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Determination of immunoglobulin G (IgG) concentration and health status of Karan Fries new born calves in different seasons

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Abstract
The present study was conducted on Holstein Frisian crossbred calves (96 healthy, diseased calves 32 diarrhoea and 32 pneumonia) of age within one month at Livestock Research Center, ICAR-National Dairy Research Institute, Karnal, India over a period of one year. The serum immunoglobulin (IgG) concentration below one month of age in normal and diseased calves in all four seasons was estimated. The serum immunoglobulin IgG concentration in normal healthy winter born calves was highest 26.45 ± 0.67mg/ml followed by autumn season calves 26.12±1.09 mg/ml and rainy season calves 25.04 ± 1.21 mg/ml. The lowest level was observed in summer born calves 23.86 ± 0.68 mg/ml. In diseased calves immunoglobulin concentration was highest in winter season 21.62 ± 0.74 mg/ml followed by rainy and summer season 20.19 ± 1.21 and 20.1 ± 1.07 mg/ml respectively. The lowest level was observed in autumn season 18.85 ± 1.36 mg/ml. The incidence of diarrhoea was highest in rainy and autumn season compare to other season and mortality was high in summer season compare to other seasons. This may be due to deficient immune status of calves in these seasons compare to other season. So by analyzing the serum immunoglobulin IgG level we can predict the morbidity and mortality of a calf in a farm level.

Keywords: Seasons, IgG, Karan Fries calves, health status

Introduction
Calves are considered as future replacement stocks in a dairy farm, so they are reared economically in a sound manner to ensure early maturity. However, calf hood diseases particularly calf diarrhoea and pneumonia cause considerable economic losses in terms of mortality, morbidity, treatment cost and long term negative consequences on performance in survivors after recovery [20]. Calves are immune-deficient at birth and the colostrum feeding provides passive protection to calves during early life and the level of circulating immunoglobulin (Ig) is the direct reflection in calves [21]. The neonatal calf, which is born with little or no humoral immunity, is totally dependent upon absorption of colostral derived immunoglobulin for its early disease resistance [27]. The influence of maternal nutrition on the early growth performance of offspring is mainly mediated through its influence on the birth weight besides milk yield and quality.

Passive immunity to some infectious agents is transferred from the cow to calf via colostrum. Transfer is by an apical tubular system in the intestinal absorptive cells for a limited time after birth. Uptake of macromolecules into the cells appears to be nonselective; however, some substances are not transferred to the blood. Cessation of transfer of material from the epithelial cells to blood occurs spontaneously at a progressively increased rate after 12 h of age with mean closure time at approximately 24 h. Proportions of the different classes of immunoglobulins in serum of calves after ingestion of colostrum reflect the proportions in colostrum when absorption is completed [26].

Variation among calves in serum concentration of immune is wide. Amount of total γ-globulin or IgG ingested per unit of body weight soon after birth is the most important factor determining concentration of these in serum. Absorption efficiency is decreased when ingestion of first colostrum is delayed, indicating the importance of colostrum intake soon after birth. Even more important is that transmigration of pathogenic bacteria can be prevented by colostrum in the intestinal lumen. Poor quality colostrum with inadequate immunoglobulin concentration contributes to failed transfer of passive immunity in calves, leading to higher calf morbidity and mortality [9].

The immunoglobulin (IgG) concentration shows a declining trend in calf serum depending on the time of colostrum feeding. So the time of colostrum feeding to a newborn calf is very crucial in initial phase of life just after parturition. Assessment of IgG level in calf serum could be a predictive management tool for the health status (mortality and morbidity) of newly born calf. [14]. Depending on the level of IgG in calf serum, animal breeder and farm manager may plan and provide extra care to newborn calves to increase the survivability of calf [30]. So the present study was designed to access the IgG level in Karen Fries calves serum to predict the health status of animals

Methods

The present study was conducted on 128 Holstein Frisian crossbred calves (96 healthy, 32 diarrhoea and 32 pneumonia) of age within one month at livestock research center, ICAR-National Dairy Research Institute, Karnal, India over a period of one year. Calves were weaned after birth on day zero and housed in a well ventilated pen with straw bedding for 0-4 days and fed colostrum @1/10th of body weight twice daily by pail feeding per day. Then on 5th day calves were shifted to another pen, where kept upto one month and fed solely with pooled whole milk @1/10th of body weight per day twice daily. Depending on meteorological variables the whole duration of study was divided into four major seasons like rainy (July-September), autumn (October-November) winter (December-March) and summer (April-June).In each season, each month 8 normal healthy calves randomly selected for blood sampling and diseased calves observed regularly in the herd and blood collected for each disease (n=8) in each season for immunoglobulin G (IgG) concentration. Both diarrhoeic and pneumonic calves were diagnosed based on clinical signs. Approval of Institutes Animal Ethics Committee (IAEC) was obtained for blood collection in the experimental calves.

Collection of Serum: From new born Karen Fries calves, between 8.30 - 9.30 AM before milk feeding or treatment 3 ml blood from each calf was collected in vacutainer tubes without anticoagulant and was kept in a slant position for isolation of serum. Indirect ELISA was performed with the help of kit (Koma Biotech K3231014) with some modifications.

Statistical analysis

The statistical analysis was done using Sigmaplot version 11.0 (Systat Software Inc., USA). Data sets were first tested for normality by Shapiro-Wilk's normality test and analysed by two way analysis of variance (ANOVA) with general linear model (GLM). All pair-wise differences in mean were compared by Tukey post hoc test.

Results and Discussion

Table 1: Serum Immunoglobulin IgG (mg/ml) concentration of normal and diseased calves in different seasons (Mean±SE)

Group	Season	Normal calves (n=96)	Diseased calves (n=64)
Karen Fries Calves	Rainy (Jul-Sept)	25.04^{a}±1.21	20.19^{a}±1.21
	Autumn (Oct-Nov)	26.12^{a}±1.09	18.85^{b}±1.36
	Winter (Dec-Mar)	26.45^{a}±0.67	21.62^{a}±0.74
	Summer (Apri-June)	23.86^{b}±0.68	20.10^{a}±1.07

Means with different superscript in a coloum differ significantly (P< 0.05)

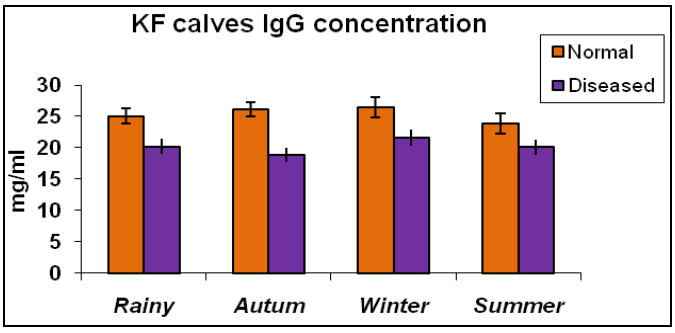

Fig 1: Serum Immunoglobulin (IgG) concentration in KF calves

The average serum immunoglobulin (IgG) concentrations in below one month of age in normal and diseased calves in all four season are presented in table 1 and figure 1. The serum immunoglobulin IgG concentration was highest in winter born calves 26.45 ± 0.67mg/ml followed by autumn calves 26.12±1.09 mg/ml and rainy season calves 25.04 ± 1.21 mg/ml. The lowest level was observed in summer born calves 23.86 ± 0.68 mg/ml. In diseased calves immunoglobulin concentration was highest in winter season 21.62 ± 0.74 mg/ml followed by rainy and summer season 20.19 ± 1.21 and 20.1 ± 1.07 mg/ml respectively. The lowest level was observed in autumn season 18.85 ± 1.36 mg/ml.

The incidence of diarrhoea was highest in rainy and autumn season compare to other season. This may be due to deficient immune status of calves in rainy and autumn season compare to other season. This is agreement with [4] reported that incidence of fever was highest in autumn season compare to the other seasons and we observed similar trend in Karen Fries calves and mortality was high in summer season compare to other seasons. This may be due to deficient immune status by defective apical tubular system in intestinal epithelium and low IgG concentration in colostrum [6&5] due to environmental stress. Also may be higher incidence of diseases in group housing calves due to amenable to cross infections.

Higher incidence of diarrhea reported in crossbred calves; which were group housed as compared to those which were individually housed [24]. Transfer of immunoglobulin from colostrums to neonates is of utmost significance in view of calf development. Passively acquired immunity during this period of initial few hours after birth is well associated with the antimicrobial protection of calves through readily available colostral immune bodies [17]. Also the neonatal imprinting is done by exposing the calves to maternal IgG which, in turn, guides the development of immune system in calves during the first 2-3 weeks. Absorbed levels of serum IgG within 24 h after birth has been well associated with growth performance of buffalo calves [26]. It indicates that big scope of growth improvement lies with raising the serum IgG status of calves. The maximum concentration of serum IgG was seen in calves receiving colostrums within 2 and 8 hr of birth [7].

The amount of immunoglobulin (Ig) absorbed from the

intestine of the calf depends on the amount of colostrums ingested, the IgG concentration of colostrums and the absorption efficiency of the gut and delay in feeding colostrums resulted in a corresponding reduction in absorption of IgG [25]. The calves that lack adequate passive immunity have susceptibility to most calf hood infectious diseases with increased mortality rate [11]. The delay in feeding colostrum to calf contributes to increasing the incidence of diarrhoea due to colibacillosis as a result of lowered natural resistance [7]. And also observe that maximum concentration of serum IgG (20.33 ± 1.70 mg/ml) was seen in calves receiving colostrum within 2 and 8 hr of birth. Availability of colostrum as single feeding at 2 hr of birth to the calves resulted in serum IgG concentration of 15.00 ± 1.83 mg/ml, which was adequate to provide disease resistance. These calves did not suffer from *E. coli* diarrhoea and had maximum weight gain up to 3 months. During diarrhoea IgG concentration was reported 10.66 ± 1.33 mg/ml. However in our study affected animals showed higher level of IgG.

No immunoglobulin (IgG) could be detected in animals of colostrums deprived because the syndesmochorial type of placenta in bovines does not allow the transfer of antibodies from mother to fetus [19]. The absence of *E.coli* diarrhoea in these calves was due to adequate serum IgG concentration which could have prevented enteric infection either by preventing transepithelial migration of microorganism or in case of invasion, the interaction of passively acquired IgG and phagocytic cells of neonates resulted in removal of invading organism [31]. Reticuloendothelial system is the principle defence against *E. coli* bacteremia and this protection was comprehensive when calves had obtained IgG concentration from colostrums [25]. The results are associated with [29] reported that local intestinal immunity is provided by early administration of colostrums for the prevention of *E.coli* diarrhoea. The maximum concentration of serum IgG (20.33 ± 1.70 mg/dl was seen in calves receiving colostrum within 2 to 8 hr of birth [7]. Although the amount of colostrum ingested provides better immunity in terms of general antibacterial activity present in colostrum it influences the genetic makeup both on absorption and synthesis ability of immunoglobulins of calves [26].

The present findings agreement with [23] A high incidence of calf hood diseases in the tropical countries also tune to high death rate in the pre-weaned calves Incidentally, high calf mortality at rural and peri-urban farms compared to rural commercial farms could be due to better management practices of animal. Adoption of proper management practices reduce mortality rate in calves [2]. Calves deprived of colostrums or calves absorbing inadequate amounts of colostral immunoglobulin (Ig) are susceptible to the various diseases [15]. Further, maternal nutritional status during late pregnancy is reported to have considerable influence on the colostrums quality and subsequent absorption by the calf [13].

Although there are many studies that have demonstrated a positive impact of maternal nutrition on the birth weight of calves [16], its effects in influencing the early growth performance of the calves is often without agreement. The results are contrast with the findings of [33] found that diarrhoea, septicemia, pneumonia or mortality of neonatal calves occurred when IgG concentration in blood serum was less than 8 mg/ml. The management target of 10mg/ml has been suggested as a minimum level of IgG in the serum of calves by approximately 24 hour of age to prevent failure of passive transfer, although the level of IgG that provides adequate protection will vary with exposure to infectious organisms, stress, environment and temperature [28]. The concentration of serum IgG in commercial market calves in which spontaneous disease occurred in high incidence [22]. They found that surviving calves had means in serum of 7.5 mg/ml IgG, 10.8 mg/ml IgM and 0.2 mg/ml IgA while those dying of septicemia had 0.8 mg/ml IgM and 0.2 mg/ml IgA. Calves dying of no septicemia and diarrhea had intermediate level of IgG (5.0 mg/ml), IgM (0.6 mg/ml) and IgA (0.24 mg/ml).

The efficiency of passive immune transfer in dairy herds, calves were sampled monthly for a full year in 19 herds, and all but one herd had one or more calves with immunoglobulin concentrations under 5.0 mg /ml. Overall calves having Ig concentration under 5.0 mg/ml were exposed to excess mortality risk (16-20%). Blood serum Ig concentrations of calves during their 2nd week of life had a 0.97 correlation with 1st week concentrations [12]. The twin calves had fed the same amount of colostrum at 20-24hr of age and found that one achieved a normal gamma globulin level while the other developed hypogammaglobulinaemia and septicemia [10].

Based on morbidity and mortality data, passive transfer is generally considered adequate if the concentration of IgG in serum is ≥10.0 g/L at 1–7 days of age [32], although figures as high as 20.0 g/L have been suggested [8]. Many authors indicate that the mortality in cattle and buffalo calves ranged from 29.1% to 39.8% [1], whereas [18] estimated that 20% calf mortality resulted in a reduction of 38% profit of a livestock farm.

In Murrah buffalo calves, the level of IgG in calf serum ranged from 4.2 to 14.88 mg/ml with a mean of 11.23 ± 0.70 mg/ml [30]. The rapid ingestion of large amount of milk and milk substitutes from an open pail can result in incomplete closure of the esophageal groove, formation of defective clot in abomasum for several hours after feeding, excessively fast abomasal emptying and overloading of the intestine leading to bacterial over proliferation and diarrhea [3]. This may be the reason in NDRI herd as zero day weaning was practiced and animals are feed in pail positioned at ground level which does not allow oesophageal groove formation while drinking milk at a very fast rate. Researchers have reported a wide range of immunoglobulin concentration in newborn calf serum. The variation in results could be due to species differences as well as different methods of rearing and estimation.

Conclusion

The study revealed that the level of immunoglobulin (IgG) calf serum of Karen Fries calves there can be variability in different seasons in absorption of immunoglobulin from one calf to another regardless the amount given, time of feeding or immunoglobulin concentration in colostrum. The incidence of diarrhoea was highest in rainy and autumn season compare to other season and mortality was high in summer season compare to other seasons. This may be due to deficient immune status of calves in these seasons compare to other season. So by analyzing the serum immunoglobulin IgG level we can predict the morbidity and mortality of a calf in a farm level.

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