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E. J. Bortone

M. G. Daccarett

J. L. Morrill

See next page for additional authors

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Performance of Holstein heifers reared on 100 or 115% of NRC requirements from 3 to 12 months of age and then switched to the opposite treatment

Authors

E. J. Bortone, M. G. Daccarett, J. L. Morrill, and Jeffrey S. Stevenson

PERFORMANCE OF HOLSTEIN HEIFERS REARED ON 100 OR 115% OF NRC REQUIREMENTS FROM 3 TO 12 MONTHS OF AGE AND THEN SWITCHED TO THE OPPOSITE TREATMENT

*E. J. Bortone, M. G. Daccarett, J. L. Morrill,
J. S. Stevenson, and A. M. Feyerherm¹*

Summary

Holstein heifers from the Kansas State University Dairy Teaching and Research Unit were used from 3 mo of age until 21 d before estimated date of calving. They were fed either 100 (control, C) or 115% (enhanced, E) of the 1989 National Research Council (NRC) requirements for major nutrients from 3 to 12 mo of age, then, until 21 d before freshening, the treatments were switched from 100 to 115% NRC (CE) or from 115 to 100% NRC (EC). At puberty, heifers had similar body weights (613, E vs 617, C) but heifers fed E were 1 month younger (11 vs 12 mo). Heifers fed the E diet were heavier and had larger heart girth at 12 mo of age than the group fed C. After switching, the group fed CE increased more in body weight, body length, wither height, and body condition than the group fed EC.

(Key Words: Heifer, NRC, Switch, Puberty, Diet.)

Introduction

Accelerating growth of replacement heifers by feeding high energy diets, thereby allowing breeding at an earlier age, can reduce feed costs and allow an earlier return on investments. However, several studies have shown that rearing heifers on high energy diets during the prepubertal stage of growth results in the detrimental accumulation of adipose tissue in the mammary gland, resulting in less milk yield after first parturition.

Heifers are often bred by age rather than weight, consequently, the size per age advantage of those animals growing more rapidly is not realized. Research has indicated that heifers fed to attain higher average daily gains (ADG > 1.6 lb/d) were younger at onset of puberty than controls (ADG < 1.6 lb/d) but they attained puberty at similar body weight (614 lb).

Often, recommendations are to have dairy heifers gain an average of at least 1.6 lb/d from 3 to 24 mo of age and freshen at around 24 mo of age with BW between 1,200 and 1,300 lb. In order to achieve these goals the heifers must attain ADG of at least 1.6 lb/d and must conceive no later than 15 mo of age. Data from a study at Kansas State showed that heifers fed 115% of NRC requirements from 3 mo of age until 21 d before freshening could achieve the desired body weight without being over conditioned, calve at an earlier age (22.6 vs 23.8 mo), and produce equal quantities of milk as heifers fed to gain 1.6 lb/d (100% NRC). However, the question of what would be the effects on performance of feeding 115% of NRC requirements for part of the growth period remained unanswered. Therefore, this research was conducted to compare performance of Holstein heifers fed either 100 or 115% of NRC requirements from 3 to 12 mo of age and then fed the opposite diet until 21 d before estimated calving date.

Procedures

Holstein heifers (n=89) from the Kansas State University Dairy Research Unit were used from 3 mo of age until 21 d before estimated date of

¹Department of Statistics.

calving. At 3 mo of age they were assigned randomly to either 100% (C) or 115% (E) of 1989 NRC requirements for energy, crude protein, Ca, P, and vitamins A and D for large dairy heifers gaining 1.6 lb/d. At 12 mo of age, the treatments were switched from 100 to 115% NRC (CE) and from 115 to 100% NRC (EC) until 21 d before freshening. Body weights were recorded weekly, and diets were least-cost formulated, based on the average body weights of heifers in the group. From 3 to 6 mo of age, the diet consisted of alfalfa hay and a concentrate composed of rolled sorghum grain, soybean meal, trace mineralized salt, Ca and P, and a vitamin E supplement. From 6 mo of age until approximately 21 d before calving, a total mixed diet was fed once daily and consisted of alfalfa hay; prairie or brome grass hay; rolled sorghum grain; trace mineralized salt; Ca and P supplement; and supplemental vitamins A, D, and E.

At 3-mo intervals, measurements of body weight and size (withers height, body length, and heart girth) were recorded. Starting at 6 mo of age, at 3-mo intervals, body condition scores were assessed using a 1 (thin) to 5 (over conditioned) scale. Pelvic area and distance between pin bones were measured and recorded. Breeding began when heifers weighed at least 770 lb BW.

Heifers (n=20) from each of the groups were selected randomly at 6 mo of age, and blood samples were collected biweekly until 14 mo of age. The samples were analyzed for progesterone (to estimate pubertal ovulation) by radioimmunoassay.

Results and Discussion

Measurements of body size and weight from 3 to 24 mo of age are shown in Figures 1 and 2. At the beginning of the experiment, the heifers were similar for all of the traits measured; however, at 9 and 12 mo, the heifers fed the EC diet had larger heart girth and were longer and heavier than the heifers fed the CE diet. Conversely, no significant differences between the two groups in withers height were noted throughout the experiment. After 12 mo of age, the CE group gained

more weight ($P<.01$) and increased more in heart girth than the EC group. Heart girth measurements and body weight were greater ($P<.05$) for the CE than for the EC group between 15 and 24 mo of age.

Body condition scores (BCS) are shown in Figure 3. At 6 mo of age, no significant differences in BCS were found; however, at 9 and 12 mo of age, the heifers fed the enhanced diet had higher BCS than the control group. After switching diets, the BCS increased more for the CE heifers than for the EC heifers, and BCS was greater ($P<.05$) at 15, 18, 21, and 24 mo of age.

Body weights, age at puberty, and reproductive traits are shown in Table 1. Heifers fed the enhanced diet were 23 days younger at puberty than controls. Body weights at puberty were similar between groups. At 12 mo of age, the heifers fed EC were 48 lb heavier than the group fed CE (648 and 600 lb, respectively). Therefore, these results agree with earlier studies in that puberty in Holstein heifers occurs at approximately 612 lb and is related more to body weight than to age.

Measurements of body weight and size 21 d before freshening are shown in Table 2. No significant differences were found between groups in age at 21 d before estimated calving date. Body weights, withers height, heart girth, and body length also were similar between groups.

In conclusion, feeding 115% of NRC requirements from 3 to 12 mo of age increased rate of gain, body weight at 12 mo, body condition, and heart girth and hastened puberty without changing body weight at puberty or reducing reproductive performance, compared to feeding 100% of NRC. Switching diets at 12 mo of age decreased the rates of gain and growth for the EC group, but increased the rates of gain and growth for CE, permitting CE to gain weight and grow at a faster rate between 12 and 24 mo of age. Although CE had the advantage after 12 mo of age, no differences were observed in age, BW, and size measurements at 21 d before estimated

calving date, suggesting that there was no advantage in either of the treatments used. Therefore, based on these results and those of the previous study at Kansas State University, we

recommend feeding Holstein dairy heifers 115% of NRC requirements of all major nutrients from 3 mo of age until shortly before freshening.

Table 1. Average Age at Puberty, and Reproductive Traits of Holstein Heifers Fed 100 or 115% NRC from 3 to 12 Mo of Age

Diet, % NRC	Puberty, age, d	Puberty, wt, lb	BW 12 mo	ADG 3-12 mo, lb/d	Serv. per conc.
100	360	612	600	1.5	1.4
115	337	619	648	1.7	1.6
SE	7, .02	7, NS	7, .001	.02, .008	.2, NS
P ¹					

¹Standard error, Probability level

Table 2. Average Body Weights and Size Measurements of Holstein Heifers 21 Days before Freshening

Variables ²	Treatment ¹				P
	CE		EC		
	Means	SE	Means	SE	
No. heifers	20		15		
Age, d	744	.4	729	.4	NS
BW, lb	1318	12	1283	12	NS
WH, in	52.4	1	52.7	1	NS
HG, in	78.3	2	78.0	2	NS
BL, in	66.5	2	66.1	1	NS

¹100 to 115% NRC (CE), 115 to 100% NRC (EC)

²Body weight (BW), withers height (WH), heart girth (HG), and body length (BL).

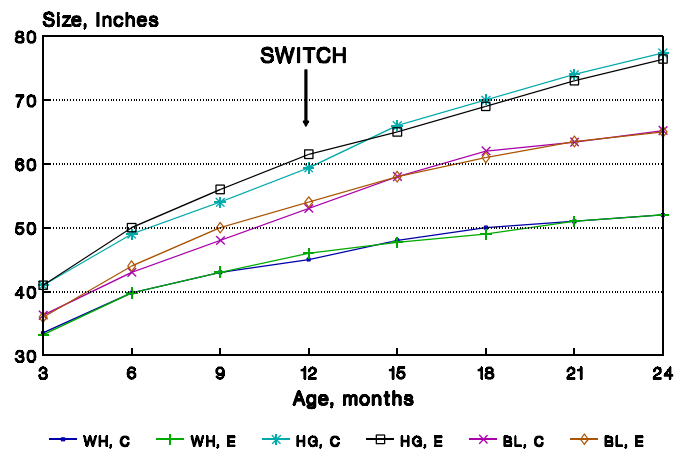


Figure 1. Size Measurements of Holstein Heifers Fed 100 or 115% NRC. For Explanation of Symbols see Text.

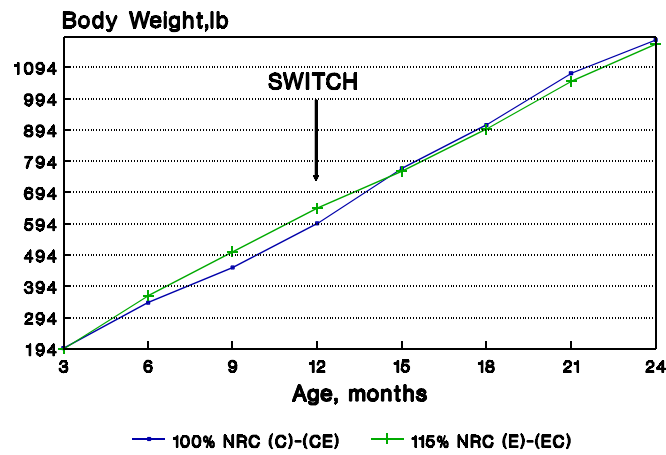


Figure 2. Body Weight of Holstein Heifers Fed 100 or 115% of NRC.

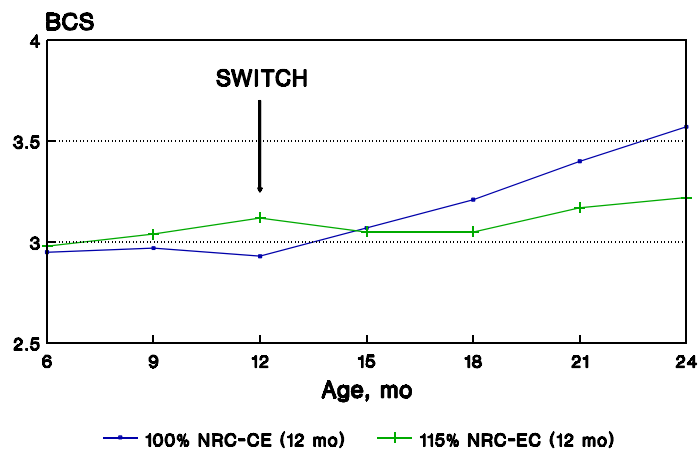


Figure 3. Body Condition Scores (BCS) of Holstein Heifers Fed 100 or 115% of NRC.