

Effect of Nutritional Plane on Health, Performance, and Muscle Metabolism in Neonatal Dairy Calves

T.L. Ollivett¹, DVM; D.V. Nydam², DVM, PhD; T.C. Linden², BS; J.J. Wakshlag³, DVM, PhD, ACVN; D.D. Bowman⁴, PhD; M. Van Amburgh⁵, PhD

¹Department of Clinical Sciences, College of Veterinary Medicine, Cornell University, Ithaca, NY 14850

²Department of Population Med and Diagnostic Sciences, College of Veterinary Medicine, Cornell University, Ithaca, NY 14850

³Department of Clinical Sciences, College of Veterinary Medicine, Cornell University, Ithaca, NY 14850

⁴Department of Microbiology and Immunology, College of Veterinary Medicine, Cornell University, Ithaca, NY 14850

⁵Department of Animal Science, College of Agriculture and Life Sciences, Cornell University, Ithaca, NY 14850

Introduction

Neonatal dairy calf maintenance energy requirements are 1.75 Mcal per day at thermoneutral temperatures. Conventional milk replacer feeding programs (e.g. 2 quarts of reconstituted solids twice per day) provide approximately 2.2 Mcal per day. Considering the abundance of environmental and pathogenic challenges faced by neonatal calves, these conventional programs provide little energy for maintaining body temperature, mounting immune responses, and growing at expected rates of 1 to 2 pounds per day and weight loss often occurs for the initial week of life. The objective of this study was to evaluate the effect of conventional nutritional plane versus a higher nutritional plane on the health status, muscle development, and initial weight loss in neonatal dairy calves.

Materials and Methods

A randomized, controlled, and double-blinded trial was performed using Holstein calves obtained from a large commercial dairy. All births were attended by study personnel, calves fed 4L 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 28-feeding (14-day) study period. Twenty-three calves were enrolled, with three lost to follow up. HPN was defined as 0.30 Mcal per kilogram of metabolic body weight (MBW) as a function of birth weight using a 28% protein, 20% fat milk replacer (n=10). CN was defined as 0.13 Mcal per kilogram MBW using a 20% protein, 20% fat milk replacer (n=10). Fecal and health scores, weight gain, dry matter intake, packed cell volume (PCV), and total protein (TP) were measured throughout the study period. Serial percutaneous muscle biopsies were performed and samples were evaluated for Atrogin-1 as a

specific marker for skeletal muscle metabolism. Data were analyzed by non-parametric methods.

Results

Initial body weight, hydration status, and passive transfer of antibodies were not different between treatment groups ($P>0.4$). Packed cell volume decreased significantly within both treatment groups between day 1 and day 2 ($P<0.05$) but did not change over time past day 2 ($P>0.3$). The number of feedings associated with severe diarrhea (FS=3) were not different between HPN and CN groups (median 5.5 feedings v. median 4.5 feedings, respectively; $P=0.36$). The HPN calves had a 3.5 times higher risk of not finishing a meal compared to the CN calves (95% CI: 1.1-11; $P=0.07$). A median of 3.3 lb (1.5 kg) of weight loss developed in the CN calves ($P=0.005$) while 2.75 lb (1.25 kg) of weight gain developed within the HPN calves ($P=0.008$) during the first week of life. HPN calves had better average daily gain than CN calves (median 445g/d v. -60g/d, respectively, $P<0.0001$). Feed efficiency (average daily gain: dry matter intake) was better for the HPN calves than the CN calves (median 524g/kg v. -139g/kg, respectively) ($P<0.0001$). Atrogin-1 concentration was higher in HPN calves than CN calves, although significance was not established (median 2.2 v. 1.1; $P=0.13$).

Significance

Despite an increased risk of not finishing a meal, calves fed the HPN diet demonstrated greater skeletal muscle metabolism, growth, and feed efficiency than the calves fed the CN diet. In addition, significant weight loss within the first week of life did not occur for the calves fed the HPN diet. Reduction of initial weight loss may have beneficial long term effects on calf health and performance, and warrants further investigation.