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Calf, heifer research trials should include necessary data

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Would you choose to do research in an area in which the number of animals may be limited or only available over a period time, have limited funding, have high variability and may require up to three years to get good follow-up data?

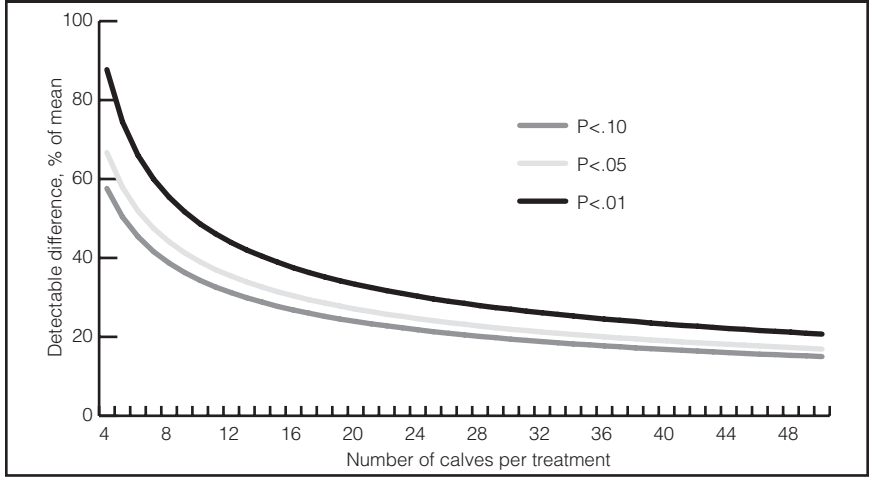
Those are some of the parameters that may be faced in research with calves and heifers. It is not a very glamorous, high-profile area, which also reflects how many dairy producers look at it in their own operations. Yet, its effects can be great in the operation of a dairy, since first-calf heifers often account for 30-50% of all the lactating animals in an established herd or 100% in new start-up herds.

At the Informal Calf Discussion held during the 2002 Animal and Dairy Science meetings in Quebec City, Que., the topic of what data and information should be collected during calf/heifer experiments and what should be included in the published report was raised. It is not a new issue.

In 1977, an article published on this topic was co-authored (Larson et al., 1977) by scientists from five research institutions. Unfortunately, adherence to the parameters defined in the report has been poor. This has been due, in part, to criticism that it is too encompassing in parameters to measure or define. Perhaps there needs to be a priority-based scheme with those parameters to always be measured and reported and then secondary and tertiary parameters listed that would enhance the picture.

Several at the discussion indicated that they will follow up on this issue and try to develop an updated approach.

FIGURE



Calf numbers needed to detect significant differences with a probability of 80% and a CV of 30%.

In the meantime, I dusted off another report (Kertz, 1977) from the same issue of the *Journal of Dairy Science* as the above report. A review of 24 preweaned calf experiments over a nine-year period revealed that five studies reported no data on experimental variation while 19 averaged 62% for the coefficient of variation (CV) for weight gain (range of 28-132%), and only 11 experiments had sufficient data to calculate an average CV of 90% (range of 27-217%) for calf starter intake. This was contrasted with four recent studies at the Purina Dairy Research Center that had an average CV of 30%.

A graph was generated to indicate the relationship between the number of calves required per treatment if there was an average CV of 30% to detect a range of differences at $P < 0.01$, 0.05 or 0.10. Purina's statistician, Dr. Larry Reutzel, had generated data for that graph. He re-created a database for the same graphic analysis now shown in the Figure.

Notice that 20-24 calves are needed per treatment to detect differences among means of 20-30%. Therefore, if a control group averaged 25 lb. of weight gain at weaning, treatments would have had to average less than 17.5-20.0 lb. or greater than 30.0-32.5 lb. to be different at $P < 0.01$-0.10 with a probability of 80% (i.e., four of five studies would yield these results).

If only 10-12 calves had been used per treatment, differences detectable per treatment would have escalated to 30-50%. None of this is necessarily a revelation, but it often is not accommodated in design or analysis of experiments.

If the number of calves per treatment had been this low (10-12), the null hypothesis had been that there was no significant difference between the control and treatments and the difference was 25% among means, then we would have concluded that there was no statistically significant difference.

However, the number of calves per treatment really precluded us from making that determination (i.e., a Type I error) when we would have found a 25% difference between the control and treatment(s) otherwise acceptable in testing that hypothesis.

On a different note, but somewhat related, if we look at our own experiments and other reported studies only in light of whether they prove what we are looking for rather than if either our study or

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other studies have elements that disprove what we are looking for, we need to reassess our assumptions and contentions or, otherwise, we do a disservice to the scientific community and related industry.

Recent trials

With all of the above as background, calf and heifer studies reported in the *Journal of Dairy Science* for the last five years were reviewed and summarized. Studies were selected that dealt with intake and growth and that had sufficient data to identify number of animals per treatment, initial and final bodyweights, average daily gain (ADG), intake, variability and feedstuff composition. It is disconcerting to find some studies that do not have all of these fundamental elements reported.

A total of 18 papers were identified, of which six reported two experiments, for a total of 24 trials. All used Holsteins (there was only one study that used Jerseys, so it was not included). Papers were further segregated into studies with preweaned calves (17 trials; for some of these trials, data were not segregated by preweaned versus postweaned status) and growing heifers (seven trials).

A synopsis follows, first for calves:

• Starting age varied from birth to 14 days. Sex varied from all heifers, a mix of heifers and bulls and all bulls. All studies did not identify if calves were male or female or of the distribution per treatment. It is generally assumed that there is no difference in performance between bull and heifer calves. A statistical summary of several years from the Purina database found that if heifer and bull calf starting weights are the same, performance is not different during the first two months. However, bulls typically weighed 7 lb. more than heifer calves (Kertz et al., 1997), so there is a difference.

• Number of calves per treatment ranged from six to 29 with a rough arithmetic average of 17 calves. This was skewed high by five studies that used purchased bull calves at an average of 27 per treatment.

• Number of treatments averaged 3.4 with a range of 2-4.

• Weaning age varied from 28 to 60 days with wide variation in the weaning scheme.

• ADG averaged 0.97 lb. (range of 0.44-1.98), but this often included some postweaning data because the data were not segregated in the reports. CV for ADG averaged 43% with a range of 20-109%. Variation decreased after weaning.

• Starter intake averaged 1.33 lb. with a range of 0.61-2.4 lb. Again, these numbers are confounded with a lack of segregation by preweaning versus postweaning data in some studies. CV for starter intake averaged 32% with a range of 19-60%. Variation decreased after weaning. This same pattern, as for ADG, is a reflection of both less variation for daily gain and intake after weaning along with higher level (e.g., 0.4 variation around a mean of 1.0 is much greater than around a mean of 2.0) of daily gain and intake.

For heifers:

• Starting age averaged 174 days with a range of 70-280 days, while starting weight averaged 350 lb. with a range of 185-500 lb.

• Number of heifers per treatment averaged 15 with a range of 3-43. Without the atypical 3 and 43 numbers, the average per treatment was 11 heifers.

• Number of treatments averaged 4.3 with a range of 3-6.

• Length of study averaged 251 days with a range of 140-549 days. Final weight averaged 902 lb. with a range of 406-1,501 lb.

• ADG averaged 2.16 lb. per day with a range of 1.44-3.27 lb. This average was particularly skewed by one study that averaged between 2.58 and 3.08 lb. CV for ADG averaged 9.1% with a range of 1.6-19%. The average was skewed by one study that averaged between 1.6-2.3% CV, which appeared to be abnormally low.

• Dry matter intake (DMI) averaged 14.8 lb. with a range of 7.0-25.1. One study did not have DMI data. CV for DMI averaged 12.4% with a range of 2.4-29%. Two studies did not include variation on DMI information.

The overall picture is of a limited number of studies, all of which did not have the requisite descriptions or data. It is often difficult to compare across studies because of different variables, including environmental conditions, but when the description of these experimental components is not given or not complete, it makes it even more tenuous and difficult.

The Bottom Line

There is a need for more complete reporting of materials and methods in calf and heifer studies. Data collection and reporting should also be comprehensive so that means and variation are presented or can be calculated. The number of animals per treatment should be large enough that significant differences can be detected for what are realistic and reasonable differences among treatments.

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