



Average Daily Gain in Preweaned Holstein Heifer Calves NAHMS Dairy 2014 Study Calf Component

Information Brief

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INTRODUCTION

Average daily gain (ADG) during the preweaning period is one way to measure the overall health of calves. Calves that are fed an adequate diet and are not sick should gain weight steadily throughout the preweaning period. Ultimately, nutrient intake and growth during the preweaning period can influence a cow’s milk production later in life. Therefore, producers can monitor ADG of heifer calves to help identify any concerns in milk feeding management, disease and treatment, and as a management tool to help select heifer calves to be kept as replacements.

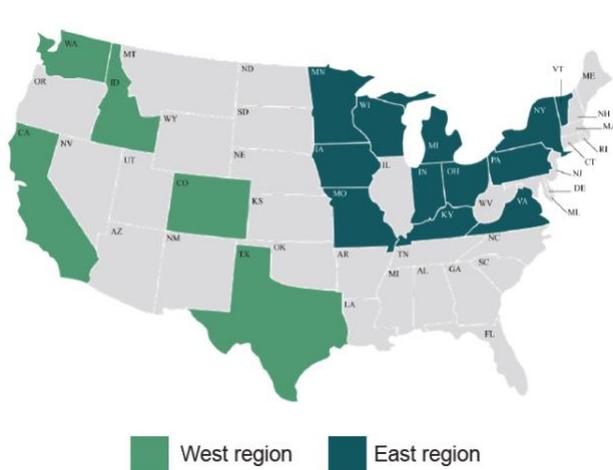
NAHMS DAIRY 2014 STUDY CALF COMPONENT

U.S. Department of Agriculture’s National Animal Health Monitoring System (NAHMS) conducted the Dairy 2014 study, which collected data on dairy health and management practices from 17 of the Nation’s major dairy States (Figure 1). These States represented 80.5 percent of U.S. dairy operations and 81.3 percent of U.S. dairy cows in 2014. The Dairy 2014 study Calf Component included 104 operations in 13 of the Nation’s major dairy States.*

One objective of the Calf Component was to evaluate average daily gain (ADG) in preweaned calves. In total, 1,410 Holstein heifer calves were evaluated to determine factors influencing ADG. Calf height and weight were recorded at 2-week intervals, and diet, disease occurrence, and treatments were recorded throughout the preweaning period. For the Dairy 2014 study, ADG for preweaned calves is defined by the following calculation:

$$\text{Weight gain during the preweaning period} = \frac{\text{weaning weight} - \text{birth weight}}{\text{age (in days) at weaning}}$$

Figure 1. States/regions that participated in the NAHMS Dairy 2014 study



West region: California, Colorado, Idaho, Texas, Washington
East region: Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, Wisconsin

*Idaho, Indiana, Kentucky, and Texas did not enroll calves in the calf component.

IMPORTANCE OF AVERAGE DAILY GAIN

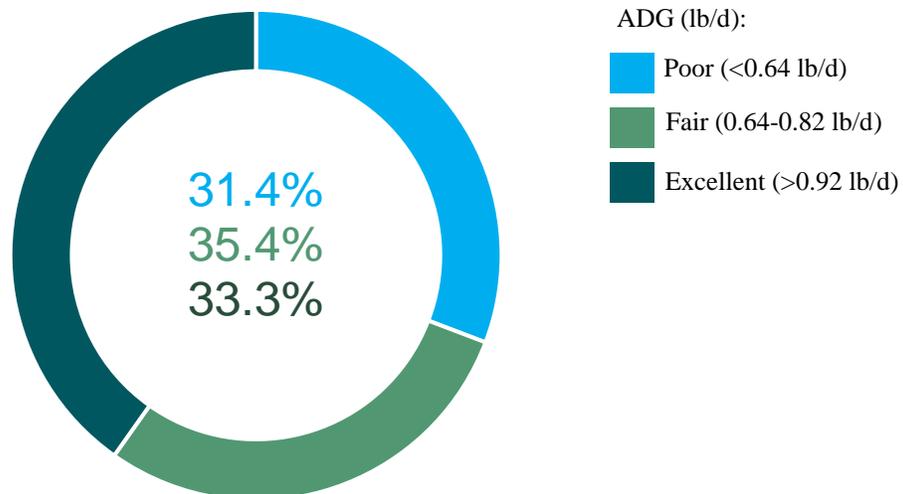
Nutrient intake and growth during the preweaning period can influence a cow's milk production later in life.¹ In addition, ADG can be used to assess calf health. In this study, ADG was influenced by many factors, including health, feeding practices, housing practices, and environmental factors (figure 2).

Figure 2. Factors influencing average daily gain (ADG) for preweaned heifers



The 1,410 calves evaluated were on a liquid diet for an average of 64.7 days and had an ADG of 1.6 lb/d (0.74 kg/d). Only 33.3 percent of calves had excellent ADG, defined as >1.8 lb/d (>0.82 kg/d), and 31.4 percent had poor ADG, defined as <1.4 lb/d (<0.64 kg/d) (figure 3).

Figure 3. Categorization of ADG (lb/d) for the 1,410 Holstein heifer calves evaluated



INFLUENCE OF FEEDING PRACTICES ON ADG

According to the National Research Council, energy requirements for maintenance of a 99 lb (45-kg) calf in thermoneutral conditions is 1.74 Mcal/d.² In thermoneutral conditions, calves do not have to expend any energy to maintain their body temperature.³ To meet these requirements, a calf requires 2.5 L of whole milk or 3.0 L of milk replacer containing 20 percent protein and 20 percent fat.⁴ These feeding amounts, however, only supply nutrients needed for maintenance and do not supply nutrients for growth.

In this study, calves fed milk replacer gained 0.22 lb/d (0.1 kg/d) less than calves fed whole milk. Often nutritional content in whole milk is higher than in milk replacers,⁵ and milk replacers frequently contain lower levels of fat than whole milk.⁴ Dietary protein is considered the rate-limiting nutrient for growth.⁴ Liquid diets that contain close to 25 percent protein are considered superior to those with 20 percent protein, when the same quantities are fed.⁴ In this study, for every 0.22 lb (0.1 kg) of protein fed per day, calves converted that into 0.044 lb/d (0.02 kg/d) of gain (i.e., 20 percent efficiency). Pasteurized milk also influences ADG. Calves fed pasteurized milk had a 0.066 lb/d (0.03 kg/d) increase in ADG compared with calves fed unpasteurized milk. Direct-fed microbials (DFM), or probiotics, can be added to the diet and are designed to improve the gut microbial profile.⁶ In this study, however, the addition of DFMs did not improve ADG in calves fed pasteurized or unpasteurized milk and resulted in decreased ADG, when added to milk replacer. Perhaps this finding is due to the fact that animals fed a DFM might have been exposed to extra stress or sickness, which could have contributed to the decision to feed a DFM.

While the amount and nutritional quality of a liquid diet is important for growth, ADG is influenced by additional factors beyond feeding practices. Feeding a higher volume of milk or milk replacer does not necessarily equate to higher ADG.

HEALTH AND OTHER FACTORS INFLUENCING ADG

Disease status is an important factor influencing calf growth. Disease during the preweaning period can impact available nutrients in multiple ways. For example, the immune system uses nutrients to fight pathogens, and disease can impact the availability of nutrients. Nutrients can be lost due to malabsorption when calves have diarrhea. In addition, disease occurrence can lower nutrient intake due to decreased appetite and feed intake.

Increasing the plane of nutrition for calves generally improves ADG and can lead to better disease resistance. Additionally, improved practices designed to prevent disease—such as insuring adequate passive immunity and maintaining clean environments for calves—can decrease disease occurrence.⁷ As expected, calves with no disease events gained 0.15 lb/d (0.07 kg/d) more than calves with one or more disease events. Diarrhea and pneumonia were the most commonly reported illnesses during the preweaning period. Other factors affected ADG as well. For example, single-birth calves gained more than twin calves, likely because twin calves generally have lower birth weights.⁸ Dam lactation also influenced ADG, as calves from first-calf heifers had lower ADGs compared with calves from second- and third-lactation cows. As was seen with twin calves, this reduced ADG might be due, in part, to lower birth weights. This finding is significant, as other studies have observed higher birth weights from multiparous cows.⁹ Fecal samples from calves were also tested for *Cryptosporidium* and *Giardia*. Calves testing positive for either organism gained 0.066 lb/d (0.03 kg/d) less than calves testing negative.

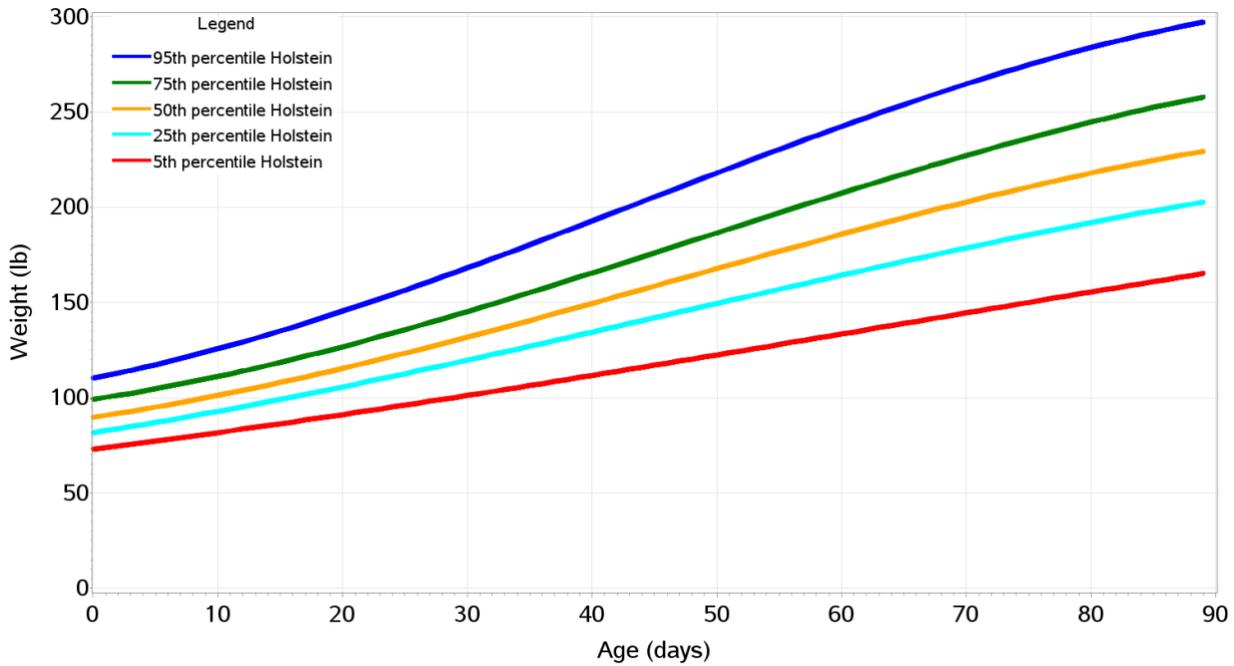
ENVIRONMENTAL FACTORS INFLUENCING ADG

Calf comfort also affects ADG. Calves bedded with sand or no bedding gained less weight than calves provided with straw or sawdust bedding. Other studies have also shown that calves excel on straw or sawdust.^{10 11} This finding is interesting, considering that sand is not ideal for calves but is the best bedding type for cows.¹² Environmental temperatures can also affect ADG. For example, heat stress in calves is associated with lower starter consumption and lower body weights at weaning.¹³ Average daily gain tended to be higher during colder temperatures (<10°C, <50°F).

EVALUATING PREWEANING GROWTH

Monitoring calf growth is an excellent way to evaluate calf management and health.¹⁴ Measuring calf height and weight—rather than visual assessment alone—and comparing the results to herd goals is important to maintain a productive herd. The calf component study measured calf weight and height at approximately 2-week intervals using a weight tape. See figure 4 for the growth chart for all calves included in the calf component study.

Figure 4. Preweaning growth chart for all Holstein calves



Growth information can be used to create herd goals for future monitoring. In table 1, recommended body weights are provided for calves in different percentiles, based on study findings. This chart could be used to establish calf ADG guidelines for monitoring herd growth.

Table 1. Preweaning growth data for all Holstein calves

Age (weeks)	5 th percentile lb/kg	25 th percentile lb/kg	50 th percentile lb/kg	75 th percentile lb/kg	95 th percentile lb/kg
Birthweight	74 (34)	80 (36)	89 (41)	98(45)	111(51)
2	87 (40)	97 (44)	108 (49)	120(55)	128(63)
4	99 (45)	115(52)	130 (59)	144(66)	171(78)
6	115 (52)	138 (63)]	157 (71)	174(79)	204(93)
8	134 (61)	164 (75)	184 (84)	205(93)	240(109)
10	152 (69)	184 (84)	204 (93)	230(105)	271(123)
ADG	0.9 lb/d (0.4 kg/d)	1.2 lb/d (0.6kg/d)	1.4 lb/d (0.6 kg/d)	1.6 lb/d (0.7 kg/d)	1.9 lb/d (0.9 kg/d)

KEY STUDY FINDINGS AND RECOMMENDATIONS FOR OPTIMIZING ADG



Feed a quantity and quality of liquid diet for the desired amount of growth. Calves with excellent preweaning growth should gain >1.8 lb/d (>0.82 kg/d).

- Increasing the amount of protein fed daily increased ADG.
- A direct-fed microbial (DFM) added to milk replacer generally resulted in a lower ADG than milk replacer without a DFM added.
- Of preweaned calves that were fed whole milk without a direct-fed microbial, those that were fed pasteurized milk had a higher ADG than calves fed unpasteurized milk.



Monitor birth weight, as it can influence ADG.

- Calves born to first-lactation dams and with lower birth weights had lower ADG.
- Singleton calves gained more than twin calves.



Keep calves healthy and free from disease.

- Calves with no disease events gained more than calves with one or more disease events.
- Calves with negative fecal tests for Cryptosporidium or Giardia gained more than calves with positive tests.



Keep calves comfortable by providing bedding, such as straw.

- Calves provided sand bedding or no bedding gained less than calves given other bedding types.



Mitigate the effects of temperature and humidity during the preweaning period.

- Preweaned calves experiencing a temperature and humidity index (THI) from <math><10^{\circ}\text{C}</math> to <math><50^{\circ}\text{F}</math> had higher ADGs.

CONCLUSION

Average daily gain during the preweaning period is an important indicator of future milk production. Thus, future milk production can be increased by evaluating and monitoring ADG in preweaned calves to ensure that the calves are meeting weight-gain goals. Calves should gain >1.8 lb/d (>0.82 kg/d). If calves are not achieving this level, multiple factors can be evaluated in an attempt to improve ADG.

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