Journal of Animal Research: v.13 n.04, p. 597-602. August 2023

DOI: 10.30954/2277-940X.04.2023.16

Relationship between Passive Immunity and Health Status of New Born Cattle and Buffalo Calves

Adil Majid Bhat[1*], Sikh Tejinder Singh[1], Ravinder Singh[2] and Ravi Singh Grewal[1]

[1]*Directorate of Livestock Farms, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab, INDIA*
[2]*Department of Veterinary Medicine, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab, INDIA*

**Corresponding author: AM Bhat; E-mail: adil.majid724@gmail.com*

Received: 25 May, 2023 **Revised:** 14 July, 2023 **Accepted:** 18 July, 2023

ABSTRACT

The aim of our study was to evaluate association between failed transfer of passive immunity (FTPI) and health of bovine calves. A prospective study on seventy four (Cattle - 18 and Buffalo - 56) new born calves was planned to evaluate the impact of passive immunity on morbidity and mortality in first two months of life. Serum total protein (STP) in g/dl between 24-48 hrs after birth was kept as standard for passive transfer. Based on levels of STP (g/dl) the calves were classified as having excellent (STP > 6.2 g/dl), good (STP = 5.8-6.1 g/dl), fair (STP = 5.1- 5.7) and poor (STP <5.1 g/dl) passive transfer. The calves were monitored for occurrence of disease especially neonatal calf diarrhoea (NCD) and mortality upto 60 days of age. The occurrence of FTPI was significantly (P<0.05) higher in buffalo as compared to cattle calves (11.1 % vs 37.5 %). Nili ravi breed of buffalo had higher odds of having FTPI as compared to murrah. With respect to disease occurrence the onset of NCD was delayed in calves without FTPI as compared to calves with FTPI. The odds of NCD in buffalo calves with excellent passive transfer (STP > 6.2 g/dl) was significantly (P < 0.05) lower as compared to calves with poor passive transfer (STP < 5.1 g/dl). The study concluded FTPI was higher in buffalo calves in comparison to cattle calves reared under same management system. The odds of mortality was higher in buffalo calves with poor passive transfer (OR = 1.2 ; 95 % CI = 0.27-5.24) as compared to calves with excellent passive transfer. Efficiency of passive transfer was found to influence NCD and mortality in new born calves.

HIGHLIGHTS

- Evaluate the association between failed transfer of passive immunity (FTPI) and health of bovine calves.
- FTPI was higher in buffalo calves in comparison to cattle calves.

Keywords: Passive immunity, calf, serum total protein, neonatal calf diarrhea, mortality

Calfhood is considered as the most sensitive period in ruminants as there is high risk of disease occurence and mortality (Souza *et al*., 2020). During this period, the calves are susceptible to different diseases (enteric and respiratory) caused by pathogens like *Escherchia coli*, *Pasteurella spp., Rotavirus*, *Cryptosporidium parvum*, *Corona virus* and occasionally *Bovine viral diarrhea virus* (Lora *et al*., 2018; Souza *et al*., 2020).

Neonatal calf diarrhea (NCD) and perinatal mortality are the main causes of death in calves upto one month of age (Lora *et al*., 2018). Calves that survive NCD may develop other diseases including pneumonia (Bovine Respiratory Disease), naval ill, joint ill, septicaemia and decreased growth rate (Brar *et al.* 2017). Bovine calves are born either with complete or partial deficit of immunoglobulin's (Ig's) and depend on Ig's present in colostrum of dam (Souza *et al*., 2019). Immunoglobulin G (IgG) is the main Ig responsible for immunity in the neonatal period and contributes about 90 % of total Ig content of colostrum (Godden, 2019). Testing of new born calves for FTPI is essential in monitoring the colostrum intake and preventing

How to cite this article: Bhat, A.M., Singh, S.T., Singh, R. and Grewal, R.S. (2023). Relationship between Passive Immunity and Health Status of New Born Cattle and Buffalo Calves. *J. Anim. Res.,* **13**(04): 597-602.

Source of Support: None; **Conflict of Interest:** None

disease occurrence in new born calves (Godden, 2019). FTPI tests are usually done in calves 24-48 hours after birth (Godden, 2019). Alternatively, STP (g/dl) can be used to assess the passive immunity in calves with STP concentration of ≥ 5.2 g/dl considered as indicative of adequate transfer of immunity (Calloway *et al*., 2002).

The present study was conducted on new born calves to evaluate the relationship between passive immunity and health status during first 60 days of life. There is abundant literature available on passive transfer in cattle calves, however very few studies are available on passive transfer and its impact on health of buffalo calves.

MATERIALS AND METHODS

Study overview

The study was conducted from March to October, 2022 at a dairy farm with herd strength of 444 buffaloes and 285 cattle. The breeds reared at the farm include buffalo: Murrah and Nili-ravi and cattle: Holstein Friesian crossbred (HF-CB) and Sahiwal.

Seventy four live cattle (18) and buffalo (56) calves were born at the farm during the study period. Among the selected calves 36 were male and 38 female. Breed-wise the number of calves includes: Murrah (39), Nili-Ravi (17), HF-CB (14) and Sahiwal (4). All the calves enrolled in the study were kept under same management system. Post birth the calves were immediately separated from dam and placed in individual pens. Naval disinfection was performed with 7 % tincture of iodine immediately after birth. The calves were dewormed by oral administration of pyrantel pamoate (10 mg/kg) at 10 and 30 days of age. Primary vaccination against foot and mouth disease and hemorrhagic septicaemia was done at the age of 3 months followed by booster dose at four month age. The new born calves were hand-fed colostrum by the local staff as per farm procedures. On average the individual calf was fed 2.5 - 3 litres of colostrum in first 24 hours of life. Subsequent colostrum feedings were done at milking times which were 0500 and 1600 hrs.

Screening for passive transfer

The new born calves were screened for successful passive transfer by indirect method using STP (g/dl) as a standard. Blood (5 ml) was collected from the new born calves at 24-48 hours of age and serum was separated immediately for analysis.

Based on efficiency of passive transfer the calves were classified as excellent (STP > 6.2g/dl), good (STP = 5.8-6.1 g/dl), fair (STP = 5.1- 5.7) and poor (STP <5.1 g/dl) (Godden *et al*., 2019). The calves were monitored for disease occurrence and mortality from birth to 60 days of age. The disease recorded includes neonatal calf diarrhea, respiratory disorders, septicemia and naval ill.

STATISTICAL ANALYSIS

Statistical analysis was done in SPSS software (Software version 16.0- SPSS Inc). All statistical analysis was done assuming significance level (*P-value*) to be <0.05. The mean values between groups were evaluated by independent *t-test* and ANOVA. The effect of FTPI on disease and mortality occurrence was evaluated by logistic regression.

RESULTS AND DISCUSSION

The aim of our study was to evaluate the impact of passive immunity on health and mortality of cattle and buffalo calves. There has been lot of work done on effect of passive immunity on health of cattle calves however literature regarding buffalo calves is scant. In this study effort was made to compare the passive transfer in buffalo and cattle calves.

The gold standard method of assessing passive immunity in domestic animals is done by estimation of immunoglobulin G (IgG) levels in the calf serum by single radial immunodiffusion (SRID) test (Dunn *et al*., 2018). The test is expensive and is not feasible to routinely screen the animals for passive immunity. In our study, the calves were screened for passive immunity using STP (g/dl) as a standard. STP of ≥ 5.2 g/dl are suggestive of adequate transfer of immunity (Tyler *et al*., 1996). As IgG's are the major protein constituent of colostrum, the increase in STP (g/dl) in newborn calf is exclusively attributed to absorption of colostrum (Hogan *et al*., 2015). Samples were collected from the calves between 24 – 48 hour after birth as sampling before 24 hours underestimates the adequacy of passive transfer (Trotz-williams *et al*., 2008).

STP (g/dl) and GGT (u/l) and percent calves with FTPI are given in Table 1. In the present study, STP (g/dl) of cattle and buffalo calves ranged from 3.5 – 9.3 and 4 – 7.8, respectively with a mean of 6.2 ± 1.23 and 5.49 ± 0.12, respectively. Similarly, GGT (U/L) of newborn cattle and buffalo calves ranged from 367 – 4677 and 49 – 3287, respectively with a mean of 576.61 ± 72.85 and 1290.27 ± 272.17, respectively. Similar results have been reported by other workers (Lora *et al*., 2018; Renaud *et al*., 2020). In our study, the mean STP (g/dl) in buffaloes was lower as compared to other studies (Chigerwe *et al*., 2015; Souza *et al*., 2019).

The mean STP and GGT levels was significantly higher ($P<0.05$) in cattle calves as compared to buffalo calves. Overall, the FTPI was significantly higher in buffalo calves as compared to cattle calves (37.5 % vs 11.11%; $P<0.05$). The incidence of FTPI in cattle calves was lower as compared to reports from other workers. Various studies have reported lower intake of colostrum by buffalo calves that are immediately separated from the dam (Chaudhary *et al*., 2022). Chaudhary *et al*. (2022) reported the average intake of colostrum by buffalo calves reared in full time contact with dam was significantly higher (P<0.05) as compared to buffalo calves separated immediately from dam after birth. The reason for lower colostrums intake may be due to strong maternal instinct of buffalo calves and their slow learning behavior to drink colostrums from pail under artificial feeding system (Vecchio *et al*., 2013; Bharti *et al*., 2018; Singh *et al*., 2018).

Previous studies on FTPI in cattle calves have reported the prevalence of 20% and 41% (Lora *et al*., 2017; Lora *et al*., 2018; Renaud *et al*., 2020). A study in South Australia reported the FTPI in cattle calves ranged from 6.5% to 52% (Skirving *et al*., 2022).

Table 1: Serum Total Protein, GGT and % FTPI in buffalo and cattle calves with successful and failed passive transfer (Mean ± SE)

	Total Protein (g/dl)	GGT (U/L)	% FTPI	Odds ratio (95 % CI)	P-value
Species					
Buffalo (n=56)	5.49 ± 0.12^{a} (4 – 7.8)	576.61 ± 72.85^{a} (49 – 3287)	21/56 (37.5 %)	4.8 (1- 22.9)	< 0.05
Cattle (n=16)	6.2 ± 1.23^{b} (3.5 – 9.3)	1290.27 ± 272.17^{b} (367 – 4677)	2/18 (11.11 %)	Reference	
Breed					
Murrah (n=39)	5.5 ± 0.15^{a} (4 – 7.8)	566.12 ± 99.43^{a} (49 – 3287)	14/39 (35.89 %)	3.3 (0.65- 17.21)	> 0.05
Nili ravi (n=17)	5.42 ± 0.21^{a} (4.1 – 7.5)	529.41 ± 78.63^{a} (63 – 1335)	7/17 (41.17 %)	4.2 (0.7- 24.9)	
HF-CB (n=14)	6.23 ± 1.3^{a} (3.5 – 9.3)	1349.18 ± 303.4^{b} (367 – 4677)	2/14 (14.28 %)	Reference	
Sahiwal (n=04)	6.00 ± 0.14^{a} (5.9 – 6.1)	819.00 ± 193.00^{a} (626 – 1012)	0/4 (0%)	—	
Sex					
Male (n=37)	5.75 ± 0.20^{a} (4.1 – 9.3)	602.45 ± 106.03^{a} (49 - 3287)	12/36 (33.33 %)	1.35 (0.49 - 3.68)	>0.05
Female (n=34)	5.5 ± 0.14^{a} (4 – 7.5)	831.05 ± 162.22^{a} (49 - 3287)	11/38 (28.94)	Reference	

^{ab}Means along the column with different superscripts differ significantly (P<0.05).

No significant (*P>0.05*) was found in FTPI between male and female calves (OR = 1.35; 4.8; 95 % CI = 0.49 - 3.68). Bragg *et al*. (2020) while studying the risk factors of FTPI in cattle calves reported sex, calving assistance and colostrum feeding assistance as risk factors of FTPI.

Nili ravi breed (OR = 4.2 ; 95% CI = 0.7- 24.9) of buffalo had higher odds of having FTPI as compared to murrah breed (OR= 3.3 ; 95 % CI = 0.65 – 17.21). All sahiwal calves including twins had adequate passive immunity. Data regarding occurrence of FTPI in different breeds is scant however one study has reported reported increased odds of FTPI in Holstein Friesian cattle as compared to Jersey cattle (Skirving *et al*., 2022).

The incidence of different diseases (NCD, respiratory disease, naval ill, fever) and mortality are given in Table 2. The incidence of NCD was higher as compared to reports by other workers (Windeyer *et al*., 2014; Lora *et al*., 2018). There was non-significant (>0.05) difference in incidence of diarrhea between calves with FTPI and without FTPI. The incidence of neonatal calf diarrhea in addition to colostrum intake is influence by other factors including poor hygiene, overcrowding, type of flooring and frequency of cleaning (Brar *et al.,* 2017).

In this study, there was significant delay in the onset of NCD in calves without FTPI as compared to calves with FTPI (Buffalo : 9.36 ± 1.30 vs 6.9 ± 0.56 and Cattle : 7.8 ± 0.8 vs 5.0 ± 0.1. Lora *et al.* (2018) reported a delayed (six days) in occurrence of NCD in calves with adequate passive transfer as compared to calves with inadequate passive immunity.

The incidence of NCD and mortality in relation to efficiency of passive transfer is given in Table 3. The odds of NCD in buffalo calves excellent passive transfer (STP > 6.2 g/dl) was significantly (*P < 0.05*) lower as compared to calves with poor passive transfer (STP < 5.1 g/dl) (OR = 12.4 ; 95 % *CI* = 1.26 -124.6). Similarly, the odds of mortality was higher in buffalo calves with poor passive transfer (OR = 1.2 ; 95 % *CI* = 0.27-5.24) as compared to calves with excellent passive transfer. Other workers have also reported the association between adequacy of passive transfer in calves and disease incidence (Lora *et al*., 2018; Godden *et al.,* 2019). The incidence of respiratory disease and naval ill was low in this study and had poor correlation with the success of passive transfer.

However, the mortality rate in this study was higher for buffalo calves as compared to cattle calves (23.21% vs 6.25%). Studies on cattle calves have reported the overall mortality between 3.1 to 6.4% (Windeyer *et al*., 2014; Lora *et al*., 2018). In buffalo calves, the mortality rate was high in calves with FTPI (28%) as compared to calves without FTPI (20%). In buffalo calves mortality rate been reported between 10% to 50% and incidence could be higher if calves are reared under sub-optimal conditions (Pasha *et al*., 2013). This is in contrast to studies on cattle calves that report significant reduction in mortality in calves with adequate passive transfer (Lora *et al*., 2018).

Table 2: Morbidity and mortality of buffalo and cattle calves in relation to presence and absence of successful passive transfer

		Buffalo calves				**Cattle calves**
		Normal calves	**FTPI calves**	**Normal calves**	**FTPI calves**	
Occurrence of diarrhea	Percent incidence	32/35 (91 %)		17/21 (81 %)	6/12 (50 %)	1/2 (50 %)
	Odds ratio, p-value	OR=2.5, P > 0.05			OR=1, P > 0.05	
Age at onset of diarrhea (Days)		9.36 ± 1.30^a	6.9 ± 0.56^b		7.8 ± 0.8^a	5.0 ± 0.1^b
	OR = 3.98; P < 0.05			OR= 5; P < 0.05		
Respiratory disease		2/35 (5.71 %)	1/21(4.76 %)		0 %	0 %
	OR=1.21 (0.1-14.2), P > 0.05					
Naval ill		4/35 (11.42 %)	1/21(4.76 %)		1/12 (8.33 %)	0/12
	OR=0.63 (0.04 -3.72), P > 0.05					
Mortality		7/35 (20.0 %)	6/21 (28.57 %)		1/14	0/2
	OR=1.6 (0.45 – 5.6), P > 0.05					

[ab]Means along the row with different superscripts differ significantly (P<0.05).

Table 3: NCD and mortality of buffalo and cattle calves in relation to efficiency of passive transfer

	Buffalo				Cattle			
	Total Protein (g/dl)							
	Excellent >6.2 g/dl	**Good** 5.8 – 6.1 g/dl	**Fair** 5.1 – 5.7 g/dl	**Poor** <5.1 g/dl	**Excellent** >6.2 g/dl	**Good** 5.8 – 6.1 g/dl	**Fair** 5.1 – 5.7 g/dl	**Poor** <5.1 g/dl
Diarrhea Occurence	8/13 (61.53 %)	6/6 (100 %)	15/16 (93.33 %)	20/21 (90.47 %)	4/10 (40 %)	—	3/4 (75 %)	2/2 (100%) —
	OR = 12.5 (1.26 -124.6), P < 0.05	OR = 1.05 (0.03 -29.08), P > 0.05	OR = 1.42 (0.08 -24.42), P > 0.05	**Reference**	OR = 0.13 (0.01 -3.62), P > 0.05	—	OR = 0.46 (0.01 -16.62), P > 0.05	**Reference**
Mortality	4/13 (30.76 %)	1/6 (16.67 %)	3/16 (18.75 %)	7/21 (33.33 %)	1/7 (14.28%)		0/7	0/2
	Reference	OR = 0.4 (0.04 - 4.11), P > 0.05	OR = 0.46 (0.09 - 2.17), P > 0.05	OR = 1.2 (0.27-5.24), P > 0.05	—		—	—

CONCLUSION

The study concluded FTPI was higher in buffalo calves in comparison to cattle calves reared under same management system. Passive immunity level influenced the occurrence of NCD and mortality in new born calves. There is further need to study the optimal colostrum management system in buffalo calves to reduce the incidence of FTPI.

REFERENCES

Bharti, P.K., Dutt, T., Patel, B.H.M., Pandey, H.O., Ojha, B., Kamal, R., Upadhyay, D., Singh, M. and Gaur, G.K. 2018. Effect of weaning age on growth measurements and sero-biochemical parameters in Murrah buffalo calves. *Indian J. Anim. Sci.,* **88**: 11.

Brar, A.P.S., Sood, N.K., Kaur, P., Singla, L.D., Sandhu, B.S., Gupta, K., Narang, D., Singh, C.K. and Chandra, M. 2017. Peri-urban outbreaks of bovine calf scours in Northern India caused by Cryptosporidium in association with other enteropathogens. *Epidemiol. Infect.,* **145**(13): 2717-2726.

Bragg, R., Macrae, A., Lycett, S., Burrough, E., Russell, G. and Corbishley, A. 2020. Prevalence and risk factors associated with failure of transfer of passive immunity in spring born beef suckler calves in Great Britain. *Prev. Vet. Med.*, **181**: 105059,

Calloway, C.D., Tyler, J.W., Tessman, R.K., Hostetler, D. and Holle, J. 2002. Comparison of refractometers and test endpoints in the measurement of serum protein concentration to assess passive transfer status in calves. *JAVMA*, **221**: 1605–1608.

Chigerwe, M., Hagey, J.V. and Aly, S.S. 2015. Determination of neonatal serum immunoglobulin G concentrations associated with mortality during the first 4 months of life in dairy heifer calves. *J. Dairy Res.*, **82**: 400–6.

Choudhary, S., Kamboj, M.L., Jamwal, S., Pal, P., Arora, D., Ingle, V., Singh, P. and Lathwal, S.S. 2022. Effect of mother contact and voluntary colostrum suckling on growth, health and stress of neonatal buffalo calves. *Indian J. Anim. Sci.*, **92**(1): 89-95.

Dunn, A., Duffy, C., Gordon, A., Morrison, S., Arguello, A., Welsh, M. and Earley, B. 2018. Comparison of single radial immunodiffusion and ELISA for the quantification of immunoglobulin G in bovine colostrum, milk and calf sera. *J. Appl. Anim. Res.,* **46**(1): 758-765.

Godden, S.M., Lombard, J.E. and Woolums, A.R. 2019. Colostrum Management for Dairy Calves. *Vet. Clin. North Am. Food Anim. Prac.,* **35**(3): 535-556.

Hogan, I., Doherty, M., Fagan, J., Kennedy, E., Conneely, M., Brady, P., Ryan, C. and Lorenz, I. 2015. Comparison of rapid laboratory tests for failure of passive transfer in the bovine. *Ir. Vet. J.,* **68**: 1–10.

Lora, I., Gottardo, F., Contiero, B., Dall Ava, B., Bonfanti, L., Stefani, A. and Barberio, A. 2018. Association between passive immunity and health status of dairy calves under 30 days of age. *Prev. Vet. Med.,* **52**: 12-15.

Pasha, T.N., Jabbar, M.A., Ijaz, A., Rehman, H. and Yousaf, M.S. 2013. Influence of weaning regimen on intake, growth characteristics and plasma blood metabolites in male buffalo calves. *Animal,* **7**: 1472–1478.

Quigley, J.D., Lago, A., Chapman, C., Erickson, P. and Polo, J. 2013. Evaluation of the brix refractometer to estimate immunoglobulin G concentration in bovine colostrum. *J. Dairy Sci.,* **96**: 1148–1155.

Renaud, D.L., Waalderbos K.M, Beavers, L., Duffield, T.F., Leslie, K.E. and Windeyer, M.C. 2020. Risk factors associated with failed transfer of passive immunity in male and female dairy calves: A 2008 retrospective cross-sectional study. *J. Dairy Sci.,* **103** (4): 3521-3528.

Singh, P.K., Kamboj, M.L., Chandra, S., Kumar, A. and Kumar, N. 2018. Influence of weaning on growth, health and behaviour of Buffalo (*Bubalus bubalis*) calves. *Indian J. Anim. Res.,* **B-3546**: 1–5.

Souza, D.C., da Silva, D.G., Fonseca, L.C.C., de Castro Fiori, L., Monteiro, B.M., Bernardes, O., Viana, R.B. and Fagliari, J.J. 2020. Passive immunity transfer in water buffaloes (*Bubalus bubalis*). *Front. Vet. Sci.,* **7**: 247.

Skirving, R., Bottema, C.D.K., Laven, R., Hue, D.T. and Petrovski, K.R. 2022. Incidence of inadequate transfer of passive immunity in dairy heifer calves in South Australia. *Animal,* **12**: 2912.

Trotz-Williams, L.A. 2008. Passive immunity in Ontario dairy calves and investigation of its association with calf management practices. *J. Dairy Sci.,* **91**: 3840–3849.

Vecchio, D., Di Palo, R., De Carlo, E., Esposito, L., Presicce, G.A., Martucciello, A., Chiosi, E., Rossi, P., Neglia, G. and Campanile, G. 2013. Effects of milk feeding, frequency and concentration on weaning and buffalo (*Bubalus bubalis*) calf growth, health and behaviour. *Trop. Anim. Health Prod.,* **45**: 1697–1702.

Windeyer, M.C., Leslie, K.E., Godden, S.M., Hodgins, D.C., Lissemore, K.D. and LeBlanc, S.J. 2014. Factors associated with morbidity, mortality, and growth of dairy heifer calves up to 3 months of age. *Prev. Vet. Med.,* **113**: 231–240.