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Short Communication

A Study on the Correlation of Serum Electrolytes and Trace Elements along with Associated Risk Factors in Diarrheic Buffalo and Cattle Calves

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Authors' Contributions
MI designed and executed the study. FA did sampling. ZA and FA processed the samples. MZH and UI compiled and analyzed the data statistically. KM, FA and UI wrote the manuscript. MI reviewed the manuscript.

Key words
Serum electrolytes, Trace elements, Diarrheic calves.

ABSTRACT

Diarrhea is a leading factor towards calf fatality and among common diseases of the calves worldwide which cause huge economic losses for the dairy and beef industry. For this study 120 clinically affected calves (n=60 cattle calves; n=60 buffalo calves) under one month of age irrespective of cause of diarrhea was selected from different livestock farms located in the outskirts of Lahore. The result showed that there was increased in packed cell volume (%) in their blood profile. The sodium and potassium concentration in ppm significantly increased (P< 0.001) while the calcium, copper and iron concentration in ppm significantly decreased (P< 0.001) in the calves having diarrhea. Copper concentration is related to the packed cell volume as in anemia copper deficiency is a significant feature. It was concluded that neonatal calf diarrhea is much common in calves and diarrhea have a significant correlation with serum electrolytes and trace elements.

According to economic survey of Pakistan livestock sector contributed almost 56.3 % of the agriculture share and 11.8 % to GDP of Pakistan, during 2014-2015. The cattle and buffaloes population has been estimated about 41.2 and 35.6 million (M), respectively which yielded 40.709 M tons milk and 1.951 M tons beef during 2014-2015 for human intake (Anonymous, 2015). Diarrhea is a leading factor towards the death of calves and is among common diseases of the calves worldwide (Pourjafar *et al*., 2011), it result in major economic losses in dairy industry. The cause of calf diarrhea may be infectious or non-infectious (Elhassan *et al*., 2011) but bad hygiene, overpopulation, overfeeding, hot/cold temperature, feeding the calves artificially and the colostrum deprivation are all predisposing factor in the complex etiology of the disease (Hemashenpagam *et al*., 2009). The degree of dehydration is estimated by the physical examination of calf and has been introduced as a reliable method (Rodastitis *et al*., 2009). In order to evaluate the serum electrolytes as well as the acid-base imbalance, there is a need of laboratory tests. Although it is understood that serum concentrations of potassium (K) and sodium (Na) are very much necessary with reference to the fluids composition used for treatment purpose (Rucker *et al*., 2008). However, information about the changes of calcium, magnesium, copper, iron and other trace minerals is lacking. Untreated changes in the serum concentrations of Ca, Mg and some trace elements may be the root of cause of some death or it changes post diarrhea complications such as growth retardation (Tajik and Nazifi, 2013). Keeping in view the importance of ruminant in our country and economical losses due to calf diarrhea this project was designed to study the correlation of serum electrolytes and trace elements along with associated risk factors in diarrheic buffalo and cattle calves.

Materials and methods

Present study was conducted at different livestock farms situated in the outskirts of district Lahore. A total of 120 calves (n=60 cattle calves; n=60 buffalo calves) clinically affected with diarrhea under one month of age irrespective of cause of diarrhea and 10 calves (n=05 cattle calves; n=05 buffalo calves) negative for diarrhea as a

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control were selected randomly for the present study. First serum was separated from 10 ml collected bloods of each calf. The samples were then allowed to clot for 30 min and centrifuged at 3,500 rpm for 5 min. The serum samples thus collected were stored at -20 °C until further analysis as described by Ijaz *et al*. (2019); Tajik and Nazifi (2013). All serum samples were prepared by Wet Digestion briefly, 0.5 ml serum sample was digested with 10 ml concentrated nitric acid at low temperature in a 100 ml digestion flask for 15-20 min until the contents in the flask were clear and the colorless material was left at the end. After that the contents were cooled and diluted up to 20 ml with distilled water in a volumetric flask and separated for the analysis of different minerals (Akhter *et al*., 2007). The blood samples were analyzed for packed cell volume (PCV) which was measured by using micro hematocrit method as described by Nazifi *et al*. (2003). The serum samples were analyzed for the determination of electrolytes and some trace elements such as calcium (Ca), sodium (Na) copper (Cu), lithium (Li), potassium (K) and iron (Fe) by using atomic absorption spectrophotometer (Nazifi *et al*., 2003) at Quality Operations Laboratory, UVAS, Lahore. The data obtained for serum electrolytes was analyzed with student's *t*-test using statistical package for social sciences (SPSS) version 17.0 (SPSS Inc., Chicago, IL, USA).

Table I.- The blood packed cell volume (%) of cow and buffalo calves with respect to breed.

Breeds of calves	Diarrheic calves (Mean ± SD)	Healthy calves (Mean ± SD)
Holstein	52.60±2.62*	39.20±2.11
Cross bred	54.30±2.71*	43.00±2.19
Sahiwal	53.80±2.48*	41.80±2.23
Nili Ravi	53.84±2.59*	42.80±2.35
Kundi	52.96±2.69*	43.20±2.38

*significant difference (P<0.05).

Results

The PCV values in all the diarrheic calves of cattle and buffalo were significantly higher than the normal range because the body of diarrheic calves exhibited dehydration that leads towards increased packed cell volume (%) in their blood profile. The Serum samples were analyzed for estimating the concentrations of electrolytes and trace elements in both cattle and buffalo diarrheic calves. In the serum sample of diarrheic as well as control group of both cattle and buffalo calves, the concentration of sodium, potassium, calcium, copper, zinc and lithium were evaluated. Serum sodium and potassium was measured in different breed groups of buffaloes and cattle, the P value of every breed was less than 0.05. It shows that in diarrheic calves of both species, the sodium and potassium concentration in ppm significantly increased from its normal values. The increase in potassium level in blood enhance the chances of cardiac failure occurred.

The calcium value in ppm was calculated from the serum of each diarrheic and control group. Serum calcium P value was less than 0.05 which shows that in diarrheic calves of both species; the calcium concentration in ppm significantly decreased from its normal values. In some diarrheic calves, increased calcium was also observed because these calves have blood in their feces that result in the calcium to come in blood as a clotting factor.

Table II.- The average serum mineral level (ppm) of cattle and buffalo calves with respect to breed.

Name of mineral	Breeds of calves	Diarrheic calves (Mean ± SD)	Healthy calves (Mean ± SD)
Sodium	Holstein	2378.5±3.2*	3404.0±3.3
	Cross bred	2477.4±3.2*	3388.0±3.1
	Sahiwal	2322.0±4.6*	3396.0±4.9
	Nili Ravi	2386.0±5.2*	3508.0±5.3
	Kundi	2338.8±3.2*	3412.0±3.3
Potassium	Holstein	275.5±2.1*	177.6±2.3
	Cross Bred	262.4±2.2*	173.5±2.3
	Sahiwal	259.7±2.1*	177.8±2.1
	Nili Ravi	267.6±2.4*	176.4±2.2
	Kundi	291.4±2.5*	164.8±2.3
Calcium	Holstein	91.80±1.20*	112.60±1.09
	Cross bred	90.48±1.26*	104.50±1.19
	Sahiwal	92.39±1.33*	105.90±1.39
	Nili Ravi	88.86±1.50*	107.20±1.40
	Kundi	88.60±1.38*	106.80±1.30
Copper	Holstein	0.53±0.03*	2.20±0.09
	Cross bred	0.44±0.02*	2.20±0.07
	Sahiwal	0.39±0.03*	2.11±0.06
	Nili Ravi	0.48±0.04*	2.15±0.08
	Kundi	0.58±0.05*	2.20±0.07
Iron	Holstein	1.03±0.02*	1.53±0.03
	Cross bred	1.00±0.03*	1.54±0.04
	Sahiwal	1.01±0.05*	1.54±0.03
	Nili Ravi	0.93±0.02*	1.47±0.03
	Kundi	0.88±0.04*	1.42±0.02
Lithium	Holstein	0.07±0.01	0.14±0.01
	Cross bred	0.07±0.01*	0.19±0.01
	Sahiwal	0.10±0.01*	0.20±0.01
	Nili Ravi	0.08±0.01*	0.22±0.02
	Kundi	0.19±0.02*	0.24±0.02

*significant difference (P<0.05).

Trace elements such as Cu, Fe and Li are needed in a very little concentration for many physiological functions.

The decrease in these trace elements showed its effects in post-diarrheic complications. Serum copper and iron was also measured in different breed groups of buffaloes and cattle calves; the P value was less than 0.05. The serum copper and iron concentration significantly decreased in the calves having diarrhea. Copper concentration is related to the packed cell volume as in anemia copper deficiency is a significant feature. The serum iron significantly decreased as iron is also in correlation with the copper, because copper is needed for the mobilization, utilization and absorption of the iron in the calf's body. Serum lithium was also measured in while its P value was greater than 0.05. The serum lithium level was not affected by the diarrhea in calves so there is no significant difference between control group and diarrheic group. Analysis by t-test in tabulated form is shown in Table II.

Discussion

Diarrhea results in deprivation of health and decrease in production potential of animals. The different causes of diarrhea includes change in environment, nutritional factor, change in nutrition, infectious agent *viz*. viral infection, bacterial infection, fungal infection (Dratwa-Chałupnik *et al*., 2012). Brooks *et al*. (1996) studied the serum concentrations to the measure serum electrolytes and trace elements. Berchtold (2009) considered that electrolyte disturbance occur during every cases of calf diarrhea and these changes cannot be predicted with clinical signs, and so the laboratory test is necessary for properly examination. In diarrheic calves there are changes in serum Na and serum K values. Our results also co-relate with his study that changes in Na and K in blood serum of diarrheic cattle and buffalo calves are significantly different. The normal serum concentration of Ca in cow has been reported as 2.43-3.1 mmol/L that is equal to 108-112ppm (Kaneko *et al*., 2008) and the mean serum Ca in diarrheic calves was 1.297 mmol/L. Hypocalcaemia has been diagnosed as a cause of hypothermia in ruminants (Rodastitis *et al*., 2009), which may explain the observed relationship between Ca and diarrhea in the current study.

PCV is used as an index for the estimation and quantification of hydration status in the calves (Constable *et al*., 2005). It is considered that PCV is the best indicator for the diagnosis of changes in hydration status (Michell *et al*., 1992). The normal value of PCV is 24-48% in cattle and 24-36 % in buffaloes. Serum copper concentration had a significant correlation with PCV ($r=-0.56$, $P<0.001$). In our study serum copper concentration had a significant correlation with PCV in buffaloes ($r=0.541$, $P< 0.001$) and in cattle ($r=0498$, $P< 0.001$). These findings satisfied the conclusions of Rucker *et al*. (2008). Berchtold (2009) studied on serum electrolytes relationship with age of calves as well as trace minerals.

Findings of Butler *et al*. (1971) were on study of early age diarrheic young calves, there are changes in serum concentrations of Na and K and association with clinical signs have been considered. There is little variations in other serum electrolytes such as serum calcium (Ca) and trace elements when animal suffering from clinical diarrhea. In the present study changes in Na, K and Ca were measured in diarrheic calves of different breeds of cattle and buffalo which are in congruent with the findings of Butler *et al*. (1971). According to the results of the current study, breed, species and age can be used in selection of Ca concentration in fluid therapy regime, and PCV, calf age and disease length can be used to make a decision about the copper supplementation in treatment of diarrheic calves. Trace elements like copper, iron and lithium are involved in the immunity, antioxidant function, growth and reproduction, so untreated decrement of some trace elements may be the cause of some death or post diarrhea complications such as growth retardation. Although, additional studies with greater sample size are needed to confirm these results

Statement of conflict of interest

The authors declare no conflict of interest.

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