

Effect of Nutritional Plane on Health and Performance in Dairy Calves after Experimental Infection with *Cryptosporidium parvum*

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Introduction

Neonatal dairy calf maintenance energy requirements are approximately 1.6 Mcal metabolizable energy (ME)/d at thermoneutral temperatures. Historically used milk replacer feeding regimens (e.g. 2 quarts of reconstituted solids twice per day) provide approximately 2.2 Mcal ME/d. Considering the abundance of environmental and pathogenic challenges faced by neonatal calves, these conventional feeding programs provide little energy reserves for maintaining body temperature, mounting immune responses, and growing at expected rates of 1.1 to 2.0 lb/d (0.5 to 0.9 kg/d). *Cryptosporidium parvum*, an enteric protozoan, is an almost ubiquitous infectious stressor of neonatal dairy calves. Infection by this organism is difficult to prevent and treat. As it is a zoonotic parasite, a few oocysts may infect and cause disease in naive people, and infections are a severe health risk in the immunocompromised. The objective of this study was to evaluate the effect of conventional nutritional plane versus a higher nutritional plane on the health and performance of dairy calves after experimental infection with *C. parvum*.

Materials and Methods

A randomized, controlled and double-blinded trial was performed using Holstein bull calves obtained from a large commercial dairy. All births were attended by study personnel, calves fed 4 L of heat-treated colostrum within one hour of birth, and then transported to individual stalls within an isolation facility. Calves were randomly assigned to a higher plane of nutrition (HPN) or conventional nutrition (CN) group and maintained for a 42-feeding (21-day) study period. Twenty-nine calves were enrolled with nine lost to follow up. HPN was defined as 0.14 Mcal/lb (0.30 Mcal/kg) of metabolic body weight (MBW) as a function of birth weight using an 28% protein, 20% fat milk replacer (n = 11). CN was defined as 0.06 Mcal/lb (0.13 Mcal/kg) MBW using a 20% protein, 20% fat milk replacer (n = 9). All calves were

inoculated with 1×10^6 *C. parvum* oocysts at the fifth feeding. Fecal and health scores, oocyst counts by immunofluorescent assay, weight gain, dry matter intake, and several blood parameters including serum total protein, haptoglobin, non-esterified fatty acids (NEFA), white blood cell counts (WBC), and hydration status based on packed cell volume (PCV) were measured throughout study period. Data were analyzed by non-parametric, linear regression, and time to event methods.

Results

Measures of passive transfer of antibodies, initial body weight and PCV at the fifth feeding were not different between treatment groups ($P > 0.1$). Oocyst shedding patterns, including onset, duration, total, and peak shedding, were not significantly different between treatment groups ($P > 0.7$). Haptoglobin, NEFA, and WBC were also not different between groups ($P > 0.2$). CN calves were dehydrated (PCV = 40%) at the end of the study, whereas HPN calves were not (PCV = 32%) ($P = 0.04$). Fecal scores (FS) improved faster in the HPN group (median = 0.1 FS/day) compared to the CN group (median = 0.01 FS/day) ($P = 0.03$). HPN calves had better average daily gain than CN calves (median = 0.95 lb vs. -0.11 lb (433 g vs. -48 g), respectively; $P < 0.001$). Feed efficiency (average daily gain: dry matter intake) was much better for the HPN group than the CN group (median = 13.2 lb/100 lb (131.9 g/kg) vs. -3.1 lb/100 lb (-31.4 g/kg), respectively; $P < 0.0001$).

Significance

Calves fed the HPN diet maintained hydration, had faster resolution of diarrhea, grew better and converted feed with greater efficiency than the calves fed the CN diet. Providing a higher level of nutrition in neonatal dairy calves significantly reduced the effect of disease due to *C. parvum* and should be considered a viable option for feeding calves on today's commercial dairy farms.