Nutritional Management of the Dairy Heifer

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Many dairymen realize that early calving heifers are more profitable simply because they start producing milk at an earlier age. However, it is becoming apparent that too rapid a growth rate in prepubertal heifers has a detrimental effect on mammary gland development.

Optimal Prepubertal and Postpubertal Growth Rates

At present, most of the work describing the influence of prepubertal growth rate on subsequent milk production has been conducted in Denmark. This work will be summarized and extrapolations will be made with respect to Holstein-Friesian cattle grown in United States and Canada.

Foldager et al. 1978 showed that fat corrected milk yield declined by as much as 30-40% in first lactation heifers that were rapidly grown at a rate of 1.1 kg/d between 5 and 11 months of age. A growth rate of 0.65 kg/d was considered the optimum prepubertal growth rate. Growth rates above and below 0.65 kg/d resulted in lower milk yields. Foldager and Sejrsen (1983) have repeated this trial with 71 cows grown a rate of 0.4 kg, 0.6 kg and 0.8 kg per day and at 2 different body weight ranges of 90-200 kg (3 mo-7 mo) and 90-325 kg (3 mo-12 mo). In each case, the moderate growth rate of 0.6 kg/d resulted in subsequently higher milk yields. When similar rates of gain were achieved in postpubertal heifers, a higher plane of nutrition resulted in significantly higher mik yields. From this work it is apparent that a high plane of nutrition prior to puberty is a detriment to subsequent milk production.

In the type of Holstein-Friesian cattle raised in North America, the optimum prepubertal growth rate to achieve optimum mammary gland development appears to be between 0.7-1.0 kg/d. Sejrsen et al. 1982 found that Holstein-Friesian heifers raised at 0.65 kg/d versus 1.2 kg/d, at a starting body weight of 170 kg (7 mo.), had 23% more mammary secretory tissue. Harrison et al. 1983 have reported similar findings with Friesian x Ayrshire heifers raised at both moderate and high planes of nutrition. Heifers raised from 3-11 months of age at 0.76 kg/d had 33% more mammary parenchyma than heifers raised at 1.18 kg/d.

The mammary gland has an allometric growth period in cattle aged between 3-9 months of age (Sinha & Tucker, 1969). During this period, mammary gland DNA synthesis exceeds that of other tissues in the body by 3.5 times.

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TABLE 1. Daily Nutrient Requirements for Early Calving Dairy Heifers

Wt.	Feed DM	Crude Protein*	TDN	Minerals		Vitamins	
				Ca*	P*	A	D
kg	kg	kg	kg	gm	gm	(1000 IU)	(IU)
LARGE BREEDS							
75	2.1	.409	1.72	19	10	3.2	495
100	2.8	.511	2.10	23	12	4.2	660
150	4.0	.634	2.76	24	14	6.4	990
200	5.2	.768	3.45	26	18	8.5	1320
250	6.3	.854	3.98	28	20	10.6	1650
300	7.2	.932	4.50	29	22	12.7	1980
350	8.0	.991	4.90	30	23	14.8	2310
400	8.6	1.037	5.27	31	24	17.0	2640
450	9.1	1.070	5.41	32	25	19.1	2970
500	9.5	1.084	5.51	34	26	21.2	3300
550	9.8	1.096	5.78	42	30	42.0	3630
600	10.0	1.100	6.00	45	32	46.0	3960
SMALL BREEDS							
25	.5	.133	0.54	7	5	1.1	165
50	1.4	.292	1.36	14	8	2.1	330
75	2.1	.382	1.72	18	10	3.2	495
100	2.8	.482	2.10	21	11	4.2	660
150	4.0	.612	2.76	23	14	6.4	990
200	5.2	.720	3.31	25	17	8.5	1320
250	6.3	.814	3.74	26	19	10.6	1650
300	7.2	.895	4.25	28	20	12.7	1980
350	7.3	.925	4.53	29	23	14.8	2310
400	7.3	1.007	4.96	29	23	17.0	2640

* Values are 20% above NRC

Mammary gland growth reverts back to isometric growth in animals aged 10-12 months. The nutritional regime of the animal during the allometric growth period will influence the outcome of this growth period. Work by Sejrsen et al. 1983 shows that heifers on a high plane of nutrition have depressed circulating levels of growth hormone and higher levels of circulating insulin. This work suggest that higher circulating levels of growth hormone induce greater mammary parenchyma development. Research quoted by Bauman & McCutcheon, 1985 confirm this hypothesis. Bauman and coworkers have found that heifers injected with growth hormone for a 14 week period prior to puberty had 19% more mammary parenchuma than placebo injected controls. In summary, it appears that a moderate plane of nutrition before puberty enhances endogenous GH secretion. Growth hormone augments mammary gland development particularly during the allometric growth period of the mammary gland.

TABLE 2. Estimated Daily Forage DM Intake as a Percent of Body Weight

Weight	Mean	Range
75	0.50	0 -0.6
100	0.75	0.5-0.90
150	1.40	0.8-1.60
200	1.60	0.9-1.80
250	1.80	1.1-2.00
300	1.90	1.3-2.10
400	1.90	1.4-2.10
500	2.00	1.6-2.20
600	2.00	1.6-2.20

Charting Heifer Growth

Based upon the influence of heifer growth rate of subsequent milk production, it is imperative that dairymen chart heifer growth. For example, most dairymen keep heifers of various ages together in the same pen or enclosure. It would be difficult for the farmer to tell by simply looking at the group of heifers which animals were achieving the optimum rate of gain both in terms of height and weight. The fact sheet entitled; "Charting Heifer Growth" depicts an example of this circumstance in Figure 1. Heifer #1 is 6½ months old and is the ideal height (45 inches) and weight, in contrast heifer #2 in the same pen looks like she is doing as well as heifer #1 based on height and weight but she's 3½ months older than heifer #1. She is undergrown and will likely be an under producer. This example brings out the importance of accurately charting heifer growth. Dairymen sometimes forget that todays heifers contribute to tomorrow's milk cheque.

Nutrient Requirements

The nutrient requirements and estimated daily forage intakes of heifers of various weights are presented in Tables 1 and 2.

Practical tips for heifers from birth to calving are listed below:

Birth to 6 Months (Calf Stage)

- offer a coarse commercial starter (18%-20% CP; 72% TDN) free choice at 1 wk of age
- switch to a grain mix (18% CP; 72% TDN) 2 wks after weaning
- restrict grain intakes to 2-3 kg/d
- offer a good quality hay free choice, don't feed silages
- chart growth "optimum growth rates of <1.0 kg/d"
- forage/grain ratio 50:50

6 to 12 Months (Heifer Stage)

- continue to feed 2 kg/d grain mix of: 16-18% CP 6-9 mo
  14-16% CP 9-12 mo
- could start to feed silages but restrict their intake to <50% of the total forage intake.
- optimum gains 0.7-0.8 kg/d
- chart growth
- forage/grain ratio 70:30

12 to 18 Months (Breeding Stage)

- feed 1 to 2 kg of the grain ration that is matched with the forage
- ensure she is gaining weight at a moderate rate 0.7-0.8 kg/d
- forage/grain ratio 70:30

18 to 24 Months (Bred Heifer Stage)

- do not over feed corn silage
- maintain a constant growth rate but don't over condition
- good quality hay/haylage may be adequate to produce gains of 0.7-0.8 kg/d
- last 2 months offer 1-2 kg/d of a grain mix (64-16% CP)
- regulate Ca2+ intakes <100 g/d

Summary

Prepubertal heifers raised on a high plane of nutrition (>1.0 kg/d) have decreased milk yield. Mammary development is inhibited by suppressed GH levels induced by the high plane of nutrition. A high plane of nutrition after puberty may have a positive effect on milk yield probably by increasing live weight and body energy depots.

The optimum growth rate for prepubertal Holstein-Friesian heifers is between 0.7-1.0 kg/d.

References

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