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Effect of Infrared Lamps to Ameliorate Morbidity and Mortality in Vrindavani Calves

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ABSTRACT

The present study was carried out to determine the effect of Infrared lamps to ameliorate morbidity and mortality in Vrindavani calves. Ten newborn calves were randomly divided into two groups (G_1 and G_2) of five each. The calves of G_1 were provided with no additional protection; however calves of G_2 were protected against cold weather by using the Infrared lamps. The health status of calves was monitored daily both in the morning and evening. The blood samples collected within six hours of birth and then at fortnightly interval were analyzed for total leukocyte count (TLC, thousands/µl) and differential leukocyte count (DLC). The physiological parameters i.e. respiration rate (RR, breaths/min), heart rate (HR, beats/min) and rectal temperature (RT, °F) were recorded at weekly interval. The health performance was better in calves of G_2 as compared to G_1. The calves in G_1 showed comparatively higher values of TLC and neutrophils and the differences were found significant ($P<0.05$) on 15th day for TLC and 15th and 45th day for neutrophils. The values of lymphocytes were found significantly ($P<0.05$) lower in calves of G_1 than G_2 on 15th and 45th day.The physiological parameters did not varied significantly between the groups except for RT which was most of the times significantly ($P<0.05$) lower in calves of G_1 than G_2. On the basis of the results, it could be concluded that the Infrared lamps are efficient in providing favourable microclimate and hence can be effectively used in calf shed to protect newborn calves from adverse conditions of winter.

Keywords: Blood parameters, Infrared lamps, Morbidity, Physiological Parameters, Vrindavani calves.

In modern dairying, management of calves plays an important role in replacement of old and unproductive animals from herd and finally to improve the economy of the farm. Newborn calves are more susceptible to the effects of cold exposure than the mature cattle because their cold defence and heat conservation rnechanisms are not fully developed (Thompson, 1973). Newborns are in metabolically unstable conditions, which make these subjects particularly sensitive to perinatal diseases resulting in high mortality (Dwyer, 2008). Diseases of the newborn and neonatal mortality are a major cause of economic loss in livestock production (Piccione *et al*., 2008). The important causes of calf mortality include immunodeficiency (White and Andrews, 1986), season effects (Fink, 1980), difficult parturition (Ahmad *et al*., 1986) and faulty management conditions (Fedida *et al*., 1984). The survival of a calf and its optimum growth rate can be achieved not only by good feeding but also with efficient management compatible to specific environmental conditions. Several effective measures including the use of calf jackets, hot box or warm water bath are used to prevent cold stress (Butler *et al*., 2010). Reduction in the overall heating requirement of calf shed can be accomplished by taking advantage of the thermal and optical properties of Infrared radiations. Hence, the study was conducted to study the effect of Infrared lamps to ameliorate morbidity and mortality in Vrindavani calves.

MATERIALS AND METHODS

Location

The experiment was carried out at the Calf Unit of Cattle and Buffalo Farm, Livestock Production Management Section, Indian Veterinary Research Institute, Izatnagar, Bareilly, Uttar Pradesh (India) which is located at an altitude of 169 meters above mean sea level and at the latitude of 28.22°N and longitude of 79.22°E.

Climatic Conditions

The average maximum and minimum values of air temperature for all seasons during the last three years (2011, 2012 and 2013) were 38.07 ºC and 7.43 ºC, respectively. During the study period, mean environmental temperature and relative humidity inside the calf shed ranged between 9.5 to 21.5 °C and 72.1 to 91.7 %, respectively. The external temperature and relative humidity varied between 7 to 18 ºC and 58 to 95 %, respectively.

Animals

Animal care and handling procedures were followed the committee of scientific research ethics, Indian Veterinary Research Institute, Izatnagar, Bareilly, Uttar Pradesh, India. All the calves were reared under similar management and proper hygienic conditions throughout the period of study. Calf shed was having double row system of housing. Calves of G_1 and G_2 were housed individually in opposite rows in the same calf shed. The pens were cleaned daily and all hygienic precautions were taken to prevent the incidence of infectious and contagious diseases.

Experimental Design

The experiment was conducted from 2nd November, 2013 to 8th February, 2014 when the environmental temperature was at the lowest. Ten newborn Vrindavani calves were randomly divided into two groups (G_1 and G_2) of five each. Calves of G_1 were provided with no heat source while the calves of G_2 were provided protection against the cold weather by providing heat using 250 W Infrared lamps. Infrared lamps were used at the rate of one per two calves placed at height of 30 inches from the body of calf. The Infrared lamps were used from 5:00 p.m. to 9:00 a.m. in order to protect the calves from adverse effects of cold weather. The Infrared lamps are in common use to protect piglets and chicks from the cold stress during winter. However, protecting calves by using Infrared lamps is a less known practice. Due to the directional, draught free and instant heat properties of Infrared radiations, the comfort zone can be achieved within a short period of time as compared to conventional warm air systems. Keeping above in view, the Infrared lamps were selected as a source of heat to protect calves from cold winter during their early part of life.

Table 1: Disease incidence and number of affected days in calves during the whole period of experiment.

Ailment	Group	Calves affected	Affected days
Calf Scours	G_1	4	21
	G_2	2	8
Respiratory problems	G_1	4	11
	G_2	1	3
Fever	G_1	2	6
	G_2	0	0
Total affected days	G_1		38
	G_2		11

Recording of Disease Incidence and Mortality

In order to check the health status of the calves, they were observed daily in the morning and evening. The number of calves suffered, kind and duration of illness such as diarrhea, dysentery, respiratory problems or other health related clinical symptoms were recorded daily for each calf. Whenever, any symptoms were noticed immediate care and treatment was given.

Hematological Parameters

The blood samples were collected from the jugular vein following the aseptic measures within 6 h of birth and then at fortnightly interval prior to feeding and watering. The blood samples were analyzed for TLC and DLC. TLC and DLC were determined by standard methods as described by Schlam *et al.* (1975).

Table 2: Mean±SE of hematological parameters of calves at fortnightly interval

Parameter	Group	0 day	15 day	30 day	45 day	60 day
TLC (thousands/µl)	G_1	9.53±0.59	12.52^{a}±0.34	10.52±0.49	11.18 ±0.47	10.64±0.62
	G_2	9.60±0.63	9.82^{b} ±0.35	10.46±0.45	9.72 ±0.57	9.86±2.37
Neutrophil (%)	G_1	48.20±2.39	47.52^{a}±2.15	36.20±2.41	43.14^{a}±2.66	38.50±2.15
	G_2	46.60±2.25	37.24^{b}±2.19	35.43±2.31	32.77^{b}±2.57	36.46±2.20
Eosinophil (%)	G_1	0.52±0.10	0.91±0.13	1.40 ±0.25	2.21+±0.19	2.25±0.32
	G_2	0.54±0.21	0.69±0.10	1.37 ±0.21	1.76±0.17	1.83±0.29
Basophil (%)	G_1	0.23±0.09	0.31±0.11	0.41±0.14	0.52±0.16	0.53±0.19
	G_2	0.26±0.10	0.40±0.13	0.37±0.12	0.60±0.18	0.70±0.17
Lymphocyte (%)	G_1	50.54±2.31	52.86^{a}±0.75	60.46±2.46	53.38^{a}±2.33	57.46±2.06
	G_2	52.30±2.42	62.72^{b}±0.52	62.28±2.24	64.42^{b}±1.47	60.82±1.83
Monocyte (%)	G_1	0.65±0.21	0.96±0.25	1.72±0.74	1.98±0.83	2.48±0.46
	G_2	0.71±0.23	0.89±0.29	1.95±0.87	2.10±0.75	2.53±0.53

TLC= Total leukocyte count

Mean showing different superscripts in lower case letters in a column differ significantly at 5% (P<0.05)

Table 3: Mean±SE of respiration rate (breaths per minute) of calves in morning and evening at weekly interval

Group	Period (in days)									
	0 day	7 day	14day	21day	28day	35day	42day	49day	56day	63day
Morning										
G_1	36.80	34.20	31.80	29.00	26.60	25.40	23.80	24.00	21.60	21.00
	±0.37	±0.37	±0.58	±0.32	±0.24	±0.75	±0.73	±0.45	±0.51	±0.55
G_2	37.40	33.80	31.00	28.00	26.00	24.00	23.20	24.20	21.80	21.20
	±0.40	±0.66	±0.45	±0.32	±0.32	±0.32	±1.07	±0.73	±0.58	±0.37
Evening										
G_1	38.40	35.60	32.00	29.60	26.60	26.20^{a}	24.00	23.40	21.80	22.40
	±0.68	±0.51	±0.89	±0.68	±0.87	±0.37	±0.32	±0.60	±0.58	±0.68
G_2	38.60	34.80	31.60	28.80	26.40	25.0^{b}	24.00	23.20	22.60	22.60
	±0.81	±1.11	±0.60	±0.37	±0.68	±0.32	±0.71	±0.66	±0.51	±0.60

Mean showing different superscripts in lower case letters in a column differ significantly at 5% (P<0.05).

Table 4: Mean±SE of heart rate (beats per minute) of calves in morning and evening at weekly interval

Group	Periods (in days)									
	0 day	7 day	14day	21day	28day	35day	42day	49day	56day	63day
Morning										
G_1	119.8 ±2.35	115.2 ±2.08	110.8 ±1.66	107.4 ±1.33	103.6 ±0.93	103.8 ±2.15	100.0 ±1.64	95.4 ±1.25	90.2 ±1.02	83.4 ±0.68
G_2	117.8 ±1.85	113.2 ±2.13	109.4 ±1.47	105.4 ±1.21	103.2 ±0.80	101.0 ±0.84	97.6 ±0.68	93.8 ±0.58	88.0 ±0.71	82.6 ±0.51
Evening										
G_1	122.0 ±2.98	116.0 ±2.35	112.2 ±1.02	108.6 ±1.83	104.4 ±1.12	103.8 ±2.11	100.6 ±1.63	96.8 ±1.46	90.8 ±1.32	83.2 ±1.16
G_2	119.2 ±2.27	116.2 ±2.54	111.8 ±1.28	107.2 ±0.97	105.0 ±1.26	103.6 ±1.21	98.4 ±0.93	94.6 ±1.21	89.8 ±0.86	83.8 ±0.66

Table 5: Mean±SE of rectal temperature (°F) of calves in morning and evening at weekly interval

Group	Periods (in days)									
	0 day	7 day	14day	21day	28day	35day	42day	49day	56day	63day
Morning										
G_1	102.52 ±0.20	102.00 ±0.11	101.52 ±0.08	101.28 ±0.10	100.92^{a} ±0.10	101.00^{a} ±0.11	102.7^{A} ±0.63	101.32 ±0.42	100.84^{a} ±0.07	100.92 ±0.10
G_2	102.38 ±0.08	101.92 ±0.10	101.72 ±0.05	101.44 ±0.12	101.20^{b} ±0.06	101.36^{b} ±0.10	101.3^{B} ±0.15	101.28 ±0.05	101.16^{b} ±0.07	101.16 ±0.07
Evening										
G_1	102.12 ±0.08	102.16 ±0.12	101.72 ±0.05	101.40 ±0.13	101.12 ±0.10	101.24 ±0.15	101.88 ±0.55	101.44 ±0.34	101.00^{A} ±0.06	101.16 ±0.07
G_2	102.36 ±0.07	102.08 ±0.10	101.80 ±0.11	101.52 ±0.10	101.36 ±0.04	101.44 ±0.12	101.56 ±0.15	101.44 ±0.07	101.28^{B} ±0.05	101.32 ±0.10

Mean showing different superscripts in lower and upper case letters in a column differ significantly at 5% ($P<0.05$) and 1% ($P<0.01$), respectively.

Physiological Parameters

In order to measure the response of newborn calves to cold stress, the physiological parameters considered were RR, HR and RT. All the observations were recorded two times in a day at weekly interval. These physiological parameters were recorded before milk feeding during morning between 7 a.m. to 7:30 a.m. and in evening between 3:30 p.m. to 4 p.m.

Meteorological Observations

Meteorological observations, *viz.* environmental temperature (ºC) and relative humidity (%) were also recorded in the calf shed daily in morning between 7:30 a.m. to 8:00 a.m. and in evening between 3:30 p.m. to 4:00 p.m. For the external macroclimatic environment the data was gathered from the Meteorological Station of Division of Physiology and Climatology, IVRI, Izatnagar.

Statistical Analysis

Data collected were analysed by Statistical Analysis System (SAS, 2011) Software Programme, version 9.3.

RESULTS AND DISCUSSION

The incidence of various diseases and number of affected days in calves of both the groups is presented in Table 1.

Incidence of Diseases in Calves

During the experimental period, it was observed that total of six calves from both groups suffered from some kind of illness. Scours was the most common and frequently encountered problem. Four animals (80 %) of G_1 and two animals (40 %) of G_2 were affected with scours. These results indicated that calves of G_1 were more susceptible to diarrhoea compared to G_2. Gulliksen *et al*. (2009) also reported that dairy calves born in winter were at greater risk of developing diarrhoea.

Respiratory problems including cold, cough and nasal discharge were higher in calves of G_1 as compared to G_2. Four animals (80 %) from G_1 and one animal (20 %) from G_2 were affected by respiratory problems. Nonnecke *et al*. (2009) also reported that calves kept in cold environment experienced more respiratory illness than calves placed in warm environment. The other uncommon health problems in calves were fever and general debility. Two calves (40 %) of G_1 suffered from fever during the whole period of experiment. The overall health performance of calves was better in calves of G_2 as compared to G_1. Resistance of newborn calves against diseases is mainly dependent on ingestion and absorption of sufficient quantities of protective colostral antibodies. Calves of G_1 might have suffered from delayed onset and decreased rate of absorption of colostral antibodies as a result of cold effect. This might have increased their susceptibility to infectious organisms and hence diseases. Olson *et al*. (1980) reported that cold stress caused a delay in onset and a significant decrease in the rate of absorption of colostral immunoglobulins in newborn calves. Better health status of calves of G_2 as compared to G_1 might be due to germicidal property of Infrared radiations and comfortable micro environment provided by Infrared lamps.

Duration of Illness

Total numbers of affected days in both the groups were 49. The affected days were higher in G_1 (38 days) as compared to G_2 (11 days). Calf scours was the main ailment found in both groups and numbers of affected days due to calf scours were higher than any other disease. The cause of long duration of illness in calves of G_1 might be due to compromised immune status due to cold stress. However in both the groups, no mortality was observed throughout the experimental period.

Hematological Parameters

The Mean ± SE of Total leukocyte count (TLC, thousands/µl) and Differential leukocyte count (DLC) of calves in both groups at fortnightly interval are presented in Table 2.

Total Leukocyte Count

The values of TLC were comparatively higher in calves of G_1 as compared to G_2 and the differences were found significant ($P < 0.05$) on 15th day of the study. The high values in calves of G_1 might be due to normal reaction of body defence mechanism against infection and also due to hemoconcentration caused by dehydration. Malik *et al*. (2013) also reported significantly ($P<0.05$) higher value of TLC in calves suffered from diarrhoea.

Differential Leukocyte Count

Differential leukocyte count (DLC) includes the count of neutrophils, eosinophils, basophils, lymphocytes and monocytes. The present study revealed increase in neutrophils i.e. neutrophilia and decreased lymphocyte i.e. lymphopenia in calves of G_1 as compared to G_2. The differences were found significant ($P < 0.05$) on 15th and 45th day of the study. This might be due to susceptibility of calves of G_1 to infection at one or other stage of the study. Sridhar *et al*. (1988) also reported neutrophilia and lymphopenia in calves suffered from scours. The values of monocytes, eosinophils and basophils did not differed significantly between the groups.

Physiological Parameters

Respiration Rate

The respiration rates of Vrindavani calves in morning and evening at weekly interval are presented in Table 3.

The values of RR were comparatively higher in calves of G_1 than G_2 during first seven weeks of age and the difference was found significantly ($P < 0.05$) higher at evening of day 35 of the study. Slightly higher respiration rates particularly at evening were observed in the calves of G_1 than G_2. Webster (1984) also reported increased respiration rate in calves during winter in general and at evening of winter in particular. The higher values of RR in calves of G_1 as compared to G_2 might be due to their greater metabolic rate as a response to cold stress.

Heart Rate

The heart rates of Vrindavani calves in morning and evening at weekly interval are presented in Table 4.

The values of HR were found comparatively higher in calves of G_1 as compared to G_2. However the values did not differed significantly between the groups. The high values of HR in calves of G_1 might be due to their response to cold stress.

Rectal temperature

The rectal temperatures of Vrindavani calves in morning and evening at weekly interval are presented in Table 5.

The RT was found comparatively lower in calves of G_1 as compared to G_2 and the differences were found significant ($P<0.05$) in the morning of 28th, 35th and 56th day and highly significant ($P<0.01$) in the evening of 56th day of study. However, significantly ($P<0.01$) higher value of RT was found in calves of G_1 as compared to G_2 in the morning of 42nd day of the study. Slightly lower rectal temperature in calves of G_1 than G_2 might be due to cold effect. Ferreira *et al.* (2006) also noticed a fall in rectal temperature in the Holstein calves during winter as compared to the summer. The results of the present study are in agreement with those reported by Bipin Kumar and Singh (2002) who observed rectal temperature of 102.5 to 103.5 ^{o}F at birth, 102.45±0.08 ^{o}F at 5 days and 101.2±0.06 ^{o}F at 28 days of age in the crossbred calves.

The present study concluded that provision of Infrared lamps provided favourable micro-environment to the calves during winter season. The Infrared lamps in the calf shed can be thus effectively used as one of the measures to ameliorate the adverse effects of cold.

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