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Calf, heifer research review for journal's 100th anniversary valuable

Bottom Line

with
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WHEN I was originally asked to write a 100-year review on calf nutrition and management for the 100th anniversary issue of the *Journal of Dairy Science* (JDS) in December 2017, I demurred, feeling that the task was way beyond what I could do, but the editors came back and said I could recruit co-authors to aid me in this effort.

Hence, I accepted the task with the help of the following co-authors, who covered 20-year segments beginning with 1917: Mark Hill of Provimi North America, Jim Quigley of Provimi North America, Jud Heinrichs of The Pennsylvania State University, Jim Linn of the University of Minnesota and Jim Drackley of the University of Illinois. Besides their knowledge in this area of calf research, there was some logic behind these author selections and the time periods they covered.

The biggest challenge was keeping each 20-year review segment to a reasonable length, as the studies with calves that were reported in JDS were extensive. Overall, about 1,500 articles were published in this subject area, beginning with about 40 in the first 20 years and ending up with nearly 600 in the last 20 years. That accounted for about 5% of all articles published in JDS over the 100-year period.

The following are some of the co-authors' comments about studies within the 20-year segments.

1917-36

This era began with the first article published by C.H. Eckles of the University of Missouri, which named its department of dairy husbandry building after Eckles. Later, Eckles moved to the University of Minnesota, where the animal science department is located on Eckles Ave. Eckles' first paper used records of 654 animals describing the bodyweight (BW) at birth for calves of different breeds.

From Hill: "Birth BW of first-, second-, ninth- and 10th-parity dams was less than birth BW of third- through eighth-parity dams. Males were 5-8% heavier than females. Length of gestation was not related to birth BW. Using a subset of 29 cows fed low or high levels of nutrients, Eckles reported that nutrition of the dam did not affect calf birth bodyweight. Eckles moved to the University of Minnesota and, in the first 20 years of the journal, published seven other papers on topics of milk substitutes, feeding yeast, calves not requiring sunlight (vitamins were supplemented), vitamin A being required and vitamin C and B vitamins not being required."

Characteristics of calf papers in this era were to use no statistics, few animals per treatment and few controls or treatments, with poorly described experimental methods and with photographs used to depict calf condition or performance.

1937-56

From Quigley: "Many concepts fundamental to current knowledge and understanding of digestion, rumen development and milk replacer formulation were developed during this period. In addition, the concept of using antibiotic growth promoters in dairy calf diets was first evaluated and developed during the 1950s."

More universities did more studies (a total of 222 articles identified) despite the impact of World War II.

1957-76

From Heinrichs: During this era, "a large number of universities in the U.S. and one in Canada contributed almost 150 papers on a variety of calf-related topics. Published studies investigated factors affecting calf birth weight, including genetics, cross-breeding programs and breed."

Conversion from English to metric units in JDS occurred during this period. Many physiological studies were done, some involving techniques not now available or possible to do, such as using radioisotopes. Key calf rumen development studies were done at Iowa State University and Cornell University. Ingredients and formulations for both milk replacers and calf starters were studied.

1977-96

This period was covered by Linn, who picked up from the 75th anniversary issue he co-authored with Don Otterby in 1981.

From Linn: "More than 400 articles on calf nutrition and management were published in JDS. With the growing research interest in calves, the North Central Regional Research Committee on Improving Large Dairy Herd Management published a paper outlining the standardized procedures for conducting and reporting data from calf experiments (Larson et al., 1977). Many of the guidelines are still in use today, aiding the interpretation of nutrition and management data across research studies."

More than 60 studies were done on colostrum antibody absorption and preservation and feeding excess colostrum or unsalable milk. Further studies were done with milk replacers and calf starters, reflecting the commonality of early-weaning programs. This included starter protein and energy levels and sources, along with the importance of water intake.

1997-2016

This period ushered in the significant addition of the "Young Calf Model" to the National Research Council's (NRC) 2001 dairy publication, as well as the increased feeding and growth rate of calves, often termed accelerated, intensive or enhanced programs.

Drackley, who co-authored, with Carl Davis, the last seminal book on calves in 1998 (*The Development, Nutrition & Management of the Young Calf*), did many studies related to intensive calf feeding. He would have reviewed most of the calf literature during this 20-year period for the successor to the 2001 dairy NRC and so was asked to review this time segment.

From Drackley: "Research on issues with calves continued to increase during this 20-year period, as evidenced by publication of more than 580 articles in JDS as well as many more in other refereed journals. In addition to papers contributed by several universities in the U.S. and Canada, the number of papers authored by scientists at universities and institutes in other countries increased dramatically during the period January 1997 through December 2016. Increased interest in calves likely resulted, in part, from changes in the industry, with larger

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farms (U.S. Department of Agriculture, 2002) and more custom calf-raising enterprises (Walker et al., 2012)."

Studies continued further substantiating the value of colostrum, minerals, vitamins, calf starter composition and management, weaning, forages, behavior and welfare and the impact of early nutrition and growth on subsequent milk production.

I think the latter topic has finally tipped the scales for producers and calf growers to adjust their thinking and practices to do a better job of feeding and management and recognize that calves are not an area in which to cut costs.

Knowledge and use of epigenetics and genomics also further the significance and value of the calf period.

Dairy heifers

Doing double duty, Heinrichs led authorship with three former graduate students of another review, this one on dairy heifer research.

"In the earliest years of the century, (JDS) had very few heifer publications — sometimes fewer than one or two per year related to the growing heifer," they noted. However, the later years, notably the past 20 years, have seen a dramatic increase in heifer research publications, with 20 or more per year. This review includes publications appearing in JDS since its beginning that had the term 'dairy heifer' in the title or keywords. Papers focusing on preweaned calves and treatments applied to heifers after their first calving were excluded. Topics related to breeding and reproduction, welfare, disease and housing and facilities are not covered to limit duplication with other articles in this issue of JDS.

"In the earliest literature on the growing heifer, researchers identified costs of feeding and implications of growth on future productivity as major concepts requiring further study to improve the overall sustainability of the dairy herd," they added. The status of knowledge of the practical feeding of dairy heifers at the time JDS was established was well summarized by Henry and Morrison (1915; page 426): 'The rearing of the heifer after six to eight months of age is an easy task, and perhaps because of this, many are stunted for lack of suitable feed.' The authors subsequently described the feeding of heifers in approximately half a page, clearly indicating opportunity for conducting and reporting additional research on growth, nutrition and management."

This heifer review has major categories on growth; age at calving; nutrient requirements, with sub-sections on protein and vitamins and minerals, and management, with sub-sections on feeding, transition to lactation and hoof health. The last section is on modeling to improve heifer management decisions.

A third review in JDS on animal welfare (von Keyserlingk and Weary, 2017) contains calf-related subject areas. I have sourced and used a number of these studies in quite a few of my past *Feedstuffs* columns.

The Bottom Line

These 100th anniversary JDS reviews on calf nutrition and management and dairy heifer research are major sources of encapsulated history and serve as a treasure trove of key studies and references. A hardcopy issue containing all 30 reviews can be ordered at https://elsstmj.directfrompublisher.com.

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