India

PC Shukla
Department of Veterinary Medicine, NDVSU, Jabalpur, Madhya Pradesh, India

Alok Mishra
Faculty of Veterinary and Animal Science, Institute of Agricultural Sciences, Rajiv Gandhi South Campus, Banaras Hindu University, Barkachha, Mirzapur, Uttar Pradesh, India

Preeti Bisht
Veterinary Officer, Uttarakhand Government, Champawat, Uttarakhand, India

Mohammed Nazeer
Department of Veterinary Clinical Complex, Post Graduate Institute of Veterinary Education and Research, Jaipur, Rajasthan, India

Pratyush Kumar
Department of Veterinary Gynaecology and Obstetrics, Post Graduate Institute of Veterinary Education and Research, Jaipur, Rajasthan, India

Srigiri Ashok Kumar
Veterinary Assistant Surgeon, Mobile Veterinary Clinic, Andhra Pradesh, India

Prabhat Gangwar
Department of Veterinary Medicine, NDVSU, Jabalpur, Madhya Pradesh, India, India

Correspondence
Manu Jaiswal
Faculty of Veterinary and Animal Science, Institute of Agricultural Sciences, Rajiv Gandhi South Campus, Banaras Hindu University, Barkachha, Uttar Pradesh, India

Study the efficacy of different rehydration electrolyte solutions in acute calf diarrhoea

Manu Jaiswal, PC Shukla, Alok Mishra, Preeti Bisht, Mohammed Nazeer, Pratyush Kumar, Srigiri Ashok Kumar and Prabhat Gangwar

Abstract
The present investigation was conducted on 40 diarrhoeic cattle calf (0-3 months old) and 08 healthy cattle calves. These calves were divided into five treatment groups (T1, T2, T3, T4, T5) and healthy control group (Tc) consisting of 08 cattle calves in each. The efficacy of different rehydration electrolyte solutions (RES-1, RES-2, RES-3, RES-4) were assessed. The efficacy was judge on the basis of clinical score, haemato-biochemical and electrolytes changes in treatment groups on various intervals (0, 3rd and 7th days). The therapeutic regimen adopted in the treatment of acute diarrhoeic calves under groups T5 in which RES-4 (Sodium Chloride, Sodium bicarbonate, Potassium chloride, Glutamine, Zinc) was given, found to be most efficacious.

Keywords: Diarrhoeic, rehydration electrolyte solutions, haemato - biochemical

Introduction
Calf diarrhoea is one of the most devastating diseases of the dairy industry worldwide [15]. Diarrhoea is defined as an increased frequency, fluidity or volume of faecal excretion. In diarrhoea, the clinico-biochemical alterations are complex in nature characterized by imbalance of fluid, electrolyte and acid base status [17]. [1] 75% of early calf mortality in dairy herds is caused by acute diarrhoea in the pre-weaning period being the major cause of productivity and economic loss in the cattle industry worldwide. Diarrhoeic calves frequently developed dehydration, strong ion acidosis, electrolyte imbalances and develop the state of negative energy balance.
The effect of diarrhoea on fluid electrolyte and acid base equilibrium depend on the type, duration, severity of the diarrhoea and the host response. Hence, before administration of electrolytes, estimation of the severity of electrolyte imbalance is necessary. Although, serum concentrations of sodium (Na) and potassium (K) are more important in relation to the composition of the fluids used for therapy [7].
The treatment of affected calves with antimicrobials is not sufficient to prevent the mortality, as these destroy the infectious agents but cannot help to exert their effects on correction of dehydration. So, looking to it the rational fluid therapy is essential for restoration of circulatory volume, electrolyte and correction of acid base status in order to correct dehydration [2]. The aim of oral electrolyte therapy is to correct dehydration by providing water and salt together with glucose and glutamine to facilitate sodium absorption. The most economic method of rehydrating calves that are mildly to moderate dehydrated is by administering oral rehydration solutions [11].
The goal of the replacement of fluids and electrolytes are the correction of present imbalances, the restoration of blood volume, adequate tissue perfusion and the treatment of shock in animals through intravenous administration or by oral administration of electrolyte solution [3].

Material and Methods
The proposed work was conducted in the Department of Veterinary Medicine, Diagnostic lab, T.V.C.C. College of Veterinary Science and Animal Husbandry, Jabalpur, Instructional Livestock Farm Complex (ILFC) Adhartal and other private dairy farms/goshala near by Jabalpur, (M.P.).
A total of 40 calves having acute diarrhoea aged within 0-3 months were taken under present study from various Private Dairy Farms/Goshala in and around, Jabalpur. Additionaly 08 healthy calves were selected from ILFC Adhartal, Jabalpur as healthy control group. For therapeutic study, a total of 40 acute diarrhoeic calves were randomly divided in to five treatment groups (T_1, T_2, T_3, T_4 and T_5) whereas, in Tc, eight normal healthy calves have served as the control group (Table 1).

Table 1: Experimental design for therapeutic study

Groups	No. of animals	Treatment
T_c	8	Healthy control
T_1	8	Standard ORS (WHO)
T_2	8	Rehydration Electrolyte Solution (RES 1)
T_3	8	Rehydration Electrolyte Solution (RES 2)
T_4	8	Rehydration Electrolyte Solution (RES 3)
T_5	8	Rehydration Electrolyte Solution (RES 4)

- In Tc (Control) group standard ORS [21] was given as per recommendation.
- The acute diarrhoeic calves of all the groups (T1-T5) were treated with medicines which included; of loxacin and Ornidazole @ 20mg /kg b.w. I/V for 3 days and Fenbendazole @7.5mg/kg b.w. PO.

RES was used @ 60 to 150 ml/kg b.w./day PO, daily for 5 days depending upon the severity of the diarrhoea [17].

Clinical examination: All affected calves were clinically examined for faecal consistency (normal, pasty, semi-liquid, watery) and suckling reflex in respect of each calf were recorded on day 0 (pre-treatment) and day 3rd and 7th (post-treatment) and scoring has been done as per Meer [13] with slight modification (Table 2).

Table 2: Clinical scores recorded in calves under study

Score	Faecal consistency	Dehydration score	Suckling reflex score
0	Normal	Normal bright eyes, pliable skin	Normal vigorous suckles
1	Pasty faeces	Mild dehydration, skin tent<3 sec.	Mild depression, calf suckles but not vigorously
2	Semi liquid faeces	Moderate dehydration, skin tent >3 sec.	Moderate depression, calf unable to stand, suckling is weak or disorganized
3	Watery Faeces	Severe dehydration, skin tent>8 sec.	Severe depression, unable to stand and suckle

Haemato-biochemical Profile: Seven ml blood was collected aseptically from jugular vein of each calf with the help of 18 Gauge needle and stored in clean, dry, sterilized labelled glass vials containing EDTA @ 1 mg/ml of blood. The haematological attributes included total erythrocyte count (TEC), haemoglobin (Hb) concentration, packed cell volume (PCV) and total leukocyte count (TLC). The haematological investigations were carried out by Auto cell analyzer (model Abacus). Serum was separated and preserved at 4^0c in refrigerator and analyzed for biochemical investigations.

Blood serum for biochemical analyser: A total of 7 ml blood was collected from each animal in a sterilized glass at each of the specified intervals for serum biochemistry. Blood was allowed to coagulate by keeping the tubes in slants and serum was separated by spinning at 3000 rpm for 10 minutes.

Sodium, potassium and chloride: Sodium, Potassium and Chloride estimations were estimated using automatic electrolyte analyzer (Cornley Acculyte-3P Electrolyte Analyzer) and the values were expressed in mEq/L.

Total protein: Total protein estimation was done using diagnostic reagent kits on blood chemistry Auto Analyser (model Erba Mannheim CHEM-5 plus v2).Ten µl of serum was taken in eppendorf tube and admixed with 500 µl total protein reagent for total protein estimation.

Rehydration Electrolyte Solutions (RES) were prepared fresh for every treatment group consisting of different chemical constituents and were used as oral rehydration therapy in acute diarrhoeic calves (Table 3).

Table 3: Composition of rehydration electrolyte solutions used in acute diarrhoeic calves

WHO	RES1	RES2	RES3	RES4
Sodium Chloride, Sodium citrate, Potassium chloride, and Dextrose	Sodium Chloride, Sodium bicarbonate Potassium chloride, Table sugar	Sodium Chloride, Sodium bicarbonate Potassium chloride, Table sugar, Zinc	Sodium Chloride, Sodium bicarbonate Potassium chloride, Glutamine	Sodium Chloride, Sodium bicarbonate Potassium, chloride Glutamine, Zinc

*These were prepared by dissolving the contents in one litre of water in each case.

Statistical analysis: The recorded data were analyzed as per the standard procedures outlined by [19].

Result

In clinical score – faecal consistency was decreased significantly in group T2, T3, T4 and T5 and non significantly in T1 after administration of various RES. The detail result of clinical score in diarrhoeic cattle calves pre and post treatment have been shown in Table-4. The dehydration score and suckling reflex was significant decrease in T5 group, whereas, non significant decrease in other treatment group. The improvement in the body condition was obtained in the calves of T5 and T1 comparably, as evident by more pliable supple skin, increased brightness of eyes, moistness of muzzle and variable rehydration status. Similar improvement on the faecal consistency of neonatal diarrhoeic calves 4 days post treatment was also reported by [14].

Table 4: Faecal consistency, Dehydration score, Suckling reflex (clinical score) of diarrhoeic calves in different treatment groups at different intervals

Groups	Faecal consistency		
	0 days	3 days	7 days
Tc	00.00^{b}±0.00	00.00±0.00	0.00±0.00
T1	1.87^{a}±0.22	0.75±0.33	0.12±0.12
T2	2.12^{Aa}±0.22	0.75^{B}±0.25	0.12^{C}±0.12
T3	2.12^{Aa}±0.22	0.87^{B}±0.22	0.12^{C}±0.12
T4	2.12^{Aa}±0.29	0.87^{B}±0.29	0.12^{C}±0.12
T5	2.12^{Aa}±0.29	0.75^{B}±0.25	00.00^{C}±0.00
Dehydration score			
Tc	00.00^{b}±0.00	00.00^{b}±0.00	0.00^{d}±0.00
T1	1.62^{a}±0.37	1.37^{a}±0.26	0.62^{c}±0.18
T2	1.75^{a}±0.31	1.62^{a}±0.26	1.50^{a}±0.18
T3	1.75^{a}±0.22	1.75^{a}±0.31	1.37^{a}±0.18
T4	1.62^{a}±0.26	1.50^{a}±0.26	1.12^{ab}±0.12
T5	1.87^{Aa}±0.29	1.25^{ABa}±0.16	0.75^{Bbc}±0.16
Suckling reflex			
Tc	00.00^{c}±0.00	00.00^{b}±0.00	0.00^{c}±0.00
T1	0.87^{b}±0.29	0.50^{b}±0.26	$0.37b^{c}$±0.26
T2	1.75^{a}±0.16	1.62^{a}±0.18	1.25^{a}±0.25
T3	1.62^{ab}±0.37	1.37^{a}±0.37	1.12^{a}±0.29
T4	1.65^{ab}±0.37	1.37^{a}±0.32	1.00^{ab}±0.26
T5	1.37^{Aab}±0.26	0.62^{Bb}±0.18	0.25^{Bc}±0.16

Mean values with superscript between treatment (a,b,c) and between interval (A, B, C) differ significantly (p<0.05).

The detail result of haematological changes in diarrhoeic cattle calves pre and post treatment have been shown in Table-5**.** The mean value of haemoglobin (g/dl) was significantly higher in most of the treatment groups i.e T1, T2, T3 and T5 on day 0 (pre treatment), however on day 3 and day 7 (post treatment) haemoglobin differed non significantly. The mean packed cell volume (%) values decreased significantly on day 3 (31.46^{ABab}±1.45) and day 7 (28.76^{Bb} ±1.31) day post treatment as compared to day 0 (34.99^{A} ±1.69) pre treatment in group T1. However, more or less similar reports have been obtained by [12]. The mean value of total erythrocyte count (million /µl) differed non significantly in all treatment groups at different intervals as compared to that of healthy control group on day 0 (pre treatment) day 3 and day 7 (post treatment).. The value of total leukocyte count (10^{3}/µl) decreased significantly at day 3 (11.46^{Bbc} ±0.62) and day 7 (9.59^{Cb} ±0.32) post treatment as compared to day 0 (13.62^{Aab}±0.62) pre treatment in T5 group. Beside this, in T2 and T3 groups the mean value of TLC were decreased significantly, but lesser than the mean values post treatment as compared to day 0.

Table 5: Haematological alterations of diarrhoeic calves in different treatment groups at different intervals

Groups	Haemoglobin (g/dl)		
	0 days	3 days	7 days
Tc	9.50 ±0.36	9.50^{b} ±0.311	9.58^{b} ±0.37
T1	10.67±0.50	9.94^{ab}±0.44	9.41^{b}±0.35
T2	11.39±0.66	11.31^{a} ±0.65	11.10^{a} ±0.65
T3	9.86 ±0.63	9.85^{b} ±0.52	9.71^{ab} ±0.55
T4	9.23±0.53	9.08^{b} ±0.50	9.05^{b}±0.49
T5	10.76 ±0.49	10.38^{ab} ±0.46	10.09^{ab} ±0.48
	Packed cell volume (%)		
Tc	30.10 ±1.15	28.99^{b} ±0.97	29.39^{b} ±1.18
T1	34.99^{A} ±1.69	31.46^{ABab}±1.45	28.76^{Bb} ±1.31
T2	35.56 ±2.25	35.43^{a} ±2.19	35.46^{a} ±2.27
T3	31.46 ±1.80	31.65^{ab} ±1.70	31.29^{ab} ±1.70
T4	30.04 ±1.55	29.76^{b} ±1.54	28.70^{b} ±1.17
T5	35.35 ±1.82	32.49^{ab}±1.50	30.88^{ab}±1.46
Total erythrocyte count (10^{6}/µl)			
Tc	8.02^{b} ±0.23	8.02^{ab} ±0.19	8.10^{ab} ±0.24
T1	8.43^{ab} ±0.32	8.16^{ab} ±0.27	7.88^{b} ±0.25
T2	11.56^{a} ±2.59	8.91^{a} ±0.41	8.83^{a} ±0.42
T3	7.90^{b} ±0.24	7.74^{b} ±0.24	7.68^{b} ±0.26
T4	7.77^{b} ±0.24	7.61^{b} ±0.25	7.52^{b} ±0.22
T5	8.35^{ab} ±0.30	8.12^{ab} ±0.29	7.93^{b} ±0.30
Total leukocyte count (10^{3}/µl)			
Tc	9.89^{a} ±0.97	10.02^{c} ±0.79	9.91^{ab} ±0.69
T1	11.56^{bc} ±0.67	10.85^{bc} ±0.62	10.85^{ab} ±0.62
T2	15.22^{Aa} ±0.61	13.75^{Aa} ±0.67	10.10^{Bab}±0.53
T3	14.25^{Aa} ±0.85	12.41^{ABab}±0.73	10.62^{Bab}±0.49
T4	13.37^{ab} ±0.60	12.23^{ab} ±0.55	11.47^{a} ±0.48
T5	13.62^{Aab}±0.62	11.46^{Bbc} ±0.62	9.59^{Cb} ±0.32

Mean values with superscript between treatment (a,b,c) and between interval (A,B,C) differ significantly (p<0.05).

The detail result of biochemical changes in diarrhoeic cattle calves pre and post treatment have been shown in Table-6. The mean value of serum sodium (mEq/L) was increased significantly in group T1 and T5 on day 3 (133.36^{Ab}±0.71), (132.61^{Ab}±1.07) and day 7 (134.93^{Ab}±0.44), (134.79^{Ab}±0.81) post treatment respectively as compared to day 0 (131.38^{Bb} ±0.77), (129.46^{Bb} ±1.20) pre treatment. The mean value of serum potassium (mEq/L) was decreased significantly in group T5 on day 3 (5.13^{Bb}±0.73) and day 7 (4.99^{Bb}±0.07) post treatment as compared to, day 0 (5.62^{A}±0.08) pre treatment also there was significant decrease on day 3 (5.16^{Bb}±0.11) post treatment as compared to day 0 (5.65^{Ab}±0.17) pre treatment in group T1. The mean value of serum chloride (mEq/L) was found to be significantly higher in group T1 and T5 comparably on day 3 (93.91^{Bb}±0.49), (93.59^{Bb}±0.51) and day 7 (95.69^{Ab}±0.26), (95.18^{Ab}±0.39) post treatment respectively as compared to day 0 (92.88^{Bb}±0.60) and (91.93^{Cb}±0.44) pre treatment. In the present study the mean value of total serum protein decreased non significantly post treatment as compared to day 0 pre treatment in group T5.

Table 6: Biochemical alterations of diarrhoeic calves in different treatment groups at different intervals

Groups	Serum sodium (mEq/L)		
	0 days	**3 days**	**7 days**
Tc	145.03^{a} ±1.73	144.37^{a} ±1.47	145.46^{a}±1.52
T1	131.38^{Bb} ±0.77	133.36^{Ab}±0.71	134.93^{Ab}±0.44
T2	131.64^{b} ±0.55	131.64^{b}±0.55	131.66^{c}±0.54
T3	131.09^{b} ±0.35	131.16^{b}±0.35	131.53^{c}±0.25
T4	130.76^{b} ±0.37	131.57^{b}±0.39	132.08^{c}±0.44
T5	129.46^{Bb} ±1.20	132.61^{Ab}±1.07	134.79^{Ab}±0.81
Serum potassium (mEq/L)			
Tc	4.27^{b}±0.24	4.30^{b}±0.73	4.59^{b}±0.22
T1	5.65^{Ab}±0.17	5.16^{Bb}±0.11	5.07^{Bb}±0.10
T2	5.19±0.26	5.04±0.23	4.90±0.25
T3	5.58^{b}±0.11	5.31^{b}±0.12	5.15^{b}±0.11
T4	5.57^{Ab}±0.09	5.26^{Ab}±0.10	5.14^{Ab}±0.09
T5	5.62^{A}±0.08	5.13^{Bb}±0.73	4.99^{Bb}±0.07
	Serum chloride (mEq/L)		
Tc	98.57^{a}±1.55	98.89^{a}±1.56	98.87^{a}±1.51
T1	92.88^{Bb}±0.60	93.91^{Bb}±0.49	95.69^{Ab}±0.26
T2	93.26^{b}±0.70	93.35^{b}±0.71	93.31^{b}±0.73
T3	93.13^{b}±0.75	93.26^{b}±0.73	93.31^{b}±0.76
T4	93.29^{b}±0.69	93.49^{b}±0.67	93.67^{b}±0.64
T5	91.93^{Cb}±0.44	93.59^{Bb}±0.51	95.18^{Ab}±0.39
Serum total protein (g/dl)			
	0 days	3 days	7 days
Tc	6.45^{b}±0.60	6.45^{b}±0.60	6.47^{b}±0.60
T1	7.38^{a}±0.10	7.26^{a}±0.08	7.14^{ab}±0.07
T2	7.66^{a}±0.13	7.61^{a}±0.12	7.61^{a}±0.13
T3	7.64^{a}±0.07	7.54^{a}±0.05	7.41^{a}±0.06
T4	7.56^{a}±0.11	7.56^{a}±0.11	7.42^{a}±0.12
T5	7.61^{Aa}±0.11	7.33^{ABab}±0.09	7.06^{Bab}±0.09

Mean values with superscript between treatment (a,b,c) and between interval (A,B,C) differ significantly (p<0.05).

On evaluation of the therapeutic efficacy of different RES used in the calves of various treatment groups (T1, T2, T3, T4 and T5) the result indicated that the T5 group in which RES-4 (Sodium Chloride, Sodium bicarbonate, Potassium chloride, Glutamine, Zinc) was given orally, was found to be most efficacious (90-95%), which is evident by the excellent clinical recovery in terms of rehydration status almost normal faecal consistency with restore suckling reflex and alertness with improved body posture, more pliable supple skin, increased brightness of eyes, moistness of muzzle with improved haemato-biochemical parameters.

Discussion

All sick calves had the usual yellow and watery diarrhoea. Calves with 4% to 8% dehydration (moderate) had a weak suckling reflex, dry mucus membrane, warm mouth and partly good muscular tone. Calves with 10% and above dehydration (severe) were unable to stand and had no suckling reflex and cold mouth with other general clinical symptoms [10]. The increase mean value of Hb in acute diarrhoeic calves was also reported by [8], advocating the reason as the haemo-concentration associated with the loss of large quantum of body fluid from the body, which was collaborated by [6]. However, [16] have explained the reason of increased mean value of Hb as dehydration which leads to decreased plasma volume. The increased mean PCV value found under the study during the phase of diarrhoea were in agreement with the findings of [4]. The increased PCV values in diarrhoeic calves were indicative of fluid loss from vascular compartment that can be corrected by overall rehydration solution therapy. The mean value of total erythrocyte count (million /µl) differed non significantly in all treatment groups at different intervals as compared to that of healthy control group on day 0 (pre treatment) day 3 and day 7 (post treatment). This is in conformity with the earlier reports of [5, 18] may be due to haemo-concentration. However, [13] had reported significant elevation of TEC values in all the scoured calves as probably due to haemo-concentration as a result of diarrhoea. Similar results of leukocytosis have been obtained by [13, 20]. The possible reason for leukocytosis might have occur due to normal reaction of body defence mechanism against infection [18].

The significantly (p<0.05) lower circulatory sodium titre signifying hyponatremia in the diarrhoeic buffalo calves in all treatment groups consistent with the earlier reports of [6] appeared to be the result from accelerated loss of the electrolytes in watery purgation. However, [16] emphasized that hyponatremia occurs due to excessive secretion of the sodium ions by intestinal villus, which is lost through the intestinal tract. [10] have reported hyperkalemia with metabolic acidosis in dehydrated neonatal ruminants and found that the heart rate increased linearly with serum potassium concentration upto K^{+}= 8 mEq/L. Similar results of hypochloremia were obtained by [8] the explanation for increasing chloride concentration is the temporary hepatic malfunction leading to increase capillary permeability with associate passage of particulate colloidal protein in to the tissues. The higher mean values of total serum protein, compared to the healthy control group on day 0 pre treatment also reported by [9]. This might have highlighted the potentially hazardous clinical status of acute tissue dehydration.

Conclusion

The evaluation of comparative efficacy of various rehydration electrolyte solutions (RES-1, RES-2, RES-3, RES-4) used as

therapy in acute diarrhoeic calves in various treatment group was studied. The overall results obtained under the present investigations have concluded that the therapeutic regimen adopted in the treatment of acute diarrhoeic calves under groups T5 in which RES-4 (Sodium Chloride, Sodium bicarbonate, Potassium chloride, Glutamine, Zinc) was given found to be most efficacious as evident by the improvement in clinical score in terms of rehydration, improved faecal consistency, suckling reflex and improved haemato-biochemical alteration.

Ethical approval: All of the procedures of this experiment were approved by the committee of ethics for research of college of veterinary science and animal husbandry, NDVSU, Jabalpur, I.D. No.VP/JB/07/2016.

Competing Interest Statement
Dr. Jaiswal has nothing to disclose.

Acknowledgment
The authors are thankful to the Dean, College of Veterinary Sciences and Animal Husbandry and Hon'ble Vice Chancellor of the University for providing all the facilities to conduct the study. The assistance of all the hospital staffs including T.V.C.C. is highly acknowledged.

Disclosure Statement
No potential conflict of interest was reported by the authors.

Ethical Approval
All of the procedures of this experiment were approved by the committee of ethics for research of college of veterinary science and animal husbandry, NDVSU, Jabalpur, I.D. No.VP/JB/07/2016.

References

1. Bartels CV, Holzhauer M, Jorritsma R, Swart WA and Lam TJ *et al*. Prevalence prediction and risk factors of enteropathogens in normal and non normal feaces of young Dutch dairy calves. Preventive Veterinary Medicine. 2010; 93:162-169.
2. Bijiwal DL and Mishra SK. Comparative studies of fluid therapies in experimental enteric coollibacillosis in calves. Indian Journal of Veterinary Medicine. 1987; 7:85-90.
3. Constable PD. Fluid and electrolyte therapy in ruminants. Veterinary Clinics of North America, 2003; 19:557-597.
4. Fernandes CE, Roy K, Shukla PC and Rao MLV *et al*. Changes in the Haematological profile in Calf Diarrhoea in Response to therapy. Intas Polivet, 2009; 10:214-215.
5. Galbat SA, El-Shemy A and Keshta HG *et al*. Clinical, hematological and some biochemical alterations in calves during diarrhoea. International Journal of Advanced Research, 2015; 3:191-196.
6. Ghanem MM, El-Fkhrany SF, Abd El-Raof YM and El-Attar HM *et al* 2012. Clinical and heamato biochemical evaluation of diarrheic neonatal buffalo calves with reference to antioxidant changes. Benha Veterinary Medical Journal (In press).
7. Groutides CP, Michell R. Changes in plasma composition in calves surviving or dying from diarrhea. British Veterinary Journal, 1990; 146: 205- 210.
8. Gupta R. 2016. Therapeutic efficacy of herbal formulations in diarrhoeic calves. M.V.Sc. thesis (Veterinary Medicine), Nanaji Deshmukh Veterinary Science University, Jabalpur.
9. Gupta R, Roy K, Shukla PC, Baghel RPS, Sharma V and Dutta IC *et al*. Therapeutic management of diarrhoea in buffalo calves with herbal electrolyte combination. Sri Lanka Veterinary Journal, 2016; 1: 1-4.
10. Guzelbektes H, Coskun A and Sen I *et al*. Relationship between the degree of dehydration and the balance of acid-based changes in dehydrated calves with diarrhoea. Bulletin of the Veterinary Institute in Pulawy, 2006; 51:83-87.
11. Judd B. 2004. Oral rehydration calves. http://www.VeterinaryPartner.com[17th August, 2004] nlm.nih.gov/pubmed/14608802>. Accessed, 2015.
12. Malik S, Verma AK, Kumar A, Gupta MK and Sharma SD *et al*. Incidence of calf diarrhoea in cattle and buffalo calves in Uttar Pradesh, India. Asian Journal of Animal and Veterinary Advances. 2012; 2:1049-1054.
13. Mir N. Rehydration and herbal therapy in calf diarrhoea. M.V.Sc. & A.H., Thesis (Veterinary Medicine) Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, 2009.
14. Mitchell AR, Brooks HW, White DG and Wagstaff AJ *et al*. The comparative effectiveness of three commercial oral solutions in correcting fluid, electrolyte and acid base disturbances caused by calf diarrhoea. British Veterinary Journal. 1992; 148:507-522.
15. Pourjafar M, Badiei K, Nadalian MG and Jafari JR *et al*. Effect of long term administration of frozen and fermented colostrum of vaccinated cows on performance and prevention of neonatal calf diarrhea. Pakistan Veterinary Journal. 2011; 31:199-202.
16. Radostits OM, Gay CC, Hinchcliff KW, Constable PD. In Veterinary Medicine: A Text Book of the Diseases of Cattle, Horses, Sheep, Pigs and Goats. 10th Ed, Saunders Elsevier, London, 2007, 851-876.
17. Radostits OM, Gay CC, Blood DC and Hinchcliff KW. Disease of the alimentary tract. A Textbook of Disease of Cattle, Sheep, Pigs, Goats and Horses. 10th Edn., Saunders publication co., Oxford, London, 2010, 99-100.
18. Shekhar S, Ranjan R, Singh CV, Kumar P, *et al*. Prevalence, Clinicohaemato-Biochemical alterations in colibacillosis in neonatal calves. International Journal of Current Microbiology and Applied Sciences. 2017; 9:3192-3198.
19. Snedecor GW, Cochran WG. Statistical Mehods. 8th Edn., The IOWA State University Press, USA, 1994.
20. Tikoo A, Soodan JS, Singh G and Singh I *et al*. Effect of various therapeutic regimens on the treatment of calf diarrhea and their effect on various clinico, hematobiochemical parameters. International Journal of Livestock Research. 2017; 7:174-183.
21. WHO. WHO drug information, 2002. http://apps.who.int/medicine does/en/d/Js4950e/2.4html