

ACCELERATE HEIFERS THROUGH TRANSITION

by

David E Weber, DVM
Biovance Technologies, Inc.
Technical Services Division

INTRODUCTION

An on-farm heifer rearing program is the second largest capital expenditure on a dairy next to the cost of feeding the milking herd (Heinrichs, 1996). Too many dairy producers tend to neglect this critical segment of the dairy operation through the justification that the economic return may not be realized for one to four years after the heifer has entered the herd. Unfortunately, this practice is an exercise in false economy.

In a recent DHIA bulletin, Cady and Smith (1996; Appendix 1) reporting on the economics of various heifer raising programs, stated “an extra day of age at first calving cost approximately twice as much as an extra day dry and 13 times as much as an extra day open”. To paraphrase what these researchers were saying, it is economically more efficient to grow heifers during the period of time when the heifer is physiologically and metabolically more efficient, than to wait until after calving when they have entered lactation and have to partition nutrients to other functions beside growth.

The purpose of this paper is to review current research related to accelerating frame and skeletal growth in heifers.

ACCELERATED GROWTH VS. OPTIMAL BODY SIZE

Over the last 20 years, dairy producers have been selecting Holstein cattle based on larger body and frame size by selecting for milk yield (Hansen, 1999; Holstein Summaries, Vol. II). Most producers and scientists believe milk production and dry matter intake are correlated to cow body size or capacity. These physical traits, plus further selection for conformation and breed type have contributed to some of the increased milk yield.

Although selection based on body size or frame has continued, many producers fail to have cattle achieve optimal genetic growth potential due to poor feeding management of these cattle as heifers. To compensate for this short fall, sire selection based on frame size is often employed and the resulting outcome is calving difficulties in first calf heifers (James and Tomlinson, 1988).

Studying longevity of Holstein cows bred for large versus small body sizes, Hansen (1999) observed that there were both advantages and disadvantages to cattle of both frame sizes. The question currently is not to produce a cow that will grow beyond her genetic growth potential for size, but rather to grow that female as a heifer at an accelerated rate so frame and body capacity are maximized per day of age. This also needs to be accomplished without inadvertently producing body weight from fat rather than lean deposition.

Scientifically Holstein dairy cattle are currently recognized to reach physiologic maturity at 60 months of age. The goal of accelerated growth is to produce a heifer that is 65% of her mature size by the time of breeding and 80-85% of adult stature at calving. At present the industry benchmarks these plateaus based on body weight. This may not be as accurate as frame measurements for determining proper fat and lean ratios in the carcass of the growing heifer (Ellison, 1999).

Previous research studying accelerated growth in heifers has focused on body weight to age relationships. In most of these reports, feeding regimes used for accelerated growth produced heifers that calved at a younger age; however, they were shorter and heavier than the control animals. These nutritional strategies not only produce shorter, heavier heifers but also negatively impact mammary secretion potential.

Recently, Hoffman (1996) introduced the concept of *volumetric growth*, which relates growth

on an internal cubic dimension rather than weight gain. This idea focuses on growth as it relates to internal volume which, in production terms, translates into dry matter intake capacity. Numerically, Hoffman estimates that a heifer who is 1 inch longer in body length, 1 inch taller at the withers and 1 inch larger in heart girth circumference at a given age has approximately 25 gallons more internal body capacity. Considering the rumen represents 22% of total body volume, this can translate into an additional 5 gallons of ruminal capacity.

HEIFERS AND TRANSITION

Transition for heifers can be difficult at best. However, if certain target points with regard to growth are achieved the stress of this event can be minimized. Each dairy heifer raising operation is different with respect to feeding programs, housing, breed, etc., however, each operation within itself should strive to attain the recommendations outlined below.

The following recommendations are based on Holstein heifers:

1. **Attain 80-85% of mature size at first calving.** Heifers following calving should be approximately 80-85% of their mature size. This means heifers having a mature body size of 1500 pounds should be 1200 to 1275 pounds by 7 to 14 days after calving. Remember the conceptus (fetus, fluids and placenta) can account for up to 150 pounds of body weight, therefore, for a heifer to weigh 1200 pounds after calving she must weigh approximately 1350 pounds immediately prior to freshening.
2. **Body condition score (BCS) between 3 to 3.5.** Heifers freshening at body condition scores above a 4 are more subject to displaced abomasums and ketosis than herd mates with lower BCS. In addition, heifers with 4 or greater BCS have a more pronounced drop in dry matter intakes the day before calving, reflecting the metabolic impact of body composition.
3. **A wither height of 56 inches at calving.** Wither height and weight per day of age have been two components used in

plotting growth in heifers. However, Markusfeld and Ezra (1993) reported that wither height of Holstein replacements at first calving was a better determinant of peak and 305 day first lactation milk yield than body weight. Similarly, Seiber et al. (1988) observed a positive relationship between first lactation milk yield and paunch girth, wither height, chest depth, or pelvic width as compared to body weight. Recording wither height change in heifers following first lactation, Kertz et al. (1997) observed that heights increased only an average of 3 cm from first to second lactation. Furthermore, wither heights increased only 2 to 3 cm over the next five year period. In general, heifers that enter lactation at 80-85% of their mature body size will be able to eat more volumetrically and partition less of these nutrients to growth.

4. **Calve heifers at 22-24 months of age.** In 1992, a NAHMS study reported that the average age at first calving for Holstein heifers nationwide was 25.9 months which would reflect a first breeding age of approximately 15 to 16 months. Long term studies examining milk production versus heifer age at first calving showed heifers freshening at 24 to 25 months at first calving were more profitable with regard to milk production, Fiez and Rimbey (1983). With respect to these studies, percent of mature size at first calving can have an impact on milking performance as it relates to dry matter intake capacity. Heifers that freshen at 24 to 25 months of age may at this point attain the 80-85% rule that could account for more milk yield. On the other hand, calving heifers at 22 to 24 months of age could achieve the same production level if they were 80-85% of their mature stature.

ACCELERATED GROWTH

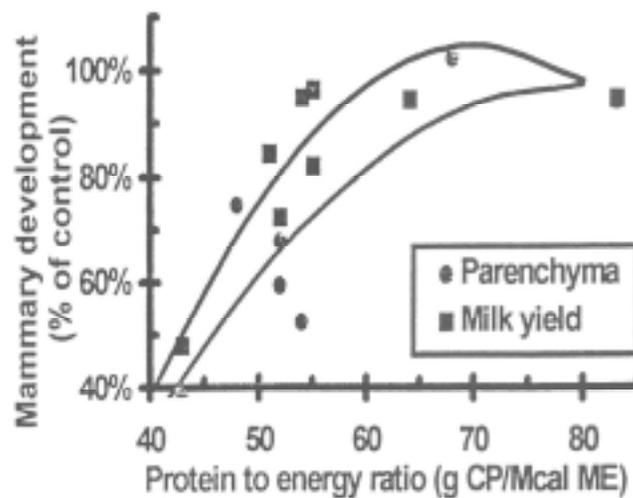
Previous research has demonstrated that accelerated growth without achieving optimal frame development is counter-productive. Studies measuring milk production of heifers fed for accelerated growth were disappointing mainly because what was achieved was weight gain and not frame development. Heifers fed for accelerated average daily gain reported decreases in first

lactation milk performance from 5 to 48% (Swanson, 1960; Little and Kay, 1979).

Van Amburgh et al. (1997) studying the effect of varying body weight gains in prepubertal heifers observed that animals fed for accelerated weight gains were shorter at the wither and were fatter, as determined by BCS. One concern with typical accelerated growth is its effect on fat infusion in mammary tissue and subsequent milk production. Pirlo et al. (1997) addressed this issue and reported that milk production was not impaired in Italian Friesian heifers fed to gain 3 pounds per day from 220 pounds to 650 pounds. These two studies demonstrate that accelerated growth can be of benefit; however, a proper balance of nutrients (protein and energy) is required to maximize frame and lean tissue development and not fat deposition.

Most of the previous studies dealing with accelerated growth were successful in reducing the days to first calving and increasing average daily gain. However, much of the variation was related to metabolic protein and metabolic energy ratios resulting from each ration. The link of metabolic protein to metabolic energy levels is critical in determining character of growth (Radcliff et al., 1996; Capuco et al., 1995; Waldo et al., 1997). VandeHaar (1998) states that metabolic protein level is important as it relates to metabolizable energy and the ratio between these nutrients is critical. In VandeHaar's equation (CP:ME), urea (NPN) cannot be used in calculating this ratio (Figure 1).

Figure 1. Dietary protein and mammary development.



REFERENCES

- Cady, R. A. and T. R. Smith. 1996. Economics of heifer raising programs. Presented at NRAES Conference. Harrisburg, PA.
- Capuco, A. V., J. J. Smith, D. R. Waldo and C. E. Rexroad. 1995. Influence of prepubertal dietary regimen on mammary growth of Holstein heifers. *J. Dairy Sci.* 78:2709.
- Ellison, B. E. 1999. Recent concepts in raising dairy replacement heifers. *New Horizons*.
- Fiez, E. A. and N R. Rimbey. 1983. Optimum age at first calving. National Dairy Database, Version 2. Center for Dairy Profitability. University of Wisconsin, Madison.
- Hansen, L. B. 1999. Longevity of Holstein Cows bred to be large versus small for body size. Proceedings 1999 Western Canadian Dairy Seminar.
- Heinrichs, A. J. 1996. The Importance of Heifer Raising to a Profitable Dairy farm. Proceeding from Calves, Heifers and Dairy Profitability National Conference. Harrisburg, PA.
- Hoffman, P.C. 1996. Optimum body size of Holstein replacement heifers. *J. Dairy Sci.* 75:836.
- James, R. E., and D. J. Tomlinson. 1988. "We must watch how our heifers grow." *Hoards Dairyman* 133:717 No. 14.
- Kertz, A. F., L. F. Reutzel, B. A. Barton, R. L. Ely. 1997. Body weight, Body Condition Score, and wither height of prepartum Holstein cows and birth weight and sex of calves by parity: A database and summary. *J. Dairy Sci.* 80:525-529.
- Little, W., and R. M. Kay. 1979. The effects of rapid rearing and early calving on the subsequent performance of dairy heifers. *Animal Production* 29:131-142.
- Pirlo, G. M. Capelletti, and G. Marchetto. 1997. Effects of energy and protein allowances in diets of prepubertal heifers on growth and milk production. *J. Dairy Sci.* 80:730.
- Registered Holstein Type Production Sire Summaries, Vol. II.
- Swanson, E. W. 1960. Effect of rapid growth with fattening of dairy heifers on their lactational ability. *J. Dairy Sci.* 43:377-387.
- Van Amburgh, M.E., D. M. Galton, R. W. Everett, D. G. Fox, L. E. Chase, and H. N. Erb. 1997. *J. Dairy Sci.* 81:525.
- VandeHaar, M. J. 1998. Current concepts in feeding dairy replacements. Tri State Dairy Nutrition Seminar, Ft. Wayne, IN.
- Waldo, D.R., H. F. Tyrell, A. V. Capuco, and C. E. Rexroad, Jr. 1997. Components of growth in Holstein heifers fed either alfalfa or corn silage diets to produce two daily gains. *J. Dairy Sci.* 80:1674.

Appendix 1

Example from Cady and Smith 1996 on Economics of Heifer Raising Programs:

AN ILLUSTRATIVE HEIFER ENTERPRISE EXAMPLE

To illustrate the possible savings we will examine a hypothetical but typical 100 cow Holstein herd. To simplify matters for the sake of demonstration, we will make the following assumptions.

- Herd Assumptions:
 - 25,000 lb 305 ME herd average
 - 13 mo calving interval

- Lactation length is 336 days (11 mo)
- Dry period is 60 days (2 mo)

- 40% replacement rate
- AFC does not influence involuntary culling rate in first lactation
- 10 % death loss in heifer herd
- Cull weight of 1300 lb.
- Management in the milking herd is ideal regardless of AFC
- Using correct ME factors to estimate actual lactation production

Financial Assumptions:

- \$ 3.00/cwt return to milk enterprise to pay for heifers and return to management
 - \$12.00 mailbox milk price
 - \$ 9.00 make milk price (less heifer replacement costs)
- \$1.45 per day cost to raise heifers
- \$ 65 average calf value at birth
 - \$100 heifer calf
 - \$ 30 bull calf
 - 50:50 sex ratio at birth
- \$.30/lb beef price for cull cattle

No sales of heifer replacements for dairy purposes

Table 2. Expected lactation production for four 336 day lactations from a 25,000 lb ME cow calving for the first time at 24 mo of age and 30 mo of age.

24 Mo AFC

Lac.	Age	Lactation	Cumulative	Age at
<u>No.</u>	<u>(Mo)</u>	<u>Production</u>	<u>Production</u>	<u>Dryoff</u>
1	24	19,639	19,639	35
2	37	22,567	42,206	48
3	50	24,696	66,902	61
4	63	25,665	92,567	74

30 Mo AFC

Lac.	Age	Lactation	Cumulative	Age at
<u>No.</u>	<u>(Mo)</u>	<u>Production</u>	<u>Production</u>	<u>Dryoff</u>
1	30	21,368	21,368	41
2	43	23,798	45,166	54
3	56	25,416	70,582	67
4	69	25,919	96,501	80

Table 3. Cash flow at various points for heifers producing 25,000 lb ME milk at \$3 margin and \$1.45 per day rearing costs.

Age at First Calving

	<u>24 Mo</u>	<u>30 Mo</u>	<u>Difference (30-24)</u>
Rearing costs	\$1,059	\$1,323	\$264
Payoff milk required	35,287 lb.	44,109 lb.	8,822 lb.
1 st Lac. Income + calf	\$654	\$706	\$52
Income over rearing costs	(\$404)	(\$617)	(\$213)
3 Lac. Income + calves	\$2,202	\$2,312	\$110
Income over rearing costs	\$1,143	\$ 989	(\$154)

Table 3. illustrates the first reason for increased costs due to advanced AFC. On the first line, the \$264 difference in rearing costs for the 30 mo old heifer is simply due to 182 extra days spent in the rearing pen. Furthermore, the heifer calving at 30 mo does not produce enough milk to make up for the difference in rearing costs for the additional 6 mo of age despite the fact she produces more milk and generates more income during lactation. While she is expected to produce 3,934 more pounds of milk over 4 lactations, that is not even half the 8,822 lb required to make up the \$264 dollar difference in rearing costs. As pointed out earlier, by fourth lactation, there ceases to be any additional milk advantage due to advanced age. Consequently, there is never enough opportunity for the older heifer to make up the difference in rearing costs when she is 6 mo older than optimum. Furthermore, the differences in Table 3 tend to understate the difference in cash flow because we are looking at heifers of dissimilar ages as defined by completion of a lactation. Table 4 compares heifers at a constant age of 48 mo.

	<u>24 Mo</u>	<u>30 Mo</u>	<u>Difference</u> <u>(30-24)</u>
Milking status@ 48 mo	Dry	Milking	N/A
Number of calves	2	2	0
No. of productive mo	22	16	-6
Total Milk	42,207 lb.	35,694 lb.	-6,513 lb.
Milk income + calves	\$1,396	\$1,201	(\$195)
Income over rearing costs	\$ 338	(\$122)	(\$460)
Breakeven cull age (mo)	37	45	-8

