



Department of Animal Science

1999 Animal Science  
Research Report

## EFFECT OF GROWTH RATE ON MAMMARY GLAND DEVELOPMENT AT PUBERTY IN BEEF HEIFERS

Pages 293-295

### *Authors:*

**S.L. Charles, K.A.  
Vonnahme, J.V.  
Yelich, H.G.  
Dolezal and R.P.  
Wettemann**

### **Story in Brief**

The effect of three rates of gain on mammary development was evaluated in Angus x Hereford heifers (n=38). At 8 mo of age, heifers were allotted by body weight and age to one of three treatments: 1) full-fed (FF) to gain 1.36 kg/d; 2) limit-fed (LF) to gain .68 kg/d; 3) maintenance-full-fed (MFF) to gain .23 kg/d for 16 wk, then full-fed to gain 1.36 kg/d. Weekly blood samples were taken via tail venipuncture. Progesterone concentrations  $\geq$  1ng/mL in two consecutive weekly blood samples were considered the onset of puberty. Within 10 d after the onset of puberty, heifers were slaughtered. Mammary glands were removed and stored at -20° C until analyzed for DNA and fat. Mammary DNA (an estimate of the number of cells) was quantified in homogenized samples with Hoechst H 33258 dye with a fluorescence spectrophotometer. We previously reported that FF heifers were younger, heavier, and had greater carcass fat at puberty than LF and MFF heifers. Total fat in mammary glands was greater in FF heifers than in LH and MFF heifers, but total mammary DNA was not influenced by growth rate. We conclude that rate of gain of beef heifers during 3 to 6 mo preceding puberty does not influence the number of cells in mammary tissue at puberty.

Key Words: Beef Heifers, DNA, Mammary Gland, Nutrition

### **Introduction**

Success of a profitable heifer development program is dictated by careful management of the herd to achieve early initiation of estrous cycles and conception, so heifers calve at 2 yr of age. Feeding high energy diets before puberty may increase the percentage of puberal heifers at the onset of the breeding season. Mammary growth may be reduced when Holstein and crossbred heifers are fed high-energy diets before puberty (Sejrsen et al., 1983; Capuco et al., 1995). However, feeding high energy diets after puberty does not influence growth of mammary tissue. Buskirk et al. (1996) demonstrated that crossbred heifers had reduced milk production if fed high energy diets at approximately 4 to 6 mo of age. Although total mammary tissue was reduced when Holstein heifers were fed to gain rapidly between 4 to 6 mo of age, there was no decline in subsequent milk production (Capuco et al., 1995). Age at the time of nutritional treatment may account for variability of responses in mammary development (Sejrsen et al., 1995). The objective of the current study was to determine the effects of three rates of gain after weaning on mammary gland development at puberty in beef heifers.

### **Materials and Methods**

At 8 mo of age, Angus x Hereford heifers (n=38) were allotted by body weight and age to one of three treatments: 1) full-fed (FF) to gain 1.36 kg/d; 2) limit-fed (LF) to gain .68 kg/d; 3) maintenance-full-fed (MFF) to gain .23 kg/d for 16 wk, then full-fed to gain 1.36 kg/d. Weekly blood samples via tail venipuncture were taken in tubes containing EDTA, and cooled to 4° C. Plasma was obtained by centrifugation and stored at -20° C until analyzed for progesterone by radioimmunoassay. Progesterone concentrations  $\geq$  1.0 ng/mL in two consecutive weekly blood samples was considered the onset of puberty.

Within 10 d following the onset of puberty, heifers were slaughtered and mammary glands were removed and stored at -20° C. Glands were sliced, fat was removed, and remaining parenchymal tissue was ground and analyzed. Lipid and protein concentrations were quantified by ether extract and the Kjehldahl method, respectively. Ground mammary tissue samples were homogenized and DNA was quantified with Hoechst H33258 dye in a fluorescence spectrophotometer (Labarca and Paigen, 1980). The effects of dietary treatments on mammary DNA, protein, and fat were analyzed by analyses of variance.

## **Results and Discussion**

We previously reported (Yelich et al., 1995; Table 1) that FF heifers were heavier, younger, and had greater amounts of carcass fat than LF and MFF heifers. Total weight of the mammary gland was greater ( $P<.0001$ ) in the FF heifers (3.76 kg) than in LF (2.07 kg) and MFF (2.15 kg) heifers. Full-fed heifers had greater ( $P<.0001$ ) amounts of fat in the udder than LF and MFF heifers (3.01, 1.59, 1.59 kg, respectively; Table 2). Total amount of DNA in the mammary gland was not affected by nutritional treatment ( $P>.10$ ).

Factors such as age, duration of nutritional treatment, and growth rate associated with treatment may influence mammary development in heifers before puberty (Sejrsen et al., 1995). Heifers in this experiment were older at the time of treatment (approximately 8 mo of age) than heifers in previous studies (Buskirk et al., 1996; Capuco et al., 1995), suggesting that rapid weight gain of replacement heifers after weaning may not have a deleterious effect on mammary development. Although greater amounts of fat were deposited in the udders of FF heifers, the amount of DNA was not comprised by rapid weight gains. These results indicate that it may be possible to take advantage of rapid weight gains of beef heifers between 8 and 12 mo of age to decrease the age at puberty without having a deleterious effect upon subsequent milk production. Additional research is needed to evaluate whether increased growth rate prior to puberty influences subsequent milk production.

We conclude that rate of gain of beef heifers between 8 and 12 mo of age does not influence development of mammary parenchymal tissue at puberty.

## **Literature Cited**

- Buskirk, D.D. et al. 1996. *J. Anim. Sci.* 74:2649.
- Capuco, A.V. et al. 1995. *J. Dairy Sci.* 78:2709.
- Labarca, C. and K. Paigen. 1980. *Anal. Biochem.* 102:344.
- Sejrsen, K. et al. 1983. *J. Dairy Sci.* 66:846.
- Sejrsen, K. et al. 1995. *J. Anim. Sci.* 73:288.
- Yelich, J.V. et al. 1995. *J. Anim. Sci.* 73:2390.

## **Acknowledgements**

Sincere appreciation and gratitude are given to Dr. Spivey for the use of the spectrophotometer, and LaRuth Mackey for laboratory assistance.

**Table 1. Effect of rate of gain on age, BW, and body condition score (BCS) at puberty in beef heifers.**

Measure	Treatment			SE
	FF	LF	MFF	
Heifers, no	13	12	13	
Puberty BW, kg	350 <sup>a</sup>	305 <sup>b</sup>	310 <sup>b</sup>	13
Puberty age, d	370 <sup>a</sup>	415 <sup>b</sup>	403 <sup>b</sup>	12
BCS at puberty	6.4 <sup>a</sup>	5.6 <sup>b</sup>	5.4 <sup>b</sup>	.2

Adapted from J. Anim. Sci. 1995. 73:2390-2405

<sup>a,b</sup>Means differ (P<.05)

**Table 2. Effect of rate of gain on mammary gland weight, total fat, and DNA at puberty in beef heifers.**

Measure	Treatment			SE
	FF	LF	MFF	
Weight, kg	3.76 <sup>a</sup>	2.07 <sup>b</sup>	2.15 <sup>b</sup>	.23
Fat, kg	3.01 <sup>c</sup>	1.59 <sup>d</sup>	1.59 <sup>a</sup>	.21
DNA, mg	306 <sup>a</sup>	301 <sup>a</sup>	457 <sup>a</sup>	73

<sup>a,b</sup>Means differ (P<.001).

<sup>c,d</sup>Means differ (P < .001).