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FACTORS ASSOCIATED WITH DIARRHEA INCIDENCE IN BEEF CALVES FROM BIRTH TO 30 DAYS OF LIFE IN THE FRENCH MIDI PYRÉNÉES REGION.

Bendali F.[1], Bichet H.[2], Schelcher F.[3], Sanaa M.[1]

L'objectif de la présente étude est de décrire l'épidémiologie de la diarrhée des veaux (de la naissance à 1 mois d'âge) dans les élevages allaitants, et d'évaluer l'impact des pratiques d'élevage sur l'incidence des diarrhées. Nous avons conduit une enquête prospective, portant sur 94 élevages allaitant tirés au sort de la région de Midi-Pyrénées. A l'aide d'un questionnaire, nous avons recueilli des données sur les pratiques d'élevage (bâtiment, alimentation, prophylaxie etc.) et des données individuelles (condition de vêlage, première prise de colostrum etc.). D'autre part, nous avons récolté tout le long de l'étude des données sur les conditions d'ambiance variant au cours du temps (température, hygrométrie, densité des animaux). Au total, 3157 veaux ont été suivis, le taux d'incidence moyen était de 0.4 pour 100 veau-jours. Le risque de diarrhée varie selon le mois de naissance, avec deux pic en mars (RR=6.44) et en décembre (RR=4.46). A l'aide d'un modèle de survie (Cox proportionnal Hazard Model) tenant compte de la non indépendance entre les observations faites sur des animaux d'un même élevage, nous avons testé les relations entre les variables recueillies et l'incidence de la Diarrhée. La non distribution de concentré aux vaches augmente significativement le risque de diarrhée (RR=1.82). La vaccination des mères contre Escherichia coli ainsi que contre les autres maladies (IBR, BVD...) protège les veaux des diarrhées (RR=2.86 et RR=2.95 respectivement en absence de vaccination). Un vêlage dystocique ou une césarienne constitue un risque par rapport aux vêlages faciles (RR=1.33). Parmi les facteurs d'ambiance, la présence d'une forte odeur d'ammoniac et la saleté des mères étaient significativement liées à la diarrhée avec des risques relatifs de 1.9 et 1.65 respectivement.

INTRODUCTION

Diarrhea in calves less than 30days of age is of great economic importance to all beef and dairy producers. With an average incidence rate of 20%, diarrhea is the first major cause of neonatal mortality in French Midi Pyrénées (FMP) Region. The amount of financial loss due to beef calf diarrhea in FMPR was assessed to be 400 FF per calf per year (Regional assessment).

Recent epidemiological studies evaluated the influence of predetermined risk factors, and the relationship between them on morbidity (including enteritis) and mortality both at the individual calf and herd levels in dairy calves (Waltner-Toews et al., 1986, Sivula et al., 1996, Wells et al., 1996). To date, only one epidemiological study (a case control study) was recently published on risk factors associated with beef calves diarrhea (Schumann et al. 1990). This study conducted in Alberta examined only the relationship between mortality from diarrhea and herd level risk factors. No recent epidemiological assessment on the effect of management practices upon the occurrence of diarrhea in beef herds from birth to 30 days of age is available in French conditions.

The aim of our study were to describe the epidemiology of diarrhea in beef calves (DBC) from birth to 30 days of age, to evaluate individual calf and herd management practices associated with DBC within the first month of life on French beef calf herd.

MATERIAL AND METHODS

A stratified random sample of 94 beef cow-calf herds was selected from departmental agriculture statistics service lists of the 8 departments composing the FMP region. The FMP region includes 20 000 beef herds.

Beef herds with at least 30 cows were eligible for inclusion in this study. Additional producer selection criteria included, calving period (at least 80% of calving expected within the study period: 15th of December 1995 to 15th of May 1996), beef production must be the major component of total herd income, regular use of sentinel veterinary services (the region have 80 sentinel veterinarians engaged on a large monitoring system, VEGA), calf breed must be one of the 5 main region breeds (Aubrac, Blonde d'Aquitaine, Charolaise, Gasconne, Limousine).

In a first step of the study, each of the 94 selected herds was visited in December 1995. A pre-tested questionnaire was administrated by personnel interview by one of the sentinel veterinarian to the producer to determine their calf management practices, including feeding, dam and calf housing, vaccinations, claving period, treatment given at birth ... Each producer was asked to record prospectively individual calf births, easy of delivering, first colostrum feeding conditions, disease events, mother vaccinations, vitamin supplementation, treatments and deaths. To ensure good quality record data, each producer was instructed by the sentinel veterinarian and the GDS (Groupement de Défense Sanitaire) technicians about data recording procedures and using the different distributed sheets. Also all investigators received training and have several briefings with the study animators.

[1] Ecole Nationale vétérinaire d'Alfort, LEGSA, 7 avenue du Général de Gaulle, 94704 Maisons Alfort, France
[2] Réseau d'Epidémiosurveillance VEGA, rue de Las Escoumes, BP 83 Foix, France
[3] Ecole Nationale vétérinaire de Toulouse, 23 chemin des Capelles, 31076 Toulouse, France

Nine visits were planned for each herd in order to cover at least 80% of calving and to allow intervals between two visits less than ten days. The visits were conducted by the sentinel veterinary and the GDS technician (respectively 3 and 6 per herd), to collected calf sheets, serological samples, fecal samples and to record evolution of housing conditions (temperature, hygrometry, ammoniac, surface per calf, cow and calf cleanness sores) during the study period. Any calves that were less than 1 week of age at the time of the visit were sampled for serum protein levels in order to assess the effectiveness of colostrum feeding. Fecal samples were collected if we observed diarrhea during the visit, from calf with diarrhea and from control calf without diarrhea matched on age. Fecal samples were taken in order to test the presence of *Escherichia coli* (K99), rotavirus, coronavirus and cryptosporidies.

Additional data was collected on 3 of the nine visits concerning body weight scores of cows at pre and post calving to assess the effectiveness of cow feeding and the indirect impact on milk yield if we observe weight variation.

Data analysis involved estimating incidence rates for diarrhea by dividing number of failures by the number of calf-days at risk. We used LIFETEST procedure (SAS®, 1996) to assess survival and hazard function and to produce corresponding graphics. Simple association between diarrhea risk and both calf and herd level management practices were evaluated using LIFETEST procedure. Cox Proportional hazards model was performed, using PHREG procedure (SAS®, 1996), in order to assess conditional associations (multivariate model). Only variables with $p<0.20$ were considered for further analysis. The final Cox Proportional hazards model were fitted using SUDAAN software (SUDAAN, 1996). This software is designed to analyze data from complex sample surveys involving clustered data. It accounts for sample design stratification and within herd clustering when variances are estimated, unlike SAS PHREG procedure which assumes simple random samples and no correlation between outcomes observed in the same herd. SUDAAN applies Taylor linearization for implicitly defined parameter vectors to estimate the variance covariance matrix of the estimated parameters.

RESULTS AND DISCUSSION

There were 3157 calves from 94 beef herds included in the analysis. We observed 447 diarrheas, yielding an overall diarrhea incidence rate of 0.40 case per 100 beef calf-days at risk. Risk of diarrhea was highest at 1 week of age (1.68 cases per 100 beef calf-days at risk) and decrease quickly after 3 weeks of age (0.10 case per 100 beef calf-days at risk) (figure 1). The cumulative risk of diarrhea until 30 days of age varied between herds, it ranged from 0 to 70%, with a median of 8.5%. The mortality rate on all herd averaged 3.8% and the case fatality rate for diarrhea was 4%, which is lower than those observed in previous study in dairy calves (Waltner-Toews et al., 1986, Sivula et al., 1996).

Figure 1: Daily risk of diarrhea (incidence per calf-day at risk)

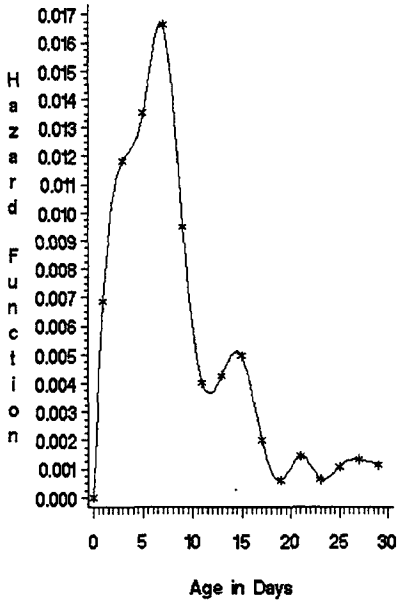


Figure 2: Daily risk of diarrhea by month of birth (incidence per calf-day at risk)

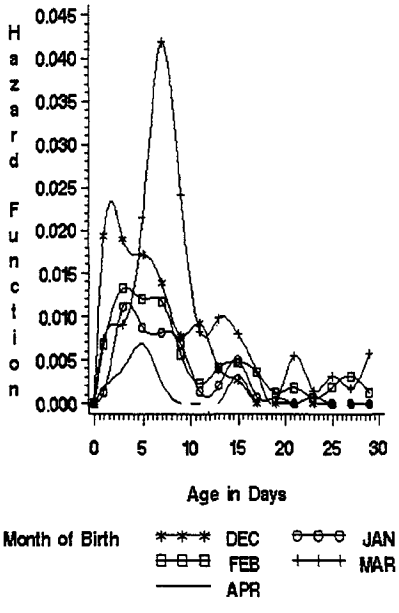
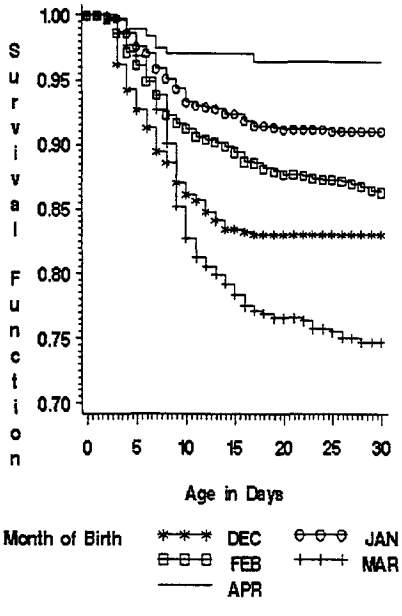


Figure 3: Daily complement of diarrhea cumultive risk by month of birth (incidence per calf-day at risk)



We observed a significant association between season of birth and the incidence rate of diarrhea (Logrank-test = 97, df=4, p=0.0001). The incidence rate was lower in April (RR=1) and January (RR=1.91), and increase on February (RR=3.09), December (RR=4.46) and Marsh (RR=6.44). Daily instantaneous risk of diarrhea was also significantly different among months of birth. It was highest at 4 days of age when calves was born on December, January, or February, at 1 week of age for calves born on Marsh, and remain lower and constant on April (fig. 2and 3). The univariate and multivariate screening procedures identified 20 variables associated with diarrhea incidence rate : Month of birth, housing type, cow feeding practices (distribution of silage, concentrate, rationing between primiparous vs. multiparous, pre and post calving), Cleaning and disinfecting of housing before and

after calving season, and after diarrhea, disinfecting of calving location, cows and calves cleanness, presence of ammoniac smell, dam vaccinations (against *E. coli*, rotavirus, and other disease), calving case, and herd size. These variables were including in the final model fitted with SUDDAN software. The final model is summarized in tab.I, with only significant variables ($p<0.05$). Colostrum feeding practices and perinatal care factors was not associated with diarrhea as shown in previous studies. It could be partially explained by the higher percentage of producers applying the recommended management practices (91% of calves had their first colostrum feeding within the 6 hours after birth). New risk Factors was identified, like cow feeding with concentrate (RR=1.82), and month of birth. Housing conditions was significantly associated with diarrhea incidence rate, failure of cleaning and disinfecting increase the risk of diarrhea 2.7 times. Absence of cleaning and disinfecting after diarrhea was found as protector factor. This association is biased because this practice is decided after observation of high rate of diarrhea. Vaccination of dams was associated with a decrease in the incidence of diarrhea a factor of 2.86 for *Escherichia coli* and 2.95 for other microorganism than *E. coli* or rotavirus (BVD, IBR, Salmonella).

Table I
Diarrhea risk Factors within the first 30 days of age: Final Cox proportional hazard model (fitted with SUDAAN software)

Variables	Level	Hazard Ratio	Lower 95% limit	Upper 95% limit
Month of birth	Dec	4.46	1.67	11.88
	Jan	1.92	0.78	4.72
	Feb	3.09	1.17	8.15
	Mar	6.44	2.81	14.78
	Apr	1		
Dam feeding concentrate	yes	1		
	no	1.82	1.05	3.16
Housing cleaning and disinfecting :				
Before calving season				
	yes	1		
	no	2.7	1.4	5.16
After diarrhea				
	yes	1		
	no	0.36	0.16	0.78
Dam vaccination :				
Escherichia coli	yes	1		
	no	2.86	1.14	7.14
Others (BVD,IBR)	yes	1		
	no	2.95	1.53	5.70
Calving conditions :	Unassisted, easy pull	1		
	Dystocia, cesarean	1.33	1.07	1.66
Ammoniac smell	Yes	1.90	1.19	3.03
	no	1		
Dam cleanness score	Clean	1		
	Dirty	1.65	1.08	2.51

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