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EFFECT OF DIETARY ENERGY SOURCE ON AGE AND WEIGHT AT PUBERTY OF BEEF HEIFERS

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Summary

Forty-four Angus and Simmental sired crossbred heifers were fed two diets of differing composition (high forage or high concentrate). Diets were fed to achieve the same average daily gain to evaluate the effect of energy source on age and weight at puberty. Age at puberty, conception rate, pregnancy rate, weight at puberty, glucose and insulin were not significantly different between treatments.

(Key Words: Heifers, Puberty, Diets, Glucose, Insulin.)

Introduction

Previous research suggests that higher levels of blood glucose may decrease age at puberty in beef heifers. Increased blood glucose level may be accomplished by feeding a high grain diet versus a high forage diet. The objective of this research was to examine the effects of feeding two diets, a high grain diet and a high forage diet, of the same energy level per day on age at puberty, weight at puberty, and blood glucose level.

Materials and Methods

Forty-four Angus and Simmental sired, crossbred heifers were allotted to two dietary treatments by age and breed of sire. The dietary treatments (Table 1) were calculated to meet NRC requirements for NE_m and NE_g for 1.1 lb of gain. The amount of feed offered was adjusted periodically to achieve equal gains per treatment. Weights were taken every 28 days after 14 hours off feed and water, with the final shrunk weight obtained after the heifers were on a common ration for 3 days. Percentage fat of live weight was estimated by the change in urea blood concentration following jugular infusion of a urea solution of each heifer on day 160 or 164 of the trial at an average age of 364 days.

Blood samples were collected, via jugular puncture, every 7 days for 28 weeks to determine cycling activity by serum progesterone. Heifers with serum progesterone >1 ng/ml for two consecutive weeks or that were observed in estrus during the breeding period were considered puberal. Serum levels of glucose and insulin were determined on samples collected on days 1, 95, and 172 by colorimeter and radioimmunoassay, respectively.

TABLE 1. DIETARY TREATMENTS (LB/HEAD/DAY)

	Treatment					
	High forage			High concentrate		
	Period (days)					
Item	1-53	54-116	117-172	1-53	54-116	117-172
Alfalfa-brome hay	11.7	14.2	14.1	.9	1.1	1.2
Corn	2.6	3.2	3.2	6.3	7.6	8.4
Soybean meal				.2	.3	.3
Limestone				.1	.1	.1
TM salt	.1	.1	.1	.1	.1	.1

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After 172 days of the trial the treatments were discontinued. The heifers were fed as one group a diet containing 68% corn silage, 28% mixed grass hay, and 4% soybean meal based supplement for the remaining 40-day breeding season. They were observed for estrus and bred by artificial insemination. After 5 days of observation and insemination, the heifers were injected with prostaglandin to synchronize estrus. Sixty-two days following the end of the breeding season, they were rectally palpated to determine pregnancy.

Results and Discussion

Percentage body fat, age at puberty or the percentage of heifers reaching puberty at various times on trial was not affected by treatment (Table 2). Other research suggests that if glucose or insulin level increases that age at puberty will be younger. Since diet did not affect glucose or insulin, it would not be expected that age at puberty would be affected.

Although puberal status was not affected by treatment, the initial (day 1) glucose level was related to whether the heifers were cycling at 116 days (Table 3). Those heifers cycling had higher initial glucose levels than those that were not ($P<.05$).

Simple correlations indicated that heifers that were older at the beginning of the trial had higher initial (day 1) glucose ($r = .33$, $P<.05$) and lower final (day 172) insulin levels ($r = -.38$, $P<.05$). Heifers that reached puberty at an earlier age had higher initial ($r = -.44$, $P<.01$) and final ($r = -.35$, $P<.05$) glucose levels. Final glucose was positively correlated with initial glucose ($r = .38$, $P<.05$). The same was true for insulin ($r = .49$, $P<.001$). Heifers that were fatter at an average age of 364 days were younger at puberty ($r = -.29$, $P = .05$) and had higher initial glucose ($r = .30$, $P = .05$).

TABLE 2. EFFECTS OF DIETARY TREATMENTS

Item	Dietary treatments	
	High forage	High concentrate
Number of animals	23	21
Initial age, days	202.0 ± 3.1	202.4 ± 3.2
Initial weight, lb	546.6 ± 9.4	550.7 ± 9.7
Final weight, lb	805.7 ± 10.9	789.8 ± 11.3
Body fat, %[a]	13.8 ± .3	13.6 ± .3
Age at puberty, days	354.0 ± 12.6	352.6 ± 13.2
Weight at puberty, lb	728.4 ± 26.8	671.3 ± 28.3
Puberal heifers, %		
Day 53	17.4	14.3
Day 116	56.5	61.9
Day 178[b]	87.0	90.5
Conception to first service, %	39.1	25.0
Pregnancy rate, %	60.9	65.0
Glucose, mg/dl		
Day 1	86.9 ± 3.7	87.8 ± 3.8
Day 95	96.9 ± 3.7	94.7 ± 3.8
Day 172	67.4 ± 1.5	64.6 ± 1.5
Insulin, ng/ml		
Day 1	.2 ± .0	.2 ± .0
Day 95	.7 ± .1	.7 ± .1
Day 172	.8 ± .1	.8 ± .1

[a] Estimated by urea dilution at an average age of 364 days.
[b] Beginning of the breeding season.

TABLE 3. GLUCOSE AND INSULIN LEVELS RELATED TO CYCLICITY ON DAY 116[a]

Item	Cyclicity	
	Nonpuberal	Puberal
Glucose, mg/dl		
Day 1	79.0 ± 3.7[b]	91.3 ± 3.1[c]
Day 95	94.6 ± 4.1	95.6 ± 3.4
Day 172	63.6 ± 1.7	66.7 ± 1.4
Insulin, ng/ml		
Day 1	.2 ± .0	.2 ± .0
Day 95	.6 ± .1	.7 ± .1
Day 172	.8 ± .1	.8 ± .1

[a] The statistical model included puberal status and age as independent variables.

[b,c] Means within a row with uncommon superscripts differ ($P<.05$).

Substituting concentrates for roughage had no obvious beneficial effect on sexual development of the heifers in this trial. The lack of a detrimental effect indicates that, when economics dictate, a high concentrate diet could be used to develop heifers.