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Factors affecting neonatal calf mortality, controlling measures and welfare practices: A review

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Abstract
Calf mortality is one of the important problems of calf rearing in dairy farms worldwide. Successful cattle production system encompasses the ability to develop healthy calves for both in economic and animal welfare points of view. Generally, early calf mortality reduces the replacement stock in any herd and thus it causes genetic loss due to reduced possibility of selection, and thereby yielded less genetic gain. A wide variety of infectious agents and lack of scientific management practices can cause mortality and reduced growth rate in the calf. There is an urgent need to educate the dairy farmers about the importance of rearing calves in terms of economic profitability. A combination of scientific practices and proper care of the dam during last phase of pregnancy, intensive care of calf after birth, improved managemental practices like feeding, housing and health care will help in solving the problem of calf mortality to a great extent.

Keywords: Animal welfare, calf, infectious diseases, intensive health care, scientific management

Introduction
The future of a dairy herd is totally dependent on the proper nurturing of young calves; thus, the calf plays a vital part in the development and profitability of a farm. Healthy calves are necessary not just for the dairy industry's survival, but also for the preservation and maintenance of high-quality germplasm. The biggest challenge, however, was the greater calf fatality rate at a young age. Given the wide range of management practices used on dairy farms, the occurrence of many diseases in calves, differences in farmer management skills, different levels of animal adaptability, and to some extent differences in socio-economic status and literacy, the mortality rate of calves varies greatly (Shrivastva, 2011) [37]. A high calf mortality rate not only lowers farm revenue, but it also reduces the number of animals available for selection, lowering selection intensity and genetic development. As a result, mortality in dairy calves is extremely important in terms of both economic losses and animal health and wellbeing (Forestall and Sorensen, 2010). The herd's production may be harmed as a result of the poor calf survival rate at delivery and at later stages of development. In dairy cows, high calf mortality minimizes genetic selection and enhances the possibility of acquiring replacement stock. Calf mortality before weaning is substantial in tropical places where zebu cattle are common, accounting for about a third of calf crop losses (Wells *et al*., 1996) [44].

Classification of mortality
- Prenatal mortality- stillbirth at <270 days of gestation
- Perinatal mortality- stillbirth at >270 days of gestation
- Neonatal mortality- calves born alive that die between 24h and 28 days
- Older calf mortality- calves born alive that die between 29 days and 84 days or 29 and 182 days

Mortality rate under good manage mental conditions
- Prenatal mortality- 2.2.5%
- Perinatal mortality- 3.5-5%
- Neonatal mortality- 3%
- Older calf mortality- 1-2 %

Accepted level of all over mortality in Indian condition- 5% (Roy, 1990)

Calf mortality rate

According to Martin and Wiggins (1973), 20 percent calf mortality reduced a cattle farm's earnings by 38 percent. Neonatal calf mortality accounts for 84 percent of overall mortality in the first month of life (Jenny *et al.* 1982) [15], and is particularly high in the third week of life (Umoh.1982). According to Afzal *et al*. (1983) [1], cow and buffalo calves died at rates ranging from 29.1% to 39.8%. Furthermore, with an average early calf death rate of 25%, there is no likelihood of replacing low-production animals on a regular basis. From birth to one year of age, Ahmad *et al* (1978) [2] discovered that cow calves had a lower death rate (43.3%) than buffalo calves (56.6%), and that males had a greater mortality rate than females in case of cattle. Digestive diseases caused the highest death rate across age groups of Murrah buffalo calves during the first month after birth (36.8%), among seasons during autumn (45.5%), and among clinical conditions (Pradhan and Panda, 1994) [29]. Buffalo calves have been known to have a high number of neonates, especially in the first three months after birth (Jain, 2005) [14]. Male calves had a mortality rate of 50.66 percent, while female calves had a mortality rate of 49.33 percent (Khan *et al.*, 2007) [18]. This higher mortality rate could be due to serum immunoglobulins, which are required for protection against various diseases during neonatal life, absorbing less in male (20.69 mg/ml) than female (25.12 mg/ml) calves. Overall buffalo calf mortality in and around Jabalpur area was 42.11 percent, according to Shakya *et al*. (2017) [33]. Sheikh (2010) [36] found that Jersey crossbred calves had an average survival rate of 89.77 percent, with the highest number of calves succumbing between birth and 15 days of age (5.68 percent), followed by 3.40 percent and 1.14 percent at 15-30 and 30-60 days of age, respectively. According to Kharkar *et al.* (2017) [19], the total mortality rate in Jersey Sahiwal crosses was 31.22 percent, with the highest percentage (15.12 percent) of calves died within one month of birth. They also discovered that overall mortality rates for calves aged 1-3 months, 3-6 months, and 6-12 months were 5.75 percent (7.06 percent for males and 4.49 percent for females), 6.10 percent (5.06 percent for males and 7.06 percent for females), and 8.44 percent (12.00 percent for males and 5.06 percent for females, respectively. According to Mishra *et al.* (2015) [25], overall death rates in the 1-3- and 3-6-month age groups were 3.61 percent and 2.41 percent, respectively, with male and female calves having rates of 3.14 percent and 1.64 percent, respectively. Within one month after delivery, both sexes had the highest mortality rate (5.44 percent).

Causes of calf mortality

Calf mortality has a variety of causes. The herd's management, the dam, and the season all have an effect. Infectious and non-infectious causes of calf death can be distinguished. Diarrhea and pneumonia are infectious diseases caused by bacteria, viruses, and protozoa. Dystocia, inappropriate colostrum feeding, low birth weight, and inadequate care methods are the most common non-infectious reasons. Dystocia is the leading cause of calf death, accounting for over half of all calf deaths (Mandal *et al.*, 2019) [21]. GGI diseases and pneumonia were the two leading causes of calf death during the first month of life, according to Torsein *et al.* (2011) [41], and these causes were impacted by housing conditions, colostrum intake, and feeding management of calves. According to Epidemiological studies on calf diarrohea in Jammu region by Tikoo *et al*., 2018 highest incidence of diarrhea cases was found in winter season (36.9%), where as species wise more number of cases were found in buffalo calves(38.1%) as compared to cow calves(27.9%). Birth weight wise both the incidence and mortality was higher (34.1 and 7.6 per cent, respectively) in 20 – 25 Kg birth weight category. Sex wise higher incidence for calf diarrhea (50.3%) and mortality (7.2%) was recorded in male calves in comparison to female calves (20.9% incidence of calf diarrohea and 3.3% calf mortality in females), where as age wise both the incidence and mortality due to calf diarrhea was higher in 11 - 20 days i.e. 38.6% and 9.8 % respectively, age group.

Overfeeding

Overfeeding of milk is usually a cause of undue fermentation in large intestine and provides a favorable condition for the pathogenic organisms to multiply and leading to enteritis (Arora, 1978) [4]

Negligence towards male calf

The majority of male calves in India are starved to death owing to a lack of demand. Male calves are permitted to nurse for a few minutes after the colostrum stage, but this is insufficient to meet their nutritional needs. According to Dhakal *et al*. (2013) [9] and Mellad *et al.* (2013) [4], the calf mortality rate in different breeds of cattle was substantially greater (P0.05) in males than females. In Jersey crossbred cattle, Pathak *et al.* (2018) [28] revealed a similar line of research results.

Poor heat regulation mechanism

According to Sachan (1963) [32] the possible cause of high mortality in buffalo calves could be their poor heat regulation mechanism which adversely affect them especially in cold weather.

Microbial factors

In India, 12.5% incidence of buffalo calves' mortality are reported and among these 36.6% calves showed diarrhea as main etiology (Kareemulla and Meena, 2004) 16[]. Major causes of calf mortality were GIT disorders (36.12%), pneumonia (18.92%), coliform infections and its complications (14.22%), intestinal parasites (15.63%) and unknown etiology (15.11%) (Balakrishnan *et al.* 1996) [5]. According to Svensson *et al.* (2006) [41] the incidence of diarrohra, ringworms and clinical respiratory tract disease in calves from 3 to 7 months of age were 2.7%, 5.6% and 5.7% respectively.

Parity of dam

Mortality of 33.4%, 37.8% and 28.8% in the calves of cows calving for the 1st, 2nd or 3rd and 4thor greater time respectively (Wells *et al.* 1996) [44]. Van Pelt *et al.* (2012) [42] obtained the decrease trend in calf mortality with increasing parity number, reaching the lowest level at ninth parity and higher. Norberg *et al*. (2013) [27] found that the mortality risk of calves increased with increasing age (parity) of dam in Jersey cattle. Mishra *et al.* (2015) [25] observed that the overall mortality rate in first, second, third and fourth or more parities was 7.17%, 4.54%, 1.40% and 2.84%, respectively and these variations were statistically significant (P<0.05).

Colostrum feeding

Colostrum helps neonatal calf to make a defense against

infectious disease. According to Bhargava and Balkrishnan (1978) [7] immunoglobulin level in buffalo calf was 29.73 mg/ml in 1 day old calfand quantity increases to 35.66 mg/ml on 2nd day of life. Colostrum which is the only source of immunoglobulin for buffalo calf contains 68.75 mg/ml on 1st day which drops to 23.73mg/ml on 2nd day and 1.01 mg/ml on fifth day of lactation. In commercial dairy farm owners did not feed the colostrum timely. They waited for the expulsion of placenta and on many occasions the animal did not release placenta for more than 7-8 h, thus the colostrum feeding was delayed, leading to lowered immunity level in calves and susceptible to disease (Ahmad *et al*., 2009) [2].

Season

Season has a significant effect on the calf mortality (Fink.1980) [10] as well as on the absorption of immunoglobulins in neonatal calves. In temperate climates the mean serum IgG1 concentrations were lowest in winter born calves and increased during the spring and early summer, perhaps this is the reason that higher mortality rates of 69.6 and 15.36 per cent had been observed in winter born buffalo calves than 39.4 and 5.97 per cent in summer born calves (Sharma *et al.*1984) [34]. Monsoon is most susceptible season to calf disease and mortality (Islam *et al*., 2005) [13]. Kumar *et al.* (2002) [20], Gulliksen *et al.* (2009) [12], McCorquodale *et al.*, (2013) [23] and Mellado *et al.* (2014) [24] reported the highest mortality of calves in winter season in different cattle breeds. The increased mortality rate of calves in winter season may be due to exposure to cold temperatures on calf mortality (Kumar *et al.*, 2002) [20], production of lower quality colostrum during the winter months (Shearer *et al.*, 1992) [35] or due to the impaired absorption of immunoglobulins from colostrum (Beam *et al.*, 2009) [6]. Kharkar *et al.* (2017) [19] observed the highest mortality in winter season (40.30%) followed by monsoon (36.47%) and summer (11.32%) seasons.

Worm infestation

Heavy losses of young buffalo calves throughout the world are caused by the roundworm *Toxocara vitulorum*. Common symptoms are diarrhea (or alternating diarrhea and constipation), dehydration, dullness, weakness, coma and finally death (Ligda, 1997, 1998). Ascariasis is probably the single factor causing heavy mortality in buffalo calves, the extent of mortality being as high as 60-80% of affected animals (Annon, 1978) [3]. The larvae of roundworms invade various organs and tissues and remain there for long, and when the host becomes pregnant, they become active again, crosses the placenta and reach the foetus causing prenatal infection. According to Singh *et al*., 2018 [39] an overall occurrence of Cryptosporidium spp. was 7.30% (32/438) in bovine calves of north and central India. The occurrence in Uttar Pradesh and Madhya Pradesh was 11.16% and 2.81%, respectively. The prevalence was more in the calves of age 0-20 days, calves of the dam in their first parity, calves with watery diarrhoea and during monsoon season.

kHousing and Hygiene

In calf houses, poor ventilation, overcrowding, no regular cleaning and disinfection predispose various diseases of calves, especially of respiratory tract leading to high calf mortality. According to Waltner *et al*. (1986b) [43] there was a decreased risk of developing both pneumonia as well as diarrhea in calves housed in calf hutches compared with the calves in indoor individuals' pens. Poor hygienic conditions may expose young calves to pathogens like E. coli, Salmonella, Pasteurella and parasites which causes neonatal mortality (Blood *et al*. 1994) [30]. Calves kept in pens develop arthritis, tenovaginitis or abscesses and even fractures and those develop naval joint illness had a poor survival rate (Britney *et al.* 1984) [8]. Mortality of calves can be reduced by rearing them on elevated and perforated floors (Simensen.1982). Similarly naval disinfection and removal of mucous from the mouth and nose reduces mortality and morbidity rates in calves (Fink.1980) [10].

Control measures

There is a need to make optimum scientific standards of calf management to prevent calf mortality and to improve their welfare standards. Keen observation and care facilities needs to be given to calf both before and after its birth.

Care before birth

- Proper calf care begins before the calf is even born. Buffaloes in the dry period are offered mineral and vitamin mixes in order to prevent issues associated with deficiency in both the demand the calf. Some of these issues include retained fetal membranes (RFM), lazy calving, calving difficulty (dystocia), milk fever, calf death and poor calf health. For example maternal deficiency of trace minerals and Vitamin E in late pregnancy can compromise the immune system of the calf. This may increase susceptibility to scour, pneumonia, navel-ill, joint-ill, etc. It is generally advised to feed dry animal mineral and vitamins for approximately six weeks pre-calving. This is in order to combat deficiencies in the total dietary intake.
- Never overcrowd close-up pens. Maternity pens should be single use to minimize the spread of disease.
- The dam should be clean before she goes into the pen because the calf may nuzzle her in search of colostrum. Be prepared to remove the calf from the dam and maternity pen immediately to avoid disease transfer. This happens primarily through "manure meals" via nose dives into the bedded pack while attempting to stand, sucking on the cow´s manure-laden body searching for colostrum, or ingesting manure-contaminated colostrum. The dam should be up-to-date on booster vaccinations. These vaccinations allow her to transfer passive immunity through colostrum to her calf.
- Simple management procedures such as ensuring adequate intake of good quality colostrum within the first 12 hours of life, housing and good hygiene to minimize disease transfer, providing clean drinking water, developing appropriate feeding protocols to encourage early rumen development and paying closer attention to climate control and animal health can all lead to improved calf vigour and performance. Good record keeping is also important so farmers can more easily identify susceptible calves and quickly treat potential problems.

Caring for newborns

- After delivery, attention shifts to the new born calf. Process the calf by stimulatingit to breathe, check its general health status and dip the navel in a strong (7%) iodine tincture solution.
- Remove the calf from the dam and provide a clean, dry

resting surface to ensure its hair coat stays dry, helping insulate against the cold ground, low airtemperatures and sudden temperature changes.

- Provide at least 6 inches of bedding as a cushion to minimize physicaltrauma. House calves in individual pens to reduce the spread of disease.
- A sound colostrum program is essentialin raising healthy calves, which are born without an immune system. Colostrum allows a calf to develop animmune system, protecting it from disease until it can produce its ownantibodies within four weeks. Becausecolostrum is essential to a healthy calf, be prepared to feed colostrum 24 hoursa day, seven days a week. Feed high quality (at least 50 grams immunoglobulinsper liter) fresh, refrigerated, orfrozen colostrum from a second or laterlactation. If colostrumis not available, feed a colostrum replacement product with 50 or moregrams of immunoglobulins per liter.
- After the colostrum´ s period, whole milk should be provided to the calf until 15 days of age @ a level of 1/10th of the calf´s body weight. Milk replacer can be fed along with the whole milk provided that it has a certain composition of nutrients. It is not advisable to completely substitute whole milk with milk replacer. Milk and/or replacer should be offered to the calf on at least two occasions per day. The milk and/or replacer should be served at body temperature (38-39°C).

Table 1: Feeding of the calf

Age (Days)	Daily gain (Kg)	DCP (g)	TDN (g)	ME (M Cal)	Ca (g)	P (g)	Vit A (1000IU)	Vit D (IU)
0-15	0.20	80	400	1.5	2.5	1.5	1.5	200
16-30	0.30	90	500	1.7	3.0	2.0	1.5	250
31-60	0.30	125	800	2.4	3.5	2.5	1.7	250
61-90	0.35	150	1000	3.6	4.0	3.0	2.0	260

- At two weeks of age, the calf should be introduced to good quality green feed and concentrates, as a calf starter (Table 3). This stimulates the rumen to grow and function properly. By following the feeding schedule in Table 2, a daily gain of 0.35 kg can be expected in Murrah calves.

Feeding schedules for calves

Table 2: Feeding schedules for calves

Age (Days)	Whole milk (I)	Skim milk (I)/Milk Replacer	Calf starter (g)	Hay (g)
0-14	4*	-	-	-
15-21	3.5	-	50	300
22-28**	3.0	-	300	500
29-35	1.5	1.0	400	550
36-42	-	2.5	600	600
43-49	-	2.0	700	700
50-56	-	1.5	800	800
57-63	-	1.0	1000	1000
64-70	-	-	1200	1100
70-77	-	-	1300	1200
78-84	-	-	1400	1400
85-91	-	-	1700	1900

*First 3 to 4 days, feed colostrum.
**Ensure a smooth and gradual change to milk replacer

Calf starter mixture-Typical calf starter mixture should have the following Ingredients as shown in table 3.

Table 3: Composition of calf starter mixture

Feed Source	Amount (%)
Crushed Barley	50
Groundnut Cake	30
Wheat Bran	08
Fish meal/Meat meal/Skim milk powder	10
Mineral mixture	02
To increase acceptability, add per 100 Kg of starter	
Molasses	5-10 Kg
Salt	500

Buffalo calves fed with Stover´s of maize, bajra and oat cannot meet their nutrient requirements and are often in negative energy and protein balance. However, feeding the calves with treated Stover´s with a urea-molasses-salt complex both enhances the palatability of the Stover´s as well as the digestibility and nutrient value.

Conclusion

Calf mortality is one of the major obstacles for dairy farms worldwide in achieving their economic target and also for animal's own welfare. The first three months of calves are the most crucial period for their survivability in any dairy farm. There can be multiple factors ranging from animals genetic structure to environmental and management that can lead to calf mortality in dairy farm. There is a need for the optimum standardization and scientific management practices to prevent as well as cure the etio-pathologies causing calf mortality. A combination of practices like proper care of dam during last phase of pregnancy, intensive care of calf after birth, improved manage mental practices and veterinary aid in emergency will help to prevent the problem to a large extent.

References

1. Afzal M, Javed MH, Anjum AD. Calf mortality: Seasonal pattern, age distribution and causes of mortality Pakistan Vet J. 1983;3:30-33.
2. Ahmad S, Yaqoob M, Hashmi N, Zaman MA, Amjad MS. Farmers'attitude towards interventions regarding buffalo calf health care and management practices under field conditions Small. 2009;80(48):60-0.
3. Annon. All India Coord. Res. Proj. on Buffaloes N.D.R.I., Karnal. Ann. Report 1978, 7.
4. Arora SP. Calf Raising N.D.R.I. Pub. No. 1978, 135.
5. Balakrishnan M, Ramesha KP, Sreenath M, Kumar S. Factors affecting mortality of buffalo calves in an organised herd. Indian J Dairy. Biosci. 1996;7:61-65.
6. Beam AL, Lombard JE, Kopral CA, Garber LP, Winter AL, Hicks JA, *et al*. Prevalence of failure of passive transfer of immunity in newborn heifer calves and associated management practices on US dairy operations. J Dairy Sci. 2009;92(8):3973-3980.
7. Bhargava H, Balakrishnan M. Genetic studies on immunoglobulin in Buffaloes. All India Coord. Res. Proj. on Buffaloes Ann.Report.1978, 1.
8. Britney JB, Martin SW, Stone JB, Curtis RA. Analysis of

early calf hood health status and subsequent dairy herd survival- ship and productivity. Prep Vet Med, 1984;3:45-52.
9. Dhakal K, Maltecca C, Cassady JP, Baloche G, Williams CM, Washburn SP. Calf birth weight, gestation length, calving ease, and neonatal calf mortality in Holstein, Jersey, and crossbred cows in a pasture system. J Dairy Sci. 2013;96:690-698.
10. Fink T. Influence of type of housing, microclimate and management on health of calves. Inaugural Disser Tierarztliche Hochshule, Hannover, 1980, 120.
11. Fuerst-Waltl B, Sørensen MK. Genetic analysis of calf and heifer losses in Danish Holstein. J Dairy Sci. 2010;93(11):5436-5442.
12. Gulliksen SM., Lie KI, Loken T, Osteras O. Calf mortality in Norwegian dairy herds. J Dairy Sci. 2009;92:2782-2795.
13. Islam SS, Ahmed AR, Ashraf A, Khanam N, Ahmed MB. Causes and consequences of calf mortality in a dairy farm of Bangladesh. J Anim. Vet. Adv. 2005;4:260-264.
14. Jain AK. Assessment of immunocompetence of buffalo and cow calves and role of neem oil as immunomo dulator. M.Sc. Thesis, JNKVV, Jabalpur, 2005.
15. Jenny BF, Cramling GE, Glaze TM. Management factors associated with calf mortality in South Carolina dairy herds. J Dairy Sci. 1981;64:2284-2289
16. Kareemulla K, Meena BS. A Status of Buffalo Based Economy in Asia. Kundu (SS), AK Misra and PS Pathak, International Book Distributing Co., Lucknow, India, 2004, 517-529.
17. Khan A, Khan MZ. Immunoglobulins in relation to neonatal calf mortality. Pakistan Vet J. 1991;11:153-162.
18. Khan ZU, Khan S, Ahmad N, Raziq A. Investigation of mortality incidence and managemental practices in buffalo calves at commercial dairy farms in Peshawar City. Agric. Biol. Sci. 2007;2:16-22.
19. Kharkar KP, Raghuwanshi DS, Lende S, Khati BM. Mortality pattern in crossbred calves of dairy cattle. J Krishi Vig. 2017;5(2):116121.
20. Kumar CR, Moorthy PRS, Rao KS, Naidu KV. Calf mortality pattern in relation to age and sex in organized livestock farms in Andhra Pradesh. Indian J Anim Sci, 2002;72(10):921-923.
21. Mandal A, Pathak K, Karunakaran M and Ghosh MK. Postnatal calf mortality-a review. Indian J. Anim. Hlth, 2109;58(2):147-156.
22. Martin SW, Schwabe CW, Franti CE. Dairy calf mortality rate: characteristics of calf mortality rates in Tulare County, California. Am. J Res. 1975;36(08):10994-4.
23. McCorquodale CE, Sewalem A, Miglior F, Kelton D, Robinson A, Koeck A *et al*. Analysis of health and survival in a population of Ontario Holstein heifer calves. J Dairy Sci. 2013;96:1880-18.
24. Mellado M, Lopez E, Veliz FG, De Santiago MA, Macias-Cruz U, Avendaño-Reyes L *et al*. Factors associated with neonatal dairy calf mortality in a hot-arid environment. Livest Sci. 2014;159:149-155.
25. Mishra AK, Rawat NS, Nanawati S, Gaur AK. Studies on the calf mortality pattern in Gir breed. Int J Livest Prod. 2015;6(4):47-51.
26. Nisar Ahmed M, Rama Rao P, Reddy MM, Murthy AS, Sriraman PK, Sastry GA. Note on calf mortality in Andhra Pradesh. Indian J Anim Sci. 1978;48:913-914.
27. Norberg E, Pryce J, Pedersen J. Short communication: A genetic study of mortality in Danish Jersey heifer calves. J Dairy Sci. 2013;96(6):4026-4030.
28. Pathak K, Koloi S, Ghosh MK, Karunakaran MK, Mandal A. Genetic analysis of calf survivability in crossbred cattle. Indian J Dairy Sci. 2018;71(6):598-603.
29. Pradhan B and Panda GM. Calving pattern and mortality trends in murrah buffalo calves reared under Orissa condition. Indian J. Anim. Prod. Health, 1994;10:143-146.
30. Rodostits OM, Blood DC, Gay CC. Veterinary Medicine: a text book of the disease of cattle, sheep, pigs, goats and horses 8 ed. BoillièreTindall, London, 1994, 1034.
31. Roy JHB. The Calf Management of Health, Butterworths, Basingstoke, Kent, UK, 1990;1:1–6.
32. Sachan DS. Studies on economic rearing of buffalo calves. M.V.SC. thesis, Jabalpur University, 1963.
33. Shakya A, Roy B, Baghel RPS. Studies on buffalo calf mortality in Jabalpur district of Madhya Pradesh. Buffalo Bulletin. 2017;36(3):521-524.
34. Sharma MC, Pathak NN, Hung NN, Lien NH, Vuc NV. Mortality in growing Murrah buffalo calves of Vietnam. Indian J Anim Sci.1984;54:998-1000.
35. Shearer J, Mohammed HO, Brenneman JS, Tran TQ. Factors associated with concentrations of immuno globulins in colostrum at the first milking post-calving. Prev Vet Med. 1992;14:143-154.
36. Sheikh IU. Influence of non-genetic factors on birth weight, sex ratio and survivability of crossbred jersey calves. Asian J Bio Sci. 2010;5(2):192-194.
37. Shrivastva M. Studies on managemental aspects of buffalo calf mortality in Mhow tehsil of Madhya Pradesh. M.V.SC. thesis, Jabalpur University.
38. Simensen E. An epidemiological studies of calf health and performance in Norwegian dairy hers. II. Factors affecting mortality. Acta Agric. Scandinavia, 1985;32:421-427.
39. Singh S, Singh R, Kamdi BP, Kasyap G, Singh R, George N, *et al*. Occurrence and pathology of cryptosporidium in bovine calves of North and Central India. J Anim Res. 2018;8(5):925.
40. Tikoo A, Soodan JS, Singh G. Epidemiological Studies on Calf Diarrhea in Jammu Region. J Anim Res. 2018; 8(3):481-486.
41. Torsein M, Lindberg A, Sandgren CH, Waller KP, Törnquist M, Svensson C. Risk factors for calf mortality in large Swedish dairy herds. Prev Vet Med. 2011;99(2-4):136-137
42. Van Pelt M, Eding H, Vessies P, De Jong G. Developing a genetic evaluation for calf survival during rearing in The Netherlands. Interbull Bulletin. 2012;46:61-65.
43. Waltner-Toews D, Martin SW, Meek AH. Dairy calf management, morbidity and mortality in Ontario Holstein herds. II. Age and seasonal pattern. Vet. Med. 1986;4:125.
44. Wells J, Dargatz DA, Ott SL. Factors associated with mortality to 21 days of life in dairy heifers in the United States. Prev. Vet. Med. 1996;29:9-19.