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Effects of Surgical Spaying on Heifer Feedlot Growth Performance and Dietary Energetics

Short Communication

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ABSTRACT

Fifty crossbred heifer calves were used in randomized complete block design experiment (5 heifers/pen and 5 replications per treatment), to compare effects on surgical spaying (SPAY) versus non-spayed intact (INTC) on growth-performance and dietary energetic efficiency during a 175-d growing finishing period. Upon initiation of the study heifers were implanted with a medium potency anabolic implant (200 mg testosterone propionate and 20 mg estradiol benzoate) and were reimplanted at day 75 (100 days previously to finishing experiment) with a high potency anabolic implant (140 mg trenbolone acetate and 14 mg estradiol. During first 35 days, spaying tended (P=0.08) to depress average daily gain (ADG, 9.9%) and dry matter intake (DMI, 7.5%). Differences in ADG were consistent with treatment effects on DMI, as observed DMI for both treatments were in good agreement with expected based on the net energy (NE) value of the diet. The cumulative ADG during the first 70 days and overall, were lower (7.0% and 4.6%, respectively; P≤0.04) for SPAY *vs.* INTC heifers. Due numerically greater DMI for INTC heifers, gain efficiency and observed *vs.* expected dietary NE were similar (P>0.27) across treatments. Surgical spaying retard has an appreciable long-term negative effect on daily weight gain of otherwise implanted feedlot heifers.

KEY WORDS anabolic, cattle, feed efficiency, ovariectomy, re-implanting, spayed *vs*. intact.

INTRODUCTION

Advantages of heifer spaying include both a reduction in physical activity and reduced risk of injury due to absence of “heat” cycles. These potential benefits might be reflected in enhancements in feedlot growth efficiency (Smith-Thomas, 2013; Ko *et al.* 2022). However, Rupp and Hamilton (2000), in a 33 trial summary observed that spaying of non-implanted heifers depressed ADG (6.5%) when comparison with intact heifers. However, ADG of implanted spayed heifers tended to be numerically greater (1.5%) than that of intact implanted heifers (Rupp and Hamilton, 2000).

Likewise, Dinusson and Haugse (1983) observed the restorative effect of implanting spayed heifers. Ovariectomized heifers exhibited a four-fold greater response in ADG due to application of growth implants than intact heifers (Garber *et al.* 1990). Therefore, the removal of ovaries can enhance the response of heifers to anabolic implantation. Nevertheless, augmentations due to implanting may not be sufficient to overcome risks and costs associated with spaying (Kelzer, 2009; AVMA, 2011). It is customary with longer term feedlot growing-finishing periods (i.e., >140 d), heifers would be reimplant at least once. To our knowledge, there is no information available evaluating feedlot growth performance response of reimplanted spayed feedlot heifers. For this reason, an experiment was conducted to evaluate the effects of surgical spaying on feedlot growth performance and efficiency of dietary net energy of heifers receiving two anabolic implants during the course of the growing-finishing period.

MATERIALS AND METHODS

All procedures involving animal care and management were in accordance with and approved by the University of California, Davis, Animal Use and Care Committee (Protocol #22271).

Sixty crossbreed heifers (approximately 25% Brahman breeding with the remainder represented by Hereford, Angus, Shorthorn, and Charolais breeds in various proportions) with an average initial weight of 253.06 ± 22.8 kg were received at the research facility 4 weeks before the start of the trial. Upon arrival, heifers were vaccinated against bovine rhinotracheitis-parainfluenza (Cattle Master Gold FP 5 L5, Zoetis, New York, NY), clostridials (Ultrabac-7, Zoetis, New York, NY), treated against internal and external parasites (Dectomax Injectable, Zoetis, New York, NY), subcutaneously injected with 1500 IU vitamin E (as d-alpha-tocopherol) 500000 IU vitamin A (as retinyl-palmitate) and 50000 IU vitamin D3 (Vital E-A+D3, Stuart Products, Bedford, TX), and 2.4 g oxytetracycline (LA-200, Zoetis, New York, NY), branded, and ear-tagged. All heifers were subject to rectal palpation in order to determine absence of pregnancy and normality of uterus and ovaries. Subsequently, 50 heifers were selected from the original group for inclusion in the experiment. Heifers were blocked by weight (5 blocks) and assigned within blocks to 10 pens (5 heifers/pen, 5 pen replications per treatment). Half of the heifers were spayed (bilateral ovariectomy, via an incision through the left paralumbar fossa, with complete removal of the ovaries using an ovariotome emasculator). All surgeries were performed under local anesthesia (10 mL of lidocaine-HCL, 2%) of and were performed by a certified large-animal-veterinarian. In order to ensure 0% pregnancy rate in intact heifers group, heifers were injected intramuscularly with 25 mg dinoprost (Lutalyse, Zoetis, Kalamazoo, MI). Pens were 50 m^2 with 33 m^2 overhead shade, automatic waters, and 4.3 m fence-line feed bunks. Heifers were fed with a steam-flaked corn-based diet formulated to meet requirements for growing-finishing feedlot beef heifers (NRC, 2016), same as it contained 11.8% crude protein and 2.23 Mcal of net energy for maintenance (NE_m)/kg.

Ingredient composition of the finishing diet was as follows (dry matter; DM basis): Alfalfa hay, 3.83%; sudan grass hay, 7.67%, steam flaked corn, 75.92, yellow grease, 2.64%, cane molasses, 7.04% limestone, 1.31%, urea, 0.97%, magnesium oxide, 0.18%, and trace mineral salt, 0.44%. Heifers were allowed *ad libitum* access to the diet. Fresh feed was provided twice daily at 08:00 and 14:00. Feed delivery was adjusted so that daily feed refusals did not exceed 5% prior to the morning feeding. Feed samples were collected from each elaborated batch. Daily feed refusal composited weekly for DM analysis (oven drying at 105 ˚C until no further weight loss; method 930.15, AOAC, 2000). Upon initiation of the experiment, heifers were implanted with 200 mg testosterone propionate/20 mg estradiol benzoate (Synovex H, Zoetis, Kalamazoo, MI), and on day 70, heifers were reimplanted with 200 mg trenbolone acetate/14 mg estradiol benzoate (Revalor-H, Merck Animal Health, Madison, NJ). All heifers were weighed before the morning meal at initiation of the experiment, and on days 35, 70, and 175.

For the growth performance and dietary energy calculations, full live weights were multiplied by 0.96 to obtain estimated initial and final shrunk body weight (SBW). Average daily gain (ADG) was determined as the difference in initial SBW and carcass adjusted final SBW divided by 175 (days on test). Gain efficiency (G:F) was determined as the ADG divided by corresponding dry matter intake (DMI).

One approach for evaluation of the efficiency of dietary energy utilization in growth-performance trials is the observed-to-expected dietary NE ratio and the observed-to-expected DMI ratio. Based on measures of growth performance (observed DMI, ADG, and average SBW), the observed dietary net energy was calculated for each treatment by means of the quadratic formula according to the procedure from Zinn *et al*. (2008) as follows:

$$x= (-b-\sqrt{b2-4ac}) / 2c$$

Where:
x: observed dietary NE_m (Mcal/kg).
a: -0.41 EM
b: 0.877 EM + 0.41 DMI + EG.
c: -0.877 DMI.

EM= energy required for maintenance (NE_m, Mcal/d), and EG= energy required for gain (NE_g, Mcal/d), were estimated using following equations: EM= $0.077 \times SBW^{0.75}$ and EG= $0.0618 \times (SBW \times 0.91)^{0.75} \times$

$ADG^{0.905}$, and DMI correspond to the average daily DMI (kg) registered during the experiment (Zinn *et al.* 2008).

Treatments were randomly assigned to pens within each block in a general complete block design. Response variables were analyzed with a linear model which includes μ as constant, τi and θj as fixed effects of treatment and block, and εijk as associated random error. Response variables Yijk are mutually independent and have a normal distribution with mean μ + τi and variance σ2. Pen was the experimental unit and initial weight the criterion of blocking. The analysis was carried out using the MIXED procedure of SAS software (SAS, 2007). Least squares means were compared using Tukey test. Significant differences among treatments were declared at P ≤ 0.05 and tendencies were declared at 0.05 < P ≤ 0.10.

RESULTS AND DISCUSSION

No morbidity or mortality was observed. Treatment effects on growth performance are shown in Table 1. During first 35days, spaying tended (P=0.08) to depress ADG (9.9%) and DMI (7.5%). Differences in ADG were consistent with treatment effects on DMI, as observed DMI for both treatments were in good agreement with expected based on the NE value of the diet (Table 2).

The cumulative ADG during the first 70 days and overall, were lower (7.0% and 4.6%, respectively; P≤0.04) for SPAY *vs.* INTC heifers. Due numerically greater DMI for INTC heifers, gain efficiency and observed *vs.* expected dietary NE were similar (P>0.27) across treatments. These results are in agreement with the results reported by Hamernik *et al.* (1985) and Bailey *et al.* (2008), but not with findings of Garber *et al.* (1990) and Perino *et al.* (1995). Inconsistencies between reports have been attributed to differences in initial weight, diet energy density, and anabolic implants (Adams *et al.* 1990; Garber *et al.* 1990). However, Plascencia *et al.* (2008), comparing a group of ovariectomized heifers fed a 1.72 Mcal NE_m/kg diet during the first 70 days followed by a 2.16 Mcal NE_m/kg of diet for the remaining 28 days *vs.* a group that were fed a 2.16 Mcal NE_m/kg diet throughout the 98 d trial, observed feeding management did not affect gain efficiency and efficiency of dietary energy utilization. Thus, it seems apparent that anabolic implants would be the more important supportive factor influencing growth efficiency of spayed heifers (Garber *et al.* 1990; Popp *et al.* 1997). In one study (Garber *et al.* 1990), ovariectomized heifers exhibited a four-fold greater ADG response to an anabolic implant than intact heifers. Compared to intact heifers Plascencia *et al.* (2008) observed that spayed heifers (implanted once with medium potency implant) greater gain efficiency and efficiency of dietary energy utilization during a 98-d fattening.

Table 1 Effect of surgical spaying on long-term fattening on dietary energy of feedlot heifers receiving two implants during fattening

Item	Treatments		SEM	P-value
	Spayed	Intact		
Days on feed	145	145		
Pen replicates	5	5		
Live weight, kg[1]				
Initial	253.91	252.79	0.982	0.32
35 d	304.74	309.22	2.358	0.25
70 d	351.88	358.15	3.289	0.13
175 d	475.81	485.43	3.018	0.04
Cumulative daily gain, kg/d				
1 to 35 d	1.452	1.612	0.068	0.08
1 to 70 d	1.399	1.505	0.035	0.04
1 to 175 d	1.268	1.329	0.014	0.02
Cumulative DM intake, kg/d				
1 to 35 d	5.811	6.283	0.195	0.07
1 to 70 d	6.186	6.604	0.226	0.14
1 to 175 d	6.514	6.901	0.164	0.08
Cumulative gain to feed ratio				
1 to 35 d	0.250	0.257	0.007	0.37
1 to 70 d	0.226	0.228	0.006	0.87
1 to 175 d	0.195	0.193	0.004	0.57

SEM: standard error of the means.

Table 2 Effect of surgical spaying on long-term fattening on dietary energy of feedlot heifers receiving two implants during fattening

Item	Treatments		SEM	P-value
	Spayed	Intact		
Days on feed	175	175		
Pen replicates	5	5		
Cumulative observed diet NE$_{m}$, Mcal/kg				
1 to 35 d	2.25	2.22	0.036	0.46
1 to 70 d	2.21	2.17	0.054	0.51
1 to 175 d	2.27	2.23	0.037	0.27
Cumulative observed diet NE$_{g}$, Mcal/kg				
1 to 35 d	1.56	1.54	0.032	0.46
1 to 70 d	1.53	1.49	0.047	0.51
1 to 175 d	1.58	1.54	0.032	0.27
Cumulative observed-to-expected diet NE$_{m}$				
1 to 35 d	1.01	1.00	0.016	0.46
1 to 70 d	0.99	0.97	0.024	0.51
1 to 175 d	1.02	1.00	0.016	0.27
Cumulative observed-to-expected diet NE$_{g}$				
1 to 35 d	1.00	0.98	0.021	0.46
1 to 70 d	0.98	0.96	0.030	0.51
1 to 175 d	1.02	0.99	0.021	0.26
Cumulative observed-to-expected DMI				
1 to 35 d	1.00	1.01	0.013	0.45
1 to 70 d	1.02	1.04	0.027	0.51
1 to 175 d	0.98	1.00	0.019	0.27

SEM: standard error of the means.

Brownson (1994) observed that spayed heifers implanted (single implant) with a low-or- moderate potency anabolic implant had similar ADG to that of intact heifers. In contrast, Bailey *et al.* (2008), in a 42-d feedlot evaluation, report a tendency for lower ADG in spayed heifers compared to intact heifers (both implanted with a medium potency anabolic implant). Unfortunately, there has been relatively little research comparing implant programs in spayed heifers. Garber *et al.* (1990), reported that spayed heifers receiving an implant of estradiol/progesterone (Synovex S) gained significantly better ($P<0.05$) than heifers receiving an implant of estradiol/testosterone (Synovex H) during a finishing period. Additionally, Perino *et al.* (1995) observed that spayed heifers receiving estradiol or estradiol + trenbolone acetate, but not trenbolone acetate alone, had greater ADG ($P<0.05$) than non-implanted, spayed heifers. There is no recent information about the effect of spaying on performance of feedlot heifers under current implantation systems in which more than one implant is used during fattening. Our hypothesis was that in long-fed heifers, the magnitude of response to spaying heifers might be compensated when receive two anabolic implants, in which one implant is a high potency implant. However, in the present study the implanting was not sufficient to compensate for overall effects of spaying on ADG. A possible explanation is the suppression of estrus associated hormonal changes due anabolic implant containing trenbolone (Preston, 1999).

CONCLUSION

Surgically spaying heifers upon entry to the feedlot retards the rate of gain, notwithstanding application of anabolic implants during a longer-term growing finishing period. Taking in account the difference in final weight and rate of gain in SPAY heifers compared to intact heifers, spayed heifers needed 7.5 more days to achieve a final weight similar to that of intact heifers.

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