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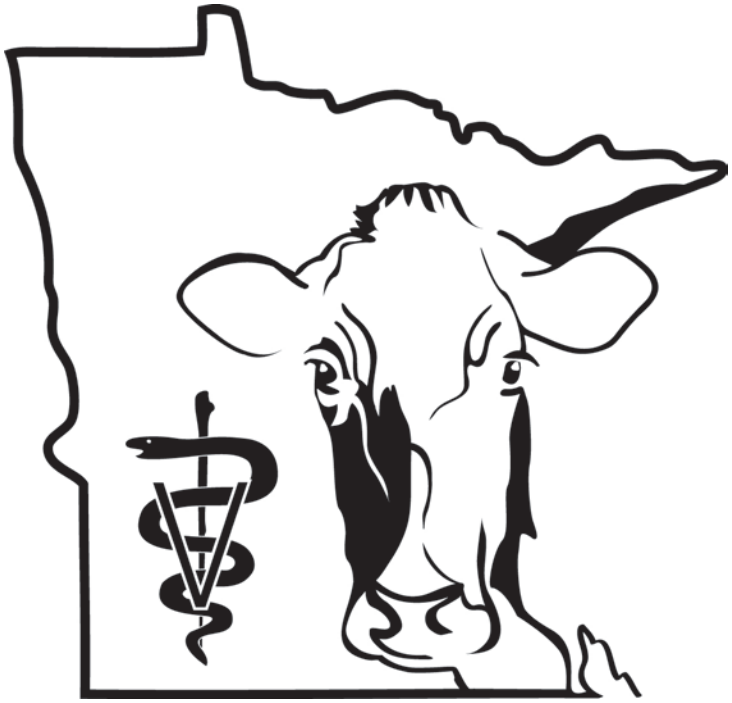

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Results of Recent Colostrum Management Projects at the University of Minnesota

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Introduction

Colostrum is the single most important management factor determining calf health and survival. Calves experiencing successful passive transfer of colostral immunoglobulins have improved preweaning health and survival, improved growth rate and feed efficiency, reduced age at onset of puberty, reduced age at first calving, and improved first and second lactation milk production. Unfortunately, many producers continue to suffer significant losses related to poor colostrum management. Factors affecting the success of a colostrum management program will include 1) Quality of colostrum fed (i.e. Ig concentration), 2) Quantity (volume) of colostrum fed, 3) Quickness of providing the first colostrum feeding after birth and 4) Cleanliness of colostrum (i.e. bacterial contamination) (McGuirk and Collins, 2004). The objective of this paper is to describe the findings from some recent research projects designed to develop and evaluate various strategies for improving colostrum management on dairy farms.

Study 1. Effect of Feeding a Plasma-Derived Commercial Colostrum Replacer on Passive Transfer of Immunoglobulin G and Preweaning Health in Holstein Calves

(Swan et al., Accepted. 2007)

Introduction and Objective: Feeding commercial colostrum replacement (CR) products may offer producers a convenient way to provide adequate passive immunity to calves while reducing the risk of pathogen exposure through colostrum, and are certainly recommended in situations where a sufficient volume of clean, high quality colostrum is not available from the cow or when stored colostrum is not available. Powdered commercial colostrum replacement (CR) products contain bovine Ig that is typically either lacteal-derived or plasma-derived, and must also contain a source of dietary protein, energy, vitamins and minerals at levels similar to maternal colostrum. Experts recommend that CR should contain a minimum of 100 grams of IgG per dose (Quigley et al., 2001). However, results of early CR research have shown mixed results, with some studies failing to achieve successful passive transfer in calves fed CR (Quigley et al., 2001). Other studies have reported better rates of successful passive transfer (serum IgG > 10.0 mg/ml), particularly when calves were fed higher doses (IgG mass) in a CR product (Foster et al., 2006). Large scale, long-term studies are lacking to describe the health and economic-benefit of adopting the practice of feeding CR as a routine management tool. The ***objective*** of this study was to describe passive transfer of immunoglobulin G (IgG) and preweaning health in newborn calves fed either a commercially available plasma-derived colostrum replacement product (CR: Acquire®, American Protein Corporation, Ames, IA) or maternal colostrum (MC).

Methods: Twelve commercial Holstein dairy farms enrolled singleton newborn heifer calves to be fed either fresh MC (n = 239 calves) or one dose of CR containing 125 g Ig (n = 218 calves) as the first colostrum feeding. For seven of these farms that routinely provided a second feeding of 1.9 L of MC to their calves 8 to 12 hrs after the first colostrum feeding, calves assigned to the CR treatment group were offered a second feeding consisting of 1.9 L of commercial milk replacer supplemented with one dose of a commercially available plasma-derived colostrum supplement (CS), containing 45 grams of Ig per dose, 8 to 12 hrs after the first colostrum feeding. A blood sample was collected from all calves between 1-8 days of age for serum IgG and total protein (TP) determination, and records of preweaning treatment and mortality events were collected.

Results: Serum IgG and TP concentrations were significantly higher in calves fed MC (IgG = 14.8 ± 7.0 mg/ml; TP = 5.5 ± 0.7 g/dl) as compared to calves fed CR (IgG = 5.8 ± 3.2 mg/ml; TP = 4.6 ± 0.5 g/dl). The proportion of calves with failure of passive transfer (serum IgG < 10.0 mg/ml) was 28.0% and 93.1% in the MC and CR treatment groups, respectively. Though a trend was present, the proportion of calves treated for illness was not statistically different for calves fed MC (51.9%) vs CR (59.6%). Total number of days treated per calf (MC = 1.7; CR = 2.0), treatment costs per calf (MC = $10.84; CR = $11.88), and proportion of calves dying (MC = 10.0%; CR = 12.4%) was not different between the two colostrum treatment groups.

Conclusions: Calves fed a commercially available plasma-derived CR product had significantly lower serum IgG and serum TP measures between 1-8 days of age than calves fed current industry-recommended volumes of MC. This difference was attributed to a large difference in total mass of IgG consumed between the two colostrum feeding groups. Feeding 125 g of Ig in one dose of a commercial CR product was not sufficient to achieve acceptable passive transfer of IgG in over 90% of CR calves. However, preweaning treatment risk, days treated, treatment costs, and mortality risk were not different between calves fed MC vs CR. Long-term follow-up of these calves (to 5 years of age) is ongoing to describe long term effects of feeding CR on longevity, productivity, risk for Johne's disease infection, and economics.

Study 2: Effect of Feeding a Colostrum-Derived Commercial Colostrum Replacer on Passive Transfer of Immunoglobulin G in Newborn Dairy Calves.

Introduction and Objective: As for the previously described study, it is important to evaluate the ability of commercially available colostrum replacement (CR) products to achieve successful passive transfer of immunoglobulins in dairy calves. The ***objective*** of this study was to describe passive transfer of immunoglobulin G (IgG) and preweaning health in newborn calves fed either a commercially available colostrum-derived colostrum replacement product (CR: Land O'Lakes Colostrum Replacement®, Land O'Lakes Animal Milk Products, St. Paul, MN) or maternal colostrum (MC).

Methods: This study was conducted at the Transition Management Facility (TMF. Emerald, WI) in summer, 2006. Newborn heifer calves were randomly assigned to be fed one of three colostrum treatment groups (n=25/group) within 1-2 hours of birth:
i) *Treatment Group 1*: Feed one dose (100 gm IgG) of LO'L Colostrum Replacement.
ii) *Treatment Group 2*: Feed two doses (200 gm IgG) of LO'L Colostrum Replacement.
iii) *Control Group*: Feed 3.8 L of fresh maternal colostrum collected from the dam.
Blood samples were collected from each calf at 0-1 hr of age (pre-colostrum feeding) and approximately 24 hrs of age for determination of serum IgG (mg/ml) concentration.

Results: Mean serum IgG measures were 9.6, 19.0 and 20.7 mg/ml in calves fed 1 dose of CR, 2 doses of CR, or 4 quarts of MC, respectively.

Conclusions: Though average serum IgG concentrations were approximately equal to the minimum goal of 10 mg/ml for successful passive transfer in calves fed only 1 dose (100 gm IgG) of CR, 50% of these calves experienced failure of passive transfer (serum IgG < 10 mg/ml). There was 100% acceptable passive transfer rate and no significant difference in serum IgG concentrations for calves fed 2 doses of CR (200 gm IgG) vs calves fed 4 quarts of MC. As research does not yet exist to describe any health differences between these groups, producers using a CR would need to decide on the perceived cost-benefit of feeding 1 dose vs 2 doses of CR.

Study 3: Effect of Artificial Mothering on Passive Absorption of IgG in Dairy Calves

Introduction and Objective. In modern dairy production systems the calf is frequently removed from the dam shortly after birth and then hand-fed the first feeding of colostrum. Reasons for this practice include reducing contact time with pathogens in the maternity pen environment plus increased control of timing and volume of colostrum at first feeding. However, early research suggests that passive transfer may be improved if calves are actively 'mothered' by the dam (Selman et al., 1971). The ***objective*** of this study was to investigate if passive absorption of colostral immunoglobulins can be improved if calves are 'artificially mothered' by vigorously rubbing the calf during colostrum feeding.

Methods. Newborn bull calves were randomly assigned to one of two colostrum treatment groups (n=25/group) within 1-2 hours after birth:
i) *Treatment Group*: Feed 1.5 doses (150 gm IgG) of a colostrum-derived commercial colostrum replacement product (LO'L Colostrum Replacement) while vigorously rubbing the calf with a dry towel and providing calm verbal stimulation, lasting 15 minutes in duration. These calves also received further verbal and tactile stimulation for an additional 15 minutes between 1-2 hours after colostrum feeding.
ii) *Control Group*: Feed 1.5 doses (150 gm IgG) of a commercial colostrum replacement product (LO'L Colostrum Replacement) with minimal verbal or tactile stimulation.
Blood samples were collected from each calf at 0-1 hr of age (pre-colostrum feeding) and approximately 24 hrs of age for determination of serum IgG (mg/ml) concentration.

Results: Mean serum IgG concentrations at 24 hours of age were not different for artificially mothered calves (IgG = 14.9 mg/ml) vs control calves (IgG = 15.5 mg/ml). Feeding 1.5 doses (150 gm IgG) of the commercial CR resulted in an overall average serum IgG of 15.2 mg/ml, with a 4.5% FPT rate (serum IgG < 10.0 mg/ml).

Conclusions. Artificial stimulation or mothering of calves, as carried out in this study, did not improve passive absorption of colostral antibodies in newborn calves. Feeding 1.5 doses (150 gms IgG) of the commercial CR resulted in acceptable passive transfer of IgG in 95.5% of calves.

Study 4. Effect of Phase of Milk out on IgG Concentration in First Milking Colostrum

Introduction and Objective. Several management factors, including dry cow vaccination program, dry cow nutrition, parity, breed, and time delay from calving to first milking can affect colostrum quality (IgG concentration). One possible additional factor: Just as milk fat and somatic cell count composition are known to vary by stage of milk out, it has been suggested that colostrum IgG concentration might also vary. This could have practical implications for producers who may hand milk only enough volume colostrum to feed the calf as compared to producers who completely milk out the cow at first milking. A European study of second milking colostrum (transition milk) previously reported that IgG concentration was somewhat diluted in the early half of milking (20-24 mg/ml IgG) but increased in the latter half of milking (35 mg/ml IgG). In that same study, fat content was lowest in the early half of milking and highest in the latter half of milking. Those researchers concluded that the best colostrum quality will come from the full, composite milking of a fresh cow. The ***objective*** of this study was to investigate the effect of stage of milk out on colostrum IgG concentration in first milking colostrum of Holstein cows.

Methods. Within 1 hour of calving, udders were routinely prepped for 25 cows. A 20 ml forestripping sample of colostrum was then collected into a sample vial prior to milking unit attachment. After unit attachment and initiation of milking, 20 ml samples of colostrum were collected at 30 second intervals from a sampling port located in the milking hose between the milking cluster and the bucket. Subsampling continued at 30 second intervals until the cow was completely milked out. Upon completion of milking, colostrum samples were selected which represented the 0 (cisternal), 25%, 50%, 75% and 100% stage of milk out. These samples were tested for total IgG concentration.

Results. The mean colostrum IgG concentration in samples representing the 0 (cisternal), 25%, 50%, 75% and 100% stage of milk out were 75.8, 70.9, 71.9, 70.4, 73.2, and 72.9 mg/ml, respectively. Though IgG concentrations were numerically highest in cisternal colostrum, followed by colostrum collected in the latter half of milk out, there was no significant effect of stage of milk out on colostrum IgG concentration.

Conclusions. Stage of milk out did not affect IgG concentration of colostrum. However, because fat composition is expected to be highest in the latter half of milk out, we still recommend that fresh animals be thoroughly milked out at first milking.

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