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Disease incidences and behavioural in *Vrindavani* neonatal calves reared under subtropical climate of India

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ABSTRACT

The present study aims to assess the prevalence of neonatal diseases in 159 crossbred *Vrindavani* calves. The experiment was conducted at Cattle and Buffalo Farm, Indian Veterinary Research Institute, Izatnagar, Bareilly during the period from January 2022 to December 2022. All the experimental calves were examined for various neonatal diseases, and epidemiological parameters, including age, season, activity, and hematological indices were recorded. The data generated throughout this study were analyzed using a two-way ANOVA with Tukey's test for multiple comparisons, conducted with IBM SPSS 20.0 software. The primary neonatal diseases observed included gastroenteritis (2.22%), navel ill (1.62%), joint ill (1.75%), respiratory infections (0.30%), and anemia with dullness (3.71%). Gastroenteritis was most prevalent from February to April and June to July month, while navel ill peaked between May and November. Respiratory diseases were more common from September to December month, whereas anemia and joint ill were consistent throughout the year. Notably, all calves exhibited good responsiveness and suckling reflex, with 96.29% having hematological indices within normal ranges for bovines. Anemia and weakness were a significant concern year-round in neonates. It was concluded that predominant neonatal diseases of *Vrindavani* calves were gastroenteritis, navel ill, respiratory infections, anaemia and joint ill. Early detection and intervention protocols need to be developed to reduce morbidity and mortality rates among calves. It was also emphasized that regular health assessments and proper hygienic care for neonatal calves could improve calf vigor and survival rates.

Keywords: Crossbred calves, Morbidity, Neonatal diseases, Prevalence, *Vrindavani* calves

Animal welfare is intrinsically linked to "natural living," where newborn calves are allowed to form social bonds with their dam and other herd mates, which is crucial for their natural survival and future performance (Whalin *et al*. 2021). A healthy calf is crucial for a profitable dairy business, but neonatal diseases, affecting calves from 48 hours to 4 weeks of age, and prenatal issues, during the first 48 hours of life, lead to significant economic losses in modern dairy farms (Arero, 2021). During the peri-parturient period, both the calf and mother are highly vulnerable to various risk factors such as hormones, environmental conditions, and management practices, which can lead to disease development after birth. The ability of neonatal calves to adapt to these stressors largely depends on their immune competency. Calf mortality peaks usually at first four weeks of life, particularly those born from high milk-yielding cows, are more susceptible to infections. To assess the health and disease status of neonatal calves, indicators such as clinical symptoms, calf behavior, and blood tests are commonly used (Barrier *et al*. 2012). For effective welfare assessment, it is essential to incorporate indicators related to the animal, environment, and management, which help identify risk factors (Barry *et al*. 2019; Barry *et al*. 2020). Identifying the specific diseases and their frequency of diseases occurrence is crucial for prioritizing interventions to safeguard the well-being of the animals.

ICAR-Indian Veterinary Research Institute (IVRI) in Bareilly, Uttar Pradesh, developed 'Vrindavani' cross-bred cattle, which consists of 25-50% indigenous Hariana breed and 50-75% exotic breeds like Jersey, Holstein Friesian, and Brown Swiss (Ahmad *et al*. 2020). Due to their highly exotic ancestry, Vrindavani calves are more vulnerable to adverse climatic and disease conditions compared to native breeds. The present study was, therefore, undertaken with the objective to study diseases incidences and behavioural responses of *Vrindavani* neonatal calves. This research aims to identifying disease threats and guiding interventions to improve their well-being, reduce suffering, and enhance future performance.

MATERIALS AND METHODS

Location of the study: The experiment was conducted at Cattle and Buffalo Breeding Farm, LPM Section, ICAR-Indian Veterinary Research Institute, Deemed University,

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Izatnagar, Bareilly, UP. The farm is situated at a latitude of 27.35° N and a longitude of 79.370° E. The region has a maximum temperature of 38°C, and a minimum temperature of 9°C, and receives an average annual rainfall of 1107.3 mm.

Experimental animals: All calves born from January, 2022 to December, 2022 were selected for the study. This experiment was conducted as per the standard operating procedures recommended by CCSEA guidelines under the Prevention of Cruelty to Animals Act (1960), India. The calves were maintained in separate pens for newborn care. The calves were fed twice daily, once between 7:00 and 8:30 AM and again between 2:30 and 3:30 PM, with fresh drinking water *ad libitum* provided throughout the day.

Data recording:

a) *Meteorological observations*- The average room temperature in the calf shed was lowest in January (11^0C) and highest in the month of June/July (30^0C). The relative humidity ranged between 72.87 to 89.77 %. The Temperature Humidity Index (THI) was within the comfortable range for the growth of the calves throughout the observation period. The calves were observed daily for one hour in the morning and evening and vital parameters and incidence of any disease were recorded up to 45 days of age.

b) *Vitality scoring*- The scoring of the vigor of the newborn calves of both groups was done randomly by a set of evaluators not related to our study. The scoring (1- 4 point scale) called VIGOR score was given for the four primary parameters of calf vitality, which stands for Visual Appearance, Initiation of Movement, General Responsiveness as described by Murray *et al.* (2021).

c) *Visual appearance*- The appearance of the newborn calves immediately after they were born and up to 1.5 hours post-birth were recorded and were graded as 1- Extremely weak & fragile, 2- Average/Fair, 3- Good, and 4- Excellent.

d) *Initiation of movement*- The time taken to stand, and reach to udder of the cow in search of colostrum was recorded on a 0-4 scale as per the method described by Rojas *et al*. (2018) with little modification and summarized below in Table 1.

e) *Suckling response*- Suckling response was also graded in 4 scale as 1 = no suckling response, 2 = weak suckling, 3 = moderate suckling response and 4 = strong suckling response

Table 1. Criteria for assessment of movement of newborn Vrindavani calves.

Criteria	Score
No movement by itself within half an hour of birth	0
For 2.5 min able to keep 2 forelegs firmly on ground	1
For 5.0 min able to keep 2 forelegs firmly on ground	2
For 2.5 min able to keep all 4 legs firmly on ground	3
For 5.0 min able to keep all 4 legs firmly on ground	4

f) *General responsiveness*- General responsiveness was graded on a 4-point scale.1: Dull, 2: Moderately responsive, 3: Normal response, and 4: Very active

g) *Normal physiological parameters*- A thorough clinical check-up was done in all the calves daily and rectal temperature, heart, and respiration rates were recorded (Radostits *et al.* 2007). Respiration rate was counted from a distance by observing flank movements and expressed as breaths per minute. The respiration rate was recorded at 1, 48, and 72 hr of birth. The heart rate was recorded at 1, 48, and 72 hr of birth using a stethoscope behind the left elbow of the calf and against the chest wall for 2 min. The rectal temperature was recorded using a standard digital thermometer within 60 min of birth, then at 48 hr and 78 hr after birth of the calf.

h) *Morphometrical parameters*

Body weight: The body weight of calves was recorded using a weighing machine on the day of birth (within 1 hr of birth), 21st and 42nd day old calves. Calves were weighed before the milk replacer was given.

Body length and chest girth: Body length, weight gain and girth circumference were measured at 0, 14, 21 and 45 days age. The chest girth circumference and body length were measured using a standard measuring tape. During the chest girth recording, the tape was applied precisely behind the front shoulder, directly behind the elbows, and 8 to 10 cm posterior to the withers. Body length was defined as the distance between the points of mid poll to the base of the tail (Blottner *et al.* 2011).

i) *Sampling-Blood sampling and analysis of hematological parameters:* Blood samples were collected from jugular vein of calves within 1 hr of birth, on days 0, 21st and 42nd in vacutainers (BD Biosciences) containing K2 EDTA for haematological analyses) using an automated haematology analyser (Make: Celltac a, Nihon Kohden, Japan). The haematological parameters measured were: (a) Haemoglobin concentration (Hb) (g/dL) (b) Packed Cell Volume (PCV) (%) (c) Total Erythrocyte Count (TEC) ($\times 10^6$/mL) (d) Total Leukocyte Count (TLC) ($\times 10^3$/mL) (e) Platelet count (PLT) ($\times 10^3$/mL).

j) *Incidence of neonatal diseases*- All the calves up to 45 days of age were clinically examined daily to record the incidence of neonatal diseases. The incidence rate of different neonatal diseases was calculated as follows:

$$\text{Incidence rate} = \frac{\text{(Total number of Vrindavani calves presented with neonatal diseases in the farm)}}{\text{(Total Vrindavani calf population at risk of developement of neonatal diseases)}} \times 100$$

Statistical analysis: The General Linear Model with two-way analysis of variance (ANOVA) followed by Tukey's test for multiple comparisons between different groups was used to test the effect of treatments, periods and interaction between treatments and periods for all the parameters using IBM SPSS 20.0 software (SPSS Inc,

Chicago, USA). All parametric data were represented as Mean ± Standard Error (SE), except for non-parametric data. These non-parametric values were expressed using Mean Ranks by the standard Mann-Whitney Test and Kruskal- Wallis test. $p<0.05$ was considered statistically significant (Snedecor and Cochran 1989).

RESULTS AND DISCUSSION

The incidence of gastroenteritis among neonatal calves is presented in Table 2 and Fig. 1. Neonatal gastroenteritis (diarrhoea) was found to be the most prevalent disease, and the incidence of gastroenteritis was highest just after winter (February - April), followed by June - July, and lowest in the month of August. Navel ill is the second most common disease of neonatal calves after gastroenteritis with highest incidence rate in the month of April, which reduced in August. Respiratory infections were significantly increased in the months of September, November, and December compared to the rest of the year. Newborn calves that were weak or dull were found more anaemic than active calves of the same age. The incidence rate of weak or dull calves increased between March and June. Joint ill disease had the least occurrence with only a few cases in the months of September and October (Fig. 1).

Physiological responses during early adaptation period: For documenting early adaptation of newborn crossbred calves, respiration rate, heart rate, and rectal temperatures were measured within 1, 48, and 72 hr of birth and between 07:00 and 09:00 AM daily before feeding milk. The heart rate showed a gradual decline towards normal heart rate. At birth, heart rates of newborn crossbred calves ranged between 98 and 105 beats per minute, which gradually reduced to 77-85 per minute at 72 hours after birth. The respiration rate was having a little different trend; it was higher at 48 hr of birth (49-58 per min); however, at 72 hr the mean respiration rate was declined (27-35/min).

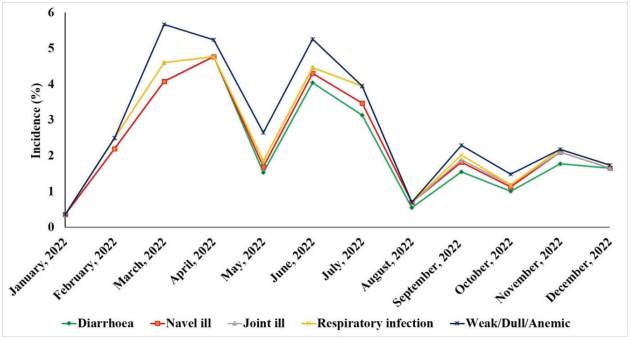

Fig. 1. Incidence of neonatal diseases in Vrindabani calves during first 45 days of life under subtropical climate

Behavioural responses of neonatal calves: The vitality of the neonatal calves revealed that the majority of the calves were active and alert, except for a few neonatal calves who were suffering from some neonatal diseases, as illustrated in Fig. 2. The visual appearance of each calf was graded on a 4-point scale, and the mean score was found to be between very good and excellent (3.5/4.0). The calves had overall good scores. The newborn calves attempted to

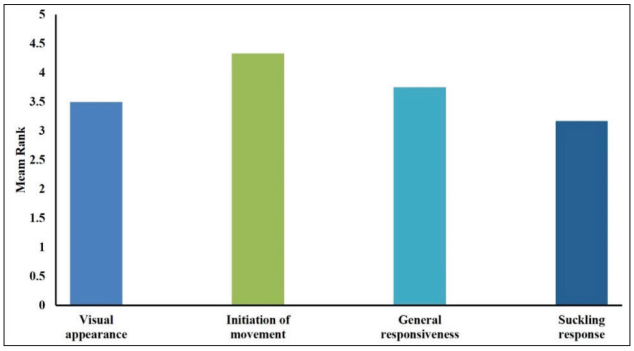

Fig. 2. Vitality scoring of Vrindabani calves during first 45 days of life under subtropical climate

Table 2. Disease incidences of neonatal *Vrindavani* calves reared under subtropical climate

Month	Gastroenteritis (%)	Navel ill (%)	Joint ill (%)	Respiratory infection (%)	Weak/Dull /Anaemic (%)
January	0.36	0.00	00.00	0.00	0.00
February	2.20	0.00	0.30	0.00	0.00
March	4.08	0.00	0.52	0.00	1.07
April	4.77	0.00	0.00	0.00	0.47
May	1.53	0.16	0.00	0.00	0.80
June	4.04	0.26	0.16	0.00	0.80
July	3.13	0.34	0.48	0.00	0.00
August	0.55	0.15	0.00	0.00	0.00
September	1.55	0.27	0.00	0.13	0.27
October	1.01	0.12	0.06	0.00	0.30
November	1.78	0.32	0.00	0.08	0.00
December	1.65	0.00	0.00	0.09	0.00
Over-all incidence	2.22	1.62	1.75	0.30	3.71

Table 3. Changes in hematological parameters in *Vrindavani* calves during first 45 days of life under subtropical climate

Haematological parameter (Unit)	0 day Mean ± SE	21st day Mean ± SE	45th day Mean ± SE
Haemoglobin (g/dL)	8.88 ± 0.44^{C}	9.42 ± 0.37^{BC}	9.82 ± 0.41^{ABC}
Haematocrit (%)	31.04 ± 2.61^{B}	33.17 ± 1.89^{AB}	36.57 ± 1.66^{AB}
Total Erythrocyte Count (× 10^{6}/µL)	6.46 ± 0.36^{C}	7.31 ± 0.28^{BC}	7.4 ± 0.49^{BC}
Total Leukocyte Count (× 10^{3}/µL)	9.32.5 ± 0.34^{AB}	9.67 ± 0.16^{AB}	8.95 ± 0.29^{A}
Platelet count (× 10^{3}/µL)	289.4 ± 6.42^{E}	557.67 ± 64.26^{D}	744.17 ± 37.03^{C}

Note: Mean values with different superscripts differ significantly (p>0.05).

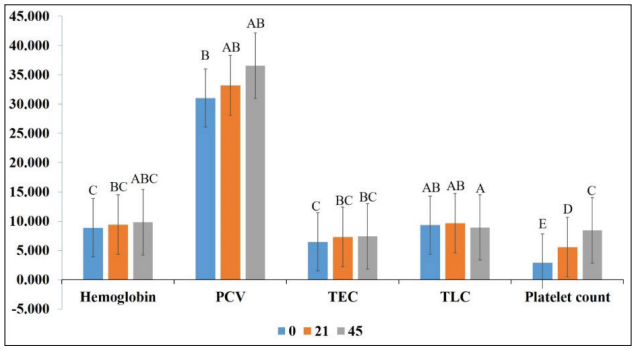

Fig. 3. Changes in hematological parameters of *Vrindavani* calves during first 45 days of life under subtropical climate

stand within one hour of their birth and had a very good mean score 4.33 out of 5.00. Out of total 159 calves, 11 calves needed external support when unable to stand on its feet in the current study. The overall rank mean for general responsiveness of the calves was fairly good (mean score 3.75 in 4.0 point scale). Similarly, suckling response was also graded in 4.0 point scale and the calves ranked mean score of 3.17 indicating good vitality and physiological adaptation of *Vrindavani* calves. As illustrated in Fig. 2, all calves had a very good suckling response between 30 min and 1 hr. The vitality of the neonatal calves also confirmed that the majority of the calves were active and alert, except for a few neonatal calves who were suffering from some neonatal diseases such as gastroenteritis, respiratory problems, and anaemia. Sharma and Joshi (2020), in their etio-epidemiological study, reported that *E. coli* and rotavirus were found to be the most prevalent in the faeces of diarrhoeic calves between the ages of 0 and 15 days. The scientific understanding of newborn illnesses in calves has been a key concern in veterinary medicine. For calves, the first four weeks of life are when mortality peaks. (Mee, 2008). During the neonatal period, incidences of gastroenteritis and respiratory infections resulted in increased morbidity as well as mortality in calves. The risk factors and management strategies that affect calf vigour were thoroughly examined following the VIGOR score (Murray *et al.* 2021).

The average body weights of calves were recorded as 26.2 ± 1.59 kg, 42.82 ± 2.01 kg, and 48.82 ± 2.3 kg on days 0, 21, and 45, respectively. The growth was very good and uniform. Similar was observed trend in the development of body length (ranged between 59.77-68.77 cm and 71.12-86.36 cm on days 0 and 45, respectively) and girth (ranged between 60.77-68.58 cm and 71.12-81.26 cm on days 0 and 45, respectively).

The hematological parameters were recorded on day 0, 21 and 45 of birth in all *Vrindavani* calves and are presented in table 3 and illustrated in Fig. 5. With increase in age, the haemoglobin content gradually increased which was well correlated with total erythrocytic counts indicating good hematopoietic response in those calves.

The leukocyte and thrombocyte counts in *Vrindavani* calves remained within normal ranges, indicating healthy development of the reticuloendothelial system and the absence of systemic infections due to effective management practices. There were no significant difference in mean corpuscular volume, mean corpuscular haemoglobin, or mean corpuscular haemoglobin concentration during the neonatal period, though red cell distribution width was notably higher on day 0. Platelet count and related metrics showed a linear increase with age, reflecting changes in the immunomodulatory and haematological profiles during the first six weeks. Physiological parameters such as heart rate, respiration rate, and rectal temperature varied within normal limits, indicating proper thermoregulation and adaptation post-birth. The average body weight of calves at birth ranged from 22-56 kg, which significantly increased by day 45. On the day of birth, the average body weight of calves ranged from 22 to 56 kg. The body weight gain showed a significant ($p < 0.05$) increase on day 45 in this study. Singh *et al.* (2011) reported that the average body weight of *Vrindavani* calves was 22.13 ± 0.12 kg at birth and 46.64 ± 0.31 kg at 3 months of age with consistently increased in body length and girth were with age. They also envisaged that 0-3-month age group *Vrindavani* calves had an average body length of 73.7 ± 1.46 cm and an average heart girth of 78.85 ± 1.65 cm. Except for a few, most of the calves had haemoglobin and total erythrocytic counts within the normal range reported for the species. The platelet count showed a linear increase along with the increase in the age of calves, which could be attributable to the immunomodulatory and haematological profile modulation with active haematopoiesis in calves.

The study identified neonatal gastroenteritis (2.22%), navel ill (1.62%), respiratory infection (0.30%), weakness or anaemia (3.71%), and joint ill (1.75%) as the

predominant diseases recorded during birth to 45 days of age in *Vrindavani* calves. It has been found that *Vrindavani* calves had better adaptation capacity compared to other calves from exotic breeds or crossbreds having a higher percentage of exotic inheritance. Anaemia and weakness were prevalent year-round, while gastroenteritis peaked in February-April and June-July. All calves displayed good responsiveness and suckling reflexes, with 96.29% having haematological indices within normal limits. Early detection and intervention protocols can be developed based on the findings to reduce morbidity and mortality rates among calves. The study emphasized the importance of regular health assessments and proper hygienic care for neonatal calves in order to enhanced calf vigour and survival rates. Enhancing calf health and welfare can improve survival and productivity, benefiting Indian dairy farmers economically while promoting animal welfare (Rojas *et al.* 2018, Murray *et al.* 2021).

It was concluded from the above study that predominant neonatal diseases of *Vrindavani* calves were gastroenteritis, navel ill, respiratory infections, anaemia and joint ill. Early detection and intervention protocols may be developed based on the findings to reduce morbidity and mortality rates among calves. Regular health assessments and proper hygienic care for neonatal calves could improve calf vigor and survival rates.

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