Replacement Report

Calf Starter Research Protein Concentrations for Calf Starters

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The popularity of high protein milk replacers in the last five years was stimulated by research from Dr. Mike Van Amburgh's lab at Cornell University (Diaz et al., 2001). In this research they, and subsequently others, reported that feeding calves more than the conventional amount of approximately one pound of a 20 to 22% protein milk replacer powder would improve growth rates in calves when the protein concentration of the milk replacer was also increased (to 25 to 28% protein). This lead to suggestions that the starter protein concentration fed with a high protein milk replacer should also be increased above 18% protein. This discussion reviews the controlled calf research on protein concentrations for calf starters fed the first two months or so of a calf's life. All protein concentrations are discussed on an as-fed basis, as listed on the feed tag.

The Dairy NRC (1989) recommended 18% protein in calf starters. The calf sub-model in the Dairy NRC (2001) predicts that energy, not protein, limits gain in calves 130 to 200 lb body weight receiving only a dry feed and under many conditions 18% CP should be adequate. The Dairy NRC (2001) estimates nutrient requirements for maintenance and growth of calves, making adjustments for efficiency of nutrient use in different environments, then sums those requirements to derive the nutrient requirements of the calf. Below are results from nine controlled research trials over the last 15 years that measured the performance of calves fed starters containing different protein concentrations.

Luchini et al. (1991) from the University of Wisconsin reported no difference in performance of calves fed 18 and 22% protein starters through 84 days of age and weaned at 26 days. They fed a 22% protein, 16% fat milk replacer at 10% of birth weight for seven days and 12% of the 7-day body weight thereafter. The University of Minnesota (Akayezu et al., 1994) reported feeding starters from 13.2 to 19.7% protein and observed calves fed 17.2 and 19.7% protein starters performed equally well or better than calves fed the lower protein starters through 56 days of age when weaned at 28 days. Their calves were in two geographic locations in different hutch types outside or in elevated stalls in heated rooms, in all seasons, with several types of liquids (transition milk, fresh waste milk, soured milk combined with milk replacer) fed at conventional amounts (approximately one gallon of liquid daily). In 2001, we reported the results of two trials where we fed starters equal in energy concentration and containing 18, 20, 22, 24, and 26% protein. Calves were fed one lb of a 20% milk protein, 20% fat milk replacer daily and weaned at 42 days. There were no differences in gain, starter intake, efficiency of gain, body condition score change, hip width change, or health from 0 to 42 days or from 42 to 56 days. At the University of Illinois, Drackley et al. (2003) reported that calves fed starters containing 22% protein were more efficient and had similar gains compared with calves fed starters with 18% protein through 42 days. They fed 18 and 22% milk protein milk replacer at 10% of birth body weight through 35 days and 5% of birth body weight through 42 days. In 2005, we fed calves starters equal in energy containing 15, 18, and 21% protein. Calves were fed one lb daily of a 20% protein, 20% fat milk replacer and weaned at either 28 or 42 days. Calf gain and efficiency of gain improved linearly with increasing level of protein in the starter from 0 to 42 days. However, by 56 days, there were no differences in gain, efficiency, hip width change, and body condition change between calves fed the 18 and 21% protein starters. Calves fed the 15% protein starter had the slowest gains, poorest efficiency, and least change in hip width. Calves weaned at 28 days had a slower daily gain, greater starter intake, and poorer efficiency from 0 to 42 days than calves weaned at 42 days. However, from 0 to 56 days, calves weaned at 28 and 42 days had similar gains, efficiency, hip width change, and

body condition change. Calves weaned at 28 days consumed more starter from 0 to 56 days than calves weaned at 42 days.

In each of these five trials, conventional milk and milk replacer feeding programs were used. There is clear evidence in both the University of Minnesota trial in 1994 and our trial in 2005 that starters less than 17 or 18% protein support less gain than starter with more protein. The other trials did not report feeding starters with less than 18% protein. Collectively, these data suggests that 18% protein as recommended by the Dairy NRC (1989, 2001) is adequate for calf starters fed with conventional milk and milk replacer programs. Data to suggest otherwise is the potential for better efficiency with a 22% protein starter reported by Drackley et al. (2003) and a trend for better efficiency as observed in our 2005 trial. Additionally, calves did benefit from a high protein starter during the first 42 days in our 2005 trial; however, this advantage in performance was lost by 56 days. Four trials that fed calves a high protein, high feeding rate milk replacer with starters containing 18% protein or more are summarized below

In 2001, we tested feeding starters equal in energy and containing 18, 20, 22, 24, and 26% protein to calves fed 1.5 lb of a 26% milk protein, 17% fat milk replacer. The calves were weaned at 42 days. There were no differences in gain, starter intake, efficiency of gain, body condition score change, hip width change, or health from 0 to 42 days or 42 to 56 days. In 2005, we evaluated feeding starters equal in energy and containing 18 or 21% protein to calves fed 1.5 lb of a 26% milk protein, 17% fat milk replacer. The calves were weaned at 42 days. There were no differences in gain, starter intake, efficiency of gain, body condition score change, hip width change, or health from 0 to 42 days or 42 to 56 days. Stamey et al. (2005) at the University of Illinois reported feeding an 18% or 22% protein starter to calves fed a 28% milk protein, 15% fat milk replacer in two trials. The milk replacer was reconstituted to 15% solids and fed at 1.5% of body weight during week 1, 2.0% of body weight during weeks 2 to 5, and 1% of body weight during week 6. They also fed a control treatment that was 20% milk protein, 20% fat milk replacer reconstituted to 12.5% solids at 1.25% of body weight during week 1 to 5 and 0.625% of body weight during week 6 and they fed this group the 18% protein starter. In the first trial, the calves fed the high protein milk replacer gained faster than calves fed the low protein milk replacer (LMR) and calves fed the high protein milk replacer with the high protein starter (HS) tended to gain faster than calves fed the high protein milk replacer with the low protein starter (LS). Daily gains from 0 to 10 weeks of age were 1.43, 1.63, and 1.78 lb per day for LMR, LS, and HS treatment groups, respectively. In the second trial, they observed no differences between the LS and HS treatment groups, but those two groups of calves had greater empty body weight gains and greater fat gains after slaughter than the LMR group. Empty body weight gains from 0 to10 weeks of age were 0.95, 1.36, 1.41 lb per day and fat gains from 0 to10 weeks of age were 5.3, 7.3, and 7.2 lb for LMR, LS, and HS treatment groups, respectively. They concluded that there was no advantage to feeding a starter greater than 18% protein with a high protein milk replacer fed at high rates.

In each of these trials, intake of starter feed and rate of gain was normal to high and no abnormal occurrences were reported. As a group, these trials addressed the issue of protein concentration of a starter rather well. However, they do not address how the protein source or sources used in a starter might impact gain. Feeds can differ in amino acid profiles, protein digestibility, and sites of digestion.

These nine controlled research trials from four different labs agree remarkably well and suggest that feeding an 18% protein starter is correct for calves fed conventional milk and milk replacer programs and for calves fed high protein, high feeding rate milk replacer programs. These results also agree well with 2001 Dairy NRC calf sub-model which uses a different approach to determining the nutrient requirements of calves. More research is needed to justify feeding starters that have greater concentrations of protein.

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