Differences in the serum immunoglobulin concentrations between dairy and beef calves from birth to 14 days of age

Guk-Hyun Suh, Tai-Young Hur, Dong-Soo Son, Chang-yong Choe, Young-Hun Jung, Byeong-suk Ahn, Chai-Yong Lee* and Chung-Gil Lee**

National Livestock Research Institute, RDA, Cheonan 330-800, Korea

Introduction

During the first two weeks of life, calves are at highest risk for death and especially during the first week. Septicemic and enteric diseases are most common in this period. The failure of passive transfer of colostral immunoglobulins (Ig) is a major determinant of septicemic disease during this period [7,15]. It also modulates the occurrence of mortality and severity of enteric and respiratory diseases in early life of calves [18].

The major Ig in colostrum is IgG, but there are also significant amounts of IgM and IgA [4]. Following ingestion by the newborn calves, a significant proportion of these Igs ingested in the colostrum is absorbed across the epithelial cells of the small intestine during the first few hours of life and transported via the lymphatic system to the blood [3]. Igs in the blood are further variably distributed to extravascular fluids and to body secretions depending upon its class [2].

These absorbed Igs protect against systemic invasion by microorganisms and septic disease during the neonatal period. Unabsorbed Igs and Igs re-secreted back into the gut play an important role in protection against intestinal disease for several weeks following birth [13]. In calves, it is known that passive immunity also influences the occurrence of respiratory disease during the first months of life and may be a determinant of lifetime productivity.

The amount of circulating Igs acquired from colostrum is primarily dependent upon two factors [1,18]. One is the amount or mass of Ig present in a feeding of colostrum. The mass of Ig fed is determined by the concentration of Ig in the colostrum and the volume that is fed. There can be substantial variation in the concentration of Ig in colostrum of dairy cows. And a significant proportion of dairy calves may fail to ingest adequate colostrum volumes before onset of the closure process in natural suckling situations and so early assisted suckling is needed. In contrast, with beef breeds relatively effective colostral Ig transfer is achieved with natural suckling.

The other is the efficiency of absorption of Igs by the calf. Under normal conditions complete loss of the ability to absorb Ig occurs by 24-36 hours after birth in calves and there is a significant reduction in absorptive ability by 8-12 hours following birth. Thus, the time from birth to feeding of the colostrum is a crucial factor affecting the absorption of colostral Igs. Compared to the beef breeds, natural suckling of dairy calves is commonly associated with a high rate of passive transfer failure due to delays in sucking coupled with low intakes [11,19]. Thus, the volume of colostrum that is ingested in dairy calves is controlled in artificial feeding systems using nipple bottle feeders or esophageal tube feeders [2,5].

The transfer of colostral Igs in both dairy and beef calves is well documented [10-12]. Kim and Han [8,9] studied the transfer of colostral Igs in the Korean native calves. In the present study, attempts were made to find the differences in the serum Ig concentrations between dairy and beef calves during the first two weeks of life. The cows and calves used in this study were from...
National Livestock Research Institute herds well-managed with adequate veterinary surveillance and provision of the nutritional requirements.

Materials and Methods

Cows and calves
Pregnant Korean native cows (20) and Holstein cows (15) 2-8 years old were chosen from the herds of National Livestock Research Institute, RDA. Approximately one day before the estimated calving, each cow was moved into an individual calving pen (3.4 × 8.0 m) with straw bedding.

The Korean native calves were born between April and August 2000, and all the dams and their calves (8 heifers and 12 bulls) were continuously observed for 6 hrs after birth. The beef calves stayed with their dams in the calving pen throughout the experiment so that they could suckle freely all the time.

The Holstein calves were born between February and July 2000, and the calves (5 heifers and 10 bulls) were left with their dams after birth for 30-40 minutes to allow each dam to clean and stimulate its calf. During the time, 500-1,000 ml of maternalcolostrum was hand-milked from each dam and bottle-fed to the calf. Calves were then moved to the individual calf barn bedded with straw and weighed. The ensuing feedings of colostrum were at 10:00 and 16:30 next day for five days. The amounts of whole colostrum fed by bottle were 80 ml/kg BW every day. From day 6 on, calves were fed whole milk 8% of their body weight throughout the experiment.

All calves were single-born after normal durations of pregnancy and normal parturitions. Prevalence of scours and signs of respiratory tract infections and other illnesses were monitored daily until the termination of the experiment.

Sample collection and analysis of immunoglobulin concentration
Blood samples (10 ml) were collected from the calves by jugular venipuncture into evacuated containers without anticoagulant before suckling or colostrum-feeding (0 hrs), at one and four days, and thereafter at two-day intervals up to 14 days after birth. Blood samples were allowed to coagulate, and serum was obtained by centrifugation (1,500 × g) for 15 minutes. Serum samples were stored at −70°C prior to analysis of IgG, IgM and IgA by single radial immunodiffusion (SRID) test (VMRD Inc., Pullman, USA) [1].

Data analysis
The serum IgG, IgM and IgA concentrations at each sampling time for both dairy and beef calves were compared using Student’s t-test of SAS [21].