Impact of Dietary Forage Quality on Ruminal Bypass of Calcium Salts of Long-Chain Omega-3 Fatty Acids in Beef Heifers When Provided in Dried Molasses Lick Tubs

D.C. Rule¹, P.A. Ludden¹, and T.D. Draney¹

Fish oil contains high levels of the omega-3 fats eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Omega-3 fatty acids are higher in muscle of grass-fed compared with feedlot-fed beef. Additionally, deposition of EPA and DHA into reproductive tract tissue of heifers could improve female reproductive performance in cattle. Feeding unsaturated fatty acids to ruminant livestock results in loss of many of these fatty acids because of ruminal biohydrogenation. We supplemented steers grown on irrigated pasture with calcium salts of fish oil, which are resistant to ruminal biohydrogenation, and observed that variation in intake of the fish oil treatment resulted in similar variation in concentrations of EPA in muscle, liver, and serum. This indicates that serum concentrations reflect tissue uptake (thus rumen bypass) of EPA and DHA. We also observed less variation in muscle concentration of the two fatty acids in cattle fed harvested forage when supplemented with fish oil calcium salts contained within dried molasses lick tubs compared with feeding as a beet pulp-based supplement. Greater serum EPA and DHA were observed when forage quality was decreased; thus, forage quality could impact ruminal bypass of fish oil calcium salts.

Objectives
Our objectives were to compare three forage qualities (low, medium, and high) fed to heifers supplemented with dried molasses lick tubs formulated to contain 30% by weight of calcium salts of fish oil fatty acids and quantify bypass potential by measuring changes in plasma concentrations of EPA and DHA.

Materials and Methods
Twenty-seven crossbred beef heifers (initial BW [bodyweight] 681±6 lb) were obtained from the University of Wyoming beef herd and randomly assigned to one of three treatments based on forage type: alfalfa hay, bromegrass hay, or a grass hay containing approximately an 80:20 ratio of Garrison creeping meadow foxtail and bromegrass to represent high-, medium-, and low-quality forage (based on crude protein). Heifers were offered forage-free choice and provided dried molasses lick tubs (250 lbs) containing calcium salts of fish oil (30% by weight), which were placed into each pen (115 × 16.4 ft) with three heifers per pen. Every seven days from the start of lick tub feeding, bodyweights and blood samples for EPA determination were obtained.

Results and Discussion
Crude protein content was the primary measure of forage quality with alfalfa being greatest (15.3%), brome intermediate (9.4%), and Garrison the least (5.5%). Concentrations of EPA and DHA in the dried molasses lick tubs were 0.38 and 0.26 oz/lb, respectively. Forage intake

¹Department of Animal Science.
was less for Garrison than for either alfalfa or brome, which were similar. Tub intake and intake of EPA and DHA were not affected by forage treatment. Average daily gain during supplementation was greater for alfalfa than brome or Garrison, and ADG was greater for brome than with Garrison, wherein heifers lost bodyweight while on Garrison. The changes in plasma concentrations of EPA during the 21-day supplementation phase for each forage are illustrated in Figure 1.

While EPA increased in plasma as days fed the fish oil calcium salts increased, concentrations in heifers fed alfalfa plateaued at day 14; whereas, EPA continued to increase when fed brome and Garrison. Confounding the results of Garrison further was the noted weight loss that occurred for heifers while fed this forage. Generally, with high-quality forage, the concentration of EPA increased for 14 days; whereas, with lesser-quality forages, the concentrations appeared to continue increasing by 21 days. The time fed the fish oil calcium salts needed to allow plasma concentrations of EPA to stabilize when fed brome or Garrison could not be determined in the present study. The results, however, indicate that greater concentrations of these fatty acids in blood may occur if supplementation continues for a longer period. If group-fed in a pasture tub, intake will likely be less because typical intakes range from 0.50 to 0.75 lb/day depending on bodyweight. We conclude that plasma concentrations of EPA in beef heifers fed forage-based diets and supplemented with fish oil calcium salts delivered within a dried molasses lick tub blood will peak earlier when fed higher-quality forage than when fed medium- or lower-quality forage.

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Contact: Dan Rule at dcrule@uwyo.edu or 307-766-3404.

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