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Randomized clinical trial of the effect of a fixed or increasing milk allowance in the first 2 weeks of life on health and performance of dairy calves

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ABSTRACT

The objective of this study was to describe the effect of offering a fixed or increasing milk allowance in the first 1 to 2 wk of life. We hypothesized that calves offered a fixed amount of milk early in life would not experience more scours, but rather would experience improved health and growth compared with calves that had their daily milk allowance slowly increased over a period of 1 to 2 wk. This randomized controlled clinical trial was conducted on 5 dairy farms in Minnesota with both a summer (June–August 2016) and winter (December–February 2017) period of enrollment. Heifer calves were enrolled at birth, weighed, and systematically assigned by birth order to either the slowly increasing (INC) control group or fixed allowance (FIX) treatment group by farm personnel. Calves assigned to the INC group were slowly increased from 4 to 5 L/d to gradually reach the full peak milk allowance of 6 to 8 L/d over a 7- to 14-d period, whereas calves assigned to the FIX group were offered a full peak milk allowance of 6 to 8 L/d beginning on d 1 after birth. The average FIX calf consumed an extra 14 L of milk as compared with INC calves over the first 2 wk of life, corresponding to an average INC intake of 5 L/d during first 1 to 2 wk of life as compared with an average intake of 6.8 L/d in FIX calves. Study technicians visited all farms weekly to collect health and performance data. Multivariable mixed models were used to describe the effect of treatment (INC/FIX) on 3-wk average daily gain (kg/d), 3-wk weight (kg), and hip height at wk 1, 3, and 7, controlling for the effect of season, birth weight, and the random effect of calf within farm. Multivariable logistic regression models were used to describe the effect of treatment on odds of technician and producer reported health events. One thousand two hundred and sixty-four heifer calves were enrolled (FIX n = 641; INC n = 623) with no difference in enrollment weight or hip height between groups. By 3 wk of age, FIX calves weighed 1.4 (0.59) kg more than INC calves, though the magnitude of this difference varied depending on the period of time INC calves were slowly increased in milk allowance (7 vs. 10 vs. 14 d). Calves in the FIX group grew 0.1 kg/d faster and were taller at wk 3 (0.3 ± 0.15 cm) of life. Forty-two percent (536/1264) of all enrolled calves had a first treatment event, with no effect of treatment on technician-reported health scores and no overall effect on producer-reported treatment or mortality events. Under the conditions of this study, offering a fixed milk allowance from d 1 of life improved calf growth during the first 3 wk as compared with a gradual increase in milk allowance, with no detrimental effect on calf health.

Key words: calf health, calf performance, milk feeding

INTRODUCTION

The health and growth of preweaning dairy calves is an important concern for dairy producers, affecting animal welfare and future performance as well as the short- and long-term economic viability of the dairy enterprise (DeNise et al., 1989; Faber et al., 2005; Soberon et al., 2012). Therefore, dairy producers must adopt management practices that produce a well-grown healthy calf. The level of nutrient intake from milk during the preweaning period is one management factor associated with preweaning health, growth, and, in most studies, improved milk production in the adult cow. Increasing milk intake above conventional rates (e.g., 10% of birth weight or approximately 4 L/d) to enhanced, accelerated, full potential, or ad libitum volumes (e.g., 20% of birth weight or approximately ≥8 L/d) has been associated with an enhanced immune response (Foote et al., 2005; Quigley et al., 2006; Ballou et al., 2015), increased resistance to diarrheal pathogens (Ollivett et al., 2012), improved growth rate, and

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improved first-lactation milk production (Foldager and Krohn, 1994; Bar-Peled et al., 1997; Soberon and Van Amburgh, 2013). As producers are learning about these benefits, the dairy industry is seeing a steady increase in adoption of the practice of feeding increased levels of milk during the preweaning period (USDA, 2016).

Unfortunately, one specific period that remains neglected within the preweaning nutrition program is the first 1 to 2 wk after birth. Producers have long been concerned that bringing calves onto high volumes of milk too quickly will result in nutritional scours or other digestive problems. As a result, most producers continue to use a traditional program of slowly increasing the volume of milk fed over a period of 1 to 2 wk or longer before reaching the target peak daily milk allowance. For example, in a recent survey of 38 upper Midwest dairies using automatic feeding systems, the average calf started at an average allowance of 5.4 L/d and increased to a peak feeding level of approximately 8 L/d over a period of 3 wk (Jorgensen et al., 2017). Given what we already know about the advantages of increased milk feeding during the entire preweaning period, it is very possible that this slowly increasing period for milk may be restricting nutrient intake in the days after birth, resulting in impaired immune function, health ,and growth during the first 2 wk of life, when calves are at greatest risk of morbidity. Observational studies have reported that, when allowed ad libitum access in the first days of life, calves will drink up to 12 L/d without causing scours, with the average calf drinking 8 L/d by 4 d of age (Jasper and Weary, 2002; de Passillé et al., 2014). Furthermore, a recent observational study offered ad libitum milk during the first 5 d of life and reported that calves that remained healthy up to 28 d of age were more likely to have consumed more milk during the first 5 d compared with calves that experienced a morbidity event (de Passillé et al., 2014). We believe that there may be several advantages to allowing calves the option of consuming more milk from d 1 of life; however, this hypothesis requires formal investigation.

The objective of our study was to complete a randomized controlled field study to describe the effect of offering a fixed amount of milk immediately from d 1 (versus a traditional slow increase program) on calf health and growth in the preweaning period. We hypothesized that calves allowed the option to drink more milk starting from d 1 would not be at greater risk for scours, would experience improved weight gain, and would experience improved health during the preweaning period compared with calves that are more gradually increased in their milk allowance over a 7- to 14-d period before eventually reaching the target peak daily milk allowance.

MATERIALS AND METHODS

This study was approved by the University of Minnesota Institutional Animal Care and Use Committee (Protocol # 1601–33432A).

Herd Selection

This randomized controlled clinical trial was conducted on a convenience sample of 5 large commercial dairy farms in Minnesota, representing predominately the Holstein breed, with calf enrollment occurring from June to August 2016 (**SUM**) and again from December to February 2017 (**WIN**). Participating herds must have housed calves individually or as pairs (i.e., no group housing) during the preweaning period and fed either pasteurized whole milk or milk replacer at a minimum full feeding program of 6 L per calf per day. Additionally, herds must have been using a milk-feeding program that slowly increased the daily milk allotted from a minimum of 4 to 5 L/d to the full feeding rate over a period of 7 or more days. Participating herds agreed to keep detailed calf health records, to adhere to the study protocols, and to allow study technicians to visit the farm on a weekly basis for study related activities. Participation was voluntary.

Calf Enrollment and Management

Newborn Holstein heifer calves were enrolled by herd staff at birth and assigned to 1 of 2 treatment groups using a systematic randomization process based on birth order. Increasing (**INC**) calves were offered a gradually increasing amount of milk over the first 7 or more days of life as per the farm's current feeding program (e.g., 4 L/d for 7 d, 6 L/d from 7–14 d, and 8 L/d for the remainder of the feeding period). Fixed level (**FIX**) calves were immediately offered the peak or maximum level of milk the farm provides after the first feeding of colostrum. The study investigators (W. A. Knauer) initially trained herd staff on enrollment and feeding procedures, health screening, and record keeping and regularly visited farms with student technicians to monitor compliance. After INC calves were increased to their full milk allotment, both treated and control groups were offered the same amount of milk for the remainder of the preweaning period. Calves exited the study when they were weaned from milk (approximately 7–8 wk).

Data Collection

An initial questionnaire was completed by each participating herd to describe general herd character-