RESEARCH ARTICLE Indian Journal of Animal Research, Volume 55 Issue 11: 1347-1351 (November 2021)

A Study on Alteration in Serum Biochemical Parameters in Colibacillosis Affected Diarrhoeic Cattle Calves

T.C. Nayak, A.P. Singh, A. Chahar[1], Savita[2], R. Yadav[3], J.P. Kachhawa, S.R. Gupta

10.18805/IJAR.B-4502

ABSTRACT

Background: The objective of the present study was to evaluate the changes in serum biochemical parameters in colibacillosis affected diarrhoeic cattle calves below one month of age.

Methods: The study was undertaken at Veterinary Clinical Complex, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India, during the period from September 2018 to March 2019. A total of 32 calves affected with colibacillosis confirmed on the basis of Multiplex PCR (for presence of K99, Stx1 and eaeA genes of *E. coli*) and eight clinically normal healthy calves (as control) were taken to investigate the serum biochemical profiles.

Result: Analysis of serum samples of calves affected with colibacillosis revealed significant increase in the values of total protein, albumin, globulin, A/G ratio, blood urea nitogen, creatinine, potassium, total oxidant status andoxidative stress index while there is a significant decrease in the values of glucose, sodium, chloride, bicarbonate, IgG, IgM and total antioxidant status. There were no significant changes observed in the values of ALP, AST and ALT in affected calves as compared to healthy control group of calves.

Key words: Colibacillosis, Cattle calves, Diarrhoea, *E. coli*, Serum biochemistry.

INTRODUCTION

Diarrhoea in calves especially calves below one month of age is known as neonatal calf diarrhoea or calf scours. It is a common disease affecting newborn calves and they are more susceptible especially during the first 28 days of their lives. The greatest losses occur when calves are kept in close confinement, as chances for transmission of causative agents of neonatal calf diarrhoea (NCD) are enhanced. Causative agents attack the intestinal epithelium of the calves and cause diarrhoea, which results in poor absorption of essential nutrients and leads to weight loss and dehydration. There are numerous infectious causes of NCD like virus (rota virus, corona virus), bacteria (*E. coli* K99; *Clostridium perfringens* Type C, *Salmonella* spp.) and parasites (Cryptosporidia and Coccidia) (Stair *et al*., 1973; Constable *et al*., 2017). Calf diarrhoea caused by *E. coli* is referred to as colibacillosis, which is a very common and severe disease of cattle calves. There are many strains of disease causing (pathogenic) and non-disease causing (non-pathogenic) *E. coli*. The pathogenic strains which induce gastroenteric disease are known as diarrhegenic *E. coli* (DEC). DEC is subdivided into different pathotypes based on their virulence properties including enterotoxigenic *E. coli*, enterohemorrhagic *E. coli*, enteroaggregative *E. coli* and enteropathogenic *E. coli* (Natato *et al*., 1998). The serum biochemical alterations in calf diarrhoea are complex in nature comprising of serious imbalances of fluid, electrolyte, acid base status, enzymes and immunoglobulin status which may be life threatening in the affected animals, so it may be helpful in understanding these changes during the disease and treatment and thereby perceiving the prognosis. Keeping this in mind, the present study was conducted to evaluate the serum biochemical alterations in collibacillosis affected diarrhoeic cattle calves.

Department of Clinical Veterinary Medicine, Ethics and Jurisprudence, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner-334 001, Rajasthan, India.

[1]Department of Epidemiology and Preventive Veterinary Medicine, Rajasthan University of Veterinary and Animal Sciences, Bikaner-334 001, India.

[2]Department of Animal Husbandry and Dairying, Panchkula-134 109, Haryana, India.

[3]Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar-125 004, Haryana, India.

Corresponding Author: T.C. Nayak, Department of Clinical Veterinary Medicine, Ethics and Jurisprudence, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner-334 001, Rajasthan, India.
Email: tsubhashnayak@gmail.com

How to cite this article: Nayak, T.C., Singh, A.P., Chahar, A., Savita, Yadav, R., Kachhawa, J.P., Gupta, S.R. (2021). A Study on Alteration in Serum Biochemical Parameters in Colibacillosis Affected Diarrhoeic Cattle Calves. Indian Journal of Animal Research. 55(11): 1347-1351. DOI: 10.18805/IJAR.B-4502.

Submitted: 29-04-2021 **Accepted:** 19-07-2021 **Online:** 08-08-2021

MATERIALS AND METHODS

Animals

Present investigation was carried out in cattle calves aged below one month of age, showing classical clinical signs of diarrhea irrespective of sex and breed at private dairy farms, individual holdings and in Veterinary Clinical Complex, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India, during the period from September 2018 to

March 2019. A total of 32 diarrhoeic calves suffering from colibacillosis which were confirmed on the basis of multiplex PCR for presence of K99, Stx1 and eaeA genes of *E. coli* were taken for the present study. Eight clinically healthy cattle calves were also randomly selected and served as control to study normal biochemical parameters.

Serum biochemical profile

Serum biochemical parameters including glucose, total protein, albumin, globulin, alanine amino transferase (ALT), aspartate amino transferase (AST), alkaline phosphatise (AlKp), serum creatinine (SCK) and blood urea nitrogen (BUN) were estimated by using the IDEXX VetTest Chemistry Analyzer. Electrolyte estimation of serum samples for sodium, potassium, chloride and bicarbonate were carried out by using CKKlyte electrolyte analyzer (ARK diagnostics Bangalore pvt. Limited).Immunoglobulin G (IgG) and immunoglobulin M(IgM) status of serum samples were estimated by using total IgM and IgG EIA kit supplied by XEMA Co., Ltd. Russia (E03130Bo and E0010Bo). Estimation of total antioxidant status (TAS) and total oxidant status (TOS) was carried out in serum samples by using ELISA kit supplied by KINESISDx (K12-2200 and K12-5539). Calculation of oxidative stress index (OSI) was carried out by dividing TOS with TAS (OSI= TOS/TAS).The Principles, reagents required, procedure, calculation and precautions used for each of them were followed as per operator's manuals.

RESULTS AND DISCUSSION

Mean and standard error (SE) values of total serum protein (g/dl) in healthy control and calves affected with colibacillosis were 6.55±0.14 g/dl and 7.84±0.11 g/dl, respectively (Table 1). There was significant increase in the total serum protein in calves affected with colibacillosis. Mean±SE values of serum albumin (g/dl) and globulin (g/dl) in calves affected with colibacillosis (3.66±0.06 and 4.18±0.06) were also significantly higher in comparison with healthy calves (2.99±0.09 and 3.56±0.06), respectively. Shekhar *et al.* (2017) and Maharishi (2019) also reported similar findings in calves affected with diarrhoea. Hyperproteinaemia in the calves affected with colibacillosis in present study might be due to hypovolaemia, haemo-concentration and reduced glomerular filtration rate (Walker *et al*., 1998). Significant increase in serum albumin concentration in the diarrhoeic calves was also reported by Fernandes (2006) and Kaur *et al*. (2006). The hyper albuminemia in affected calves observed in the present study might be due to definitive bio-response to abnormal loss of body fluids. Mean±SE values of A/G ratio in the present investigation in the healthy control and colibacillosis affected diarrhoeic calves were 0.84±0.02 and 0.88±0.01, respectively. There was significant increase in the A/G ratio in diarrhoeic calves. Our findings were in agreement with the reports of Sharma (2013) and Maharishi (2019) who also reported significant increase in the A/G ration in diarrhoeic calves. The Mean±SE values of serum glucose (mg/dl) in healthy control and calves affected with colibacillosis were 59.75±1.89 and 45.63±0.86, respectively. There was significant decrease in serum glucose values in calves affected with colibacillosis. The findings in present study were in accordance with earlier reports of Sharma (2013), Singh *et al.* (2014), Shekhar *et al.* (2017) and Maharishi (2019) who also recorded significant hypoglycaemia in diarrhoeic calves. Hypoglycaemia in diarrhoeic calves might be due to inappetence/anorexia, decreased intestinal absorption of glucose and reduced rate of conversion of lactic acid to glucose (Morris *et al*., 1985).

Values of blood urea nitrogen (mg/dl) and serum creatinine (mg/dl) in healthy control group of calves were 20.13±1.02 and 0.69±0.04, whereas, in calves affected with colibacillosis, they were 27.09±0.42 and 1.69±0.01, respectively. There was significant increase in the mean values of blood urea nitrogen and serum creatinine in calves affected with colibacillosis as compared to healthy control group of calves. It is in agreement with the Walker *et al*. (1998), Grove-White and White (1999) and Singh *et al*. (2014) who also reported similar findings. Increase in blood urea nitrogen and serum creatinine values as found in the present study might be due to inadequate renal perfusion in the calves affected with colibacillosis (Constable *et al*., 2017).

Table 1: Mean±SE values of serum biochemical parameters of healthy control and calves affected with colibacillosis.

Parameters	Healthy calves (n=8)	Colibacillosis calves (n=32)	Statistical analysis (T test)
Protein (g/dl)	6.55±0.14	7.84±0.11	**
Albumin (g/dl)	2.99±0.09	3.66±0.06	**
Globulin (g/dl)	3.56±0.06	4.18±0.06	*
A:G ratio	0.84±0.02	0.88±0.01	**
Glucose (mg/dl)	59.75±1.89	45.63±0.86	**
BUN (mg/dl)	20.13±1.02	27.09±0.42	**
Creatinine (mg/dl)	0.69±0.04	1.69±0.01	**
ALP (U/L)	72.25±1.54	72.28±1.16	NS
ALT (U/L)	38.13±1.67	38.30±0.87	NS
AST (U/L)	16.50±0.51	16.59±0.39	NS

**=p<.01 *=p<.05; NS= Non significant (p>.05).

In the present study no significant alterations were observed in the values of ALP, ALT and AST which is in accordance with a similar earlier report of Lewis *et al*. (1975) and indicated the absence of marked hepatic damage in the colibacillosis affected diarrhoeic calves.

The values of serum electrolyte parameters of healthy control and calves affected with colibacillosis are depicted in Table 2. The values of serum sodium (mmol/L) in healthy control and calves affected with colibacillosis were 131.88±0.76 and 126.71±0.30, respectively. There was a significant decrease in the serum sodium levels in the affected calves as compared to control group, and similar findings have been reported by Sobiech *et al*. (2014), Singh *et al.* (2014), Bashir *et al.* (2015), Shekhar *et al.* (2017) and Maharishi (2019). Hyponatraemia in animals affected with diarrhoea occurs as a result of excessive secretion of the sodium ions by intestinal villus cells which are lost through the intestinal tract (Radostits *et al*., 2009).

The values of serum potassium (mmol/L) in calves affected with colibacillosis (5.56±0.05) were significantly increased as compared with healthy control calves (5.21±0.03). Our findings of hyperkalaemia in diarrhoeic calves were in agreement with earlier reports of Kumar *et al*. (2010), Mir *et al*. (2010), Sharma (2013), Singh *et al.* (2014), Bashir *et al.* (2015), Shekhar *et al.* (2017) and Maharishi (2019) and this might be due to increased retention of K^+ ion by kidney, increased tubular reabsorption of K^+ ion in response to acidosis and due to cellular damage. In addition, movement of K^+ ion from intracellular to extracellular fluid might also plays as contributory factor for hyperkalaemia in the affected calves (Tasker, 1991). The mean±SE values of serum chloride (mmol/L) in healthy control and calves affected with colibacillosis were 98.05±0.97 and 95.69±0.42, respectively. Findings of the present investigation revealed that there was significant decrease in the serum chloride concentration in calves affected with colibacillosis as compared to healthy control group of calves, which was also supported by the earlier findings of Bellino *et al*. (2012), Sharma (2013), Singh *et al.* (2014), Sobiech *et al*. (2014), Bednarsk and Kupczyñski, (2015) and Maharishi (2019). In contrary to the findings of present investigation, Mir *et al*. (2010), Bashir *et al.* (2015) and Shekhar *et al.* (2017) observed hyperchloraemia in diarrhoeic calves. Increased loss of chloride ion in the intestinal tract during diarrhoea and failure of gastric H^+ and Cl^- ion to be reabsorbed by the villus of small intestine (Radostits *et al*., 2009) might be the most probable reason of hypochloraemia found in the affected calves during present investigation.

The mean±SE values of serum bicarbonate (mEq/L) in healthy control and colibacillosis affected calves were 23.84±0.26 and 15.60±0.23, respectively. There was significant decrease in the serum bicarbonate concentration in calves affected with colibacillosis than the healthy control group of calves. Similarly, Kamal (2008) also found a decrease in serum bicarbonate values during a study in diarrhoeic cattle calves. Electrolyte imbalance marked by high H^+ ions concentration concurrent with $NaHCO_3^-$ deficit resulted in metabolic acidosis.

Mean±SE values of Immunoglobulin G (mg/ml) and Immunoglobulin M (mg/ml) in healthy control group of calves

Table 2: Mean±SE values of serum electrolyte parameters of healthy control and calves affected with colibacillosis.

Parameters	Healthy calves (n=8)	Colibacillosis calves (n=32)	Statistical analysis (T test)
Serum sodium (mmol/L)	131.88±0.76	126.71±0.30	**
Serum potassium (mmol/L)	5.21±0.03	5.56±0.05	**
Serum chloride (mmol/L)	98.05±0.97	95.69±0.42	**
Serum bicarbonate (mEq/L)	23.84±0.26	15.60±0.23	**

Par**=p<.01; *=p<.05.

Table 3: Mean±SE values of Immunomodulation related parameters (IgG and IgM) of healthy control and calves affected with colibacillosis.

Parameters	Healthy calves (n=8)	Colibacillosis calves (n=32)	Statistical analysis (T test)
IgG (mg/ml)	18.24±0.76	14.68±0.31	**
IgM (mg/ml)	1.63±0.07	0.70±0.02	**

**=p<.01; *=p<.05.

Table 4: Mean±SE values Oxidative stress related parameters of healthy control and calves affected with colibacillosis.

Parameters	Healthy calves (n=8)	Colibacillosis calves (n=32)	Statistical analysis (T test)
TAS (mmol Trolox Equiv./L)	0.59±0.03	0.52±0.01	*
TOS (µmol H_2O_2 Equiv./L)	11.28±0.36	14.08±0.35	**
OSI	19.31±0.22	27.02±0.52	**

**=p<.01; *=p<.05.

were 18.24±0.76 and 1.63±0.07, whereas; in calves affected with colibacillosis 14.68±0.31 and 0.70±0.02, respectively (Table 3). There was significant decrease in the serum IgG and IgM values in colibacillosis affected diarrhoeic calves. Gay *et al*. (1965) reported association of colibacillosis with the deficiency of plasma immunoglobulins. Thronton *et al*. (1972) and Manoiu *et al*. (1972) observed low gamma-globulin in diarrhoeic and dehydrated calves. The risk of development of infectious diseases is greater in calves in which there has been failure of passive transfer of maternal immunoglobulins (Gay, 1983). Chand and Pandey (2010) reported that suckling method of colostrum feeding predisposes calves for development of diarrhoea due to lower level of IgG (14.61±2.62 mg/ml) in such calves. However, Gutzwiller (2002) reported that serum IgG concentration was not correlated with diarrhoea.

Mean±SE values of total antioxidant status (mmol Trolox Equiv./L), total oxidant status (µmol H_2O_2 Equiv./L) and oxidative stress index (OSI) (TOS/TAS) in healthy control group of calves were 0.59±0.03, 11.28±0.36 and 19.31±0.22, respectively, whereas, in calves affected with colibacillosis were 0.52±0.01, 14.08±0.35 and 27.02±0.52, respectively (Table 4). There was a significant increase in the total oxidant status andoxidative stress index in the calves affected with colibacillosis, however, there was significant decrease in total oxidant status. Our findings are in agreement with the study conducted by Kabu *et al*. (2015). Similarly, many researchers also reported an increase in the values of TOS in many other diseases. Altindag *et al*. (2007) reported the higher TOS in the patients with osteoarthritis compared to the control group. Aslan *et al*. (2011) demonstrated that TOS levels were significantly higher in patients with ulcerative colitis while TAC was significantly lower. This rise of total oxidant status and decreased TAC appeared to be possibly associated with stress caused by the disease (Kabu *et al*., 2015).

REFERENCES

Altindag, O., Kocyigit, A., Çelik, N., Çelik, H. and Soran, N. (2007). DNA Damage and oxidative stress in patients with osteoarthritis: A pilot study. Rheumatism. 22: 60-63.

Aslan, M., Nazligu, Y., Bolukbas, C., Bolukbas, F.F., Horoz, M., Dulger, A.C., Erdur, F.M., Celik, H. and Kocyigit, A. (2011). Peripheral lymphocyte DNA damage and oxidative stress in patients with ulcerative colitis. Polskie Archiwum Medycyny Wewnetrznej-Polish Archives of Internal Medicine. 121: 223-9.

Bashir, S., Ashraf, I., Dar, A.M., Majid, A., Bhat, A. and Farooq, J. (2015). Isolation and detection of *Escherichia coli* from diarrhoeic calves along with biochemical and hematologic parameters. Journal of Cell and Tissue Research. 15(2): 5059-5061.

Bednarsk, I.M. and Kupczyñski, R. (2015). Analysis of acid-base disorders in calves with lactic acidosis using a classic model and strong ion approach. Turkish Journal of Veterinary and Animal Sciences. 39(5): 615-620.

Bellino, C., Arnaudo, F., Biolatti, C., Borrelli, A., Gianella, P., Maurella, C. and D'Angelo, A. (2012). Development of a diagnostic diagram for rapid field assessment of acidosis severity in diarrheic calves. Journal of the American Veterinary Medical Association. 240(3): 312-316.

Chand, N. and Pandey, N.N. (2010). Serum immunoglobulin-G concentration in calves fed colostrum. Indian Veterinary Journal. 87(2): 183-184.

Constable, P.D., Hinchcliff, K.W., Done, S.H. and Grünberg, W. (2017). Veterinary Medicine: A Textbook of the Diseases of Cattle, Sheep, Pigs, Goats and Horses. 11th edn. Elsevier Health Sciences. 2: 1879-1899.

Fernandes, C.E. (2006). Etiology and therapeutic management of calf diarrhoea M.V.Sc. Thesis (Veterinary Medicine) Jawaharlal Nehru KrishiVishwaVidyalaya, Jabalpur, India.

Gay, C.C. (1983). Failure of passive transfer of colostral immunoglobulines and neonatal diseases in calves. A review. VIDO in proceedings. 4th Int. Symp. Neonatal diarrhoea. 346-364.

Gay, C.C., Anderson, N., Fisher, E.W. and McEwan, A.D. (1965). Gamma globulin levels and neonatal mortality in market calves. Veterinary Record. 77: 148-149.

Grove- White, D.H. and White, D.G. (1999). Abdominal distension in collapsed diarrhoeic calves: Biochemical findings and treatment. Veterinary Record. 144: 639-642.

Gutzwiller, A. (2002). Effect of colostrum intake on diarrhoea incidence in new-born calves. Schweiz Arch Tierheilkd. 144(2): 59-64.

Kabu, M., Cigerci, I.H., Uyarlar, C. and Celik, H.A. (2015). Determination of pre and post treatment oxidative status and oxidative DNA damage in diarrheic calves. Indian Journal of Animal Research. 49(6): 830-833.

Kamal, A. (2008). Biochemical studies in Swiss Holstein calves affected by diarrhoea. Research in Veterinary Science. 1(1): 16-27.

Kaur, K., Randhawa, S.S. and Chhabra, S. (2006). Haemato-biochemical profile of diarrhoeic dairy calves affected with colibacilosis. Indian Journal of Veterinary Medicine. 26(1): 9-11.

Kumar, B.K., Shekher, P. and Kumar, N. (2010). A clinical study on neonatal calf diarrhoea. Intas Polivet. 11(2): 233-235.

Lewis, L.P., Phillip, R.W. and Elliot (1975). C.D.: Changes in plasma glucose and lactate concentration and enzyme activities in the neonatal calf with diarrhoea. American Journal of Veterinary Research. 36: 413-16.

Maharishi, T. (2019). Therapeutic study of A*eglemarmelos* in calf diarrhoea. M.V.Sc. Thesis submitted to RAJUVAS, Bikaner (Rajasthan).

Manoiu, I., May, I., Costia, V., Marschang, A. and Sinchievici, B. (1972). Changes in blood values in dehydration due to enteritis in calves and their management. Lucrariale, Institutute de Carcetari Veterinaresi Biopreparate. Pasteur. 8: 95-110. Veterinary Bulletin. 42: 6415.

Mir, N., Shukla, P.C., Baghel, R.P.S., Dixit, P. and Saroori, A.R. (2010). Haematobiochemical profile of diarrhoeic calves. Veterinary Practitioner. 11(1): 66-68.

Morris, J.A., Wells, G.A.H., Scott, A.C. and Sojka, W.J. (1985). A comparison of methods for demonstrating colonization in the small intestine of piglets by enterotoxigenic *E.coli*. British Veterinary Journal. 141: 484-489.

Natato, J.P. and Kaper, J.B. (1998). Diarrheagenic *Escherichia coli*. Clinical Microbiology Reviews. 11: 142-201.

Radostits, O.M., Gay, C.C., Blood, D.C. and Hinchcliff. (2009). Veterinary Medicine. A Text Book of Diseases of Cattle, Sheep, Pigs, Goats and Horses. 10th edn., New York, W.B. Saunders Company Ltd. pp. 779-781.

Sharma, S.K. (2013). Epidemiological, clinical and haemato-biochemical characterization of calf diarrhoea and evaluation of therapeutic eegimens. Ph.D. Thesis submitted to RAJUVAS, Bikaner (Rajasthan).

Shekhar, S., Ranjan, R., Singh, C.V. and Kumar, P. (2017). Prevalence, clinicohaemato-biochemical alterations in colibacillosis in neonatal calves. International Journal of Current Microbiology. 6(9): 3192-3198.

Singh, M., Gupta, K.V., Mandal, B.D., Bansal, K.S., Sharma, K.D., Shakya, M. and Gopinath, D. (2014). A study on alteration in haematological parameter in colibacillosis affected calves. International Journal of Advanced Research. 2(7): 746-750.

Sobiech, P., Rekawek, W., Ali, M., Targonski, R., Zarezynska, K. Snarska, A. and Stopyra, A. (2014). Changes in blood acid-base balance parameters and coagulation profile during diarrhoea in calves. Polish Journal Veterinary Science. 16(3): 543-549.

Stair, E.L., Mebus, C.A., Twiehaus, M. and Underdahl, N.R. (1973). Neonatal calf diarrhoea electron microscopy of intestines infected with a Reovirus-Like Agent. Veterinary Pathology. 10: 155.

Tasker, J.B. (1991). Fluids, Electrolytes and Acid Base Balance. In: Clinical Biochemistry of Domestic Animals. Vol. II, 2nd edn. Academic press, New York.

Thronton, J.R., Willoughby, R.A. and McSherry, B.J. (1972). Studies on diarrhoea in neonatal calves: The plasma proteins of normal and diarrhoeic calves during first 10 days of age. Canadian Journal of Comparative Medicine. 36: 17-25.

Walker, P.G., Constable, P.D., Morin, D.E., Foreman, J.H., Drackley, J.K. and Thurmon, J.C. (1998). Comparison of hypertonic saline dextran solution and lactated Ringer's solution for resuscitating severely dehydrated calves with diarrhoea. Journal of the American Veterinary Medical Association. 213: 113-22.