PERFORMANCE, CARCASS, AND MEAT PALATABILITY TRAITS OF OPEN AND 30-MONTH OLD HEIFERS THAT PRODUCED ONE CALF

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Summary

Eighty-seven 3/8 Simmental x 5/8 Hereford heifers calved at 2 years of age and were designated as Single-Calf-Heifers (SCH). Twenty-six heifer mates that did not calve were designated as 2-year-old open heifers (2-OH), and 22, 1 year-old open heifers (1-OH) from the same source served as controls. All heifer groups were fed a high-grain diet for 112 to 137 days before slaughter. The SCH were started on feed about 1 month after calving, and their calves were weaned early about 5 weeks prior to slaughter. Thirty-three of the SCH were implanted with Synovex-H® after calving. Carcass data were obtained, and rib steaks were collected and evaluated for palatability.

Our results indicate that it is possible to produce carcasses with desirable weights, USDA quality and yield grades, and taste panel palatability ratings from heifers that have produced one calf, and then were fed a high-grain diet and slaughtered by 30 months of age. However, ribeye steaks of SCH were not as tender as those from 1-OH. Implanting heifers that have calved may result in more "hard-boned" carcasses, but likely will increase dressing percent. Cattlemen willing to provide intensive management may find that the SCH system has considerable potential.

Introduction

During the last 40 years, heifers in the U.S. slaughter mix have nearly doubled. A unique system for managing heifers for slaughter is the Single-Calf-Heifer (SCH) system, which involves retaining surplus heifers, breeding them to produce one calf, then placing the heifers and their calves in a feedlot beginning shortly after calving.

The SCH system is very efficient because it combines reproduction and meat production into one system. This system results in a dramatically higher salvage value of the heifer, relative to mature cows, and virtually eliminates maintenance costs generally associated with traditional cow-calf operations.

Preliminary results indicated that when the traditional cow-calf system was replaced with the SCH system, estimated returns increased about 3.8 times. Also, carcasses produced from the SCH system received USDA quality and yield grades similar to those of heifers of similar ages that had not calved. Because little is known about the effects of pregnancy, parturition, and lactation on physiological maturity, meat tenderness, and other palatability traits, our objectives were to evaluate those traits from cattle produced by the SCH system.

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Experimental Procedures

One hundred and thirteen 3/8 Simmental x 5/8 Hereford heifers, born in the spring of 1985, were pasture exposed to bulls at 14 to 16 months of age. Eight-seven heifers calved at about 2 years of age and were designated as Single-Calf-Heifers (SCH); 33 were implanted (I-SCH) with Synovex-H® and 54 were not implanted (NI-SCH). Twenty-six of the 113 heifers that did not calve were designated as 2-year-old open-heifers (2-OH) and served as controls. Additionally, 22, 1-year-old open heifers (1-OH), born in the spring of 1986 from the same source, were utilized for comparitive purposes as the standard heifer-production system.

The 1-OH and 2-OH groups were fed a high-grain diet for 137 and 112 days, respectively, before slaughter. Heifers that calved were started on the same high-grain diet about 1 month after calving and were fed for 137 days. The I-SCH were implanted when started on the high-grain diet. Calves were early-weaned about 5 weeks prior to slaughter, so the heifers would dry up.

Because of the normal range in calving dates, the SCH were sorted into two groups, started on feed about 1 month apart, and consequently slaughtered in two groups about 1 month apart.

After slaughter and chilling, carcasses were evaluated for USDA yield and quality grades. Fifteen wholesale ribs were randomly selected from each treatment group and vacuum aged for 7 days. Three steaks, 1 inch thick were removed from the 10th, 11th, and 12th rib-regions. Steaks from the 10th and 11th rib region were cooked to 158 F for Warner-Bratzler shear (WBS) force determinations and trained taste panel evaluations. Steaks from the 12th rib region were utilized for total and soluble collagen measurements. Six thoracic buttons from each wholesale rib were collected and analyzed for calcium content.

Results and Discussion

Performance characteristics of treatment groups are given in Table 34.1. Feedlot average daily gains were highest ($P<.05$) for 2-OH, and no differences ($P>.05$) occurred among the other treatments. Apparently, the 2-OH were able to convert most of their energy intake above maintenance to gain, whereas I-SCH and NI-SCH had to use energy above maintenance for both gain and milk production. The advantage in gain for 2-OH over 1-OH likely was due to their larger size and greater feed capacity.

Both I-SCH and 2-OH had heavier ($P<.05$) carcasses than 1-OH; whereas, NI-SCH were intermediate in carcass weights. The NI-SCH exhibited the lowest ($P<.05$) dressing percentages (60.7%),whereas there were no differences among the other treatments (range of 62.7 to 63.7%). Single-calf-heifers had acceptable average daily gains and carcass weights when compared to 1-OH. However, we have no explanation for the low dressing percentages of our NI-SCH.

There were no differences ($P>.05$) in ribeye firmness, incidence of heat ring, USDA marbling scores, and quality grades among treatment groups (Table 34.2). As expected, 1-OH had the lightest ($P<.05$) colored ribeye, whereas there were no ribeye color differences among the other treatment groups. Except for color, visual quality traits of the ribeye from heifers that calved were equal to those of 1-OH and 2-OH.

Kidney, pelvic, and heart-fat percentages were highest ($P<.05$) for 1-OH, whereas no differences existed among the other treatments (Table 34.2). There were no differences ($P>.05$) in measured or adjusted fat thicknesses, ribeye areas, or USDA yield grades among treatment groups.

Data from Tables 34.1 and 34.2 demonstrate that carcass weights and USDA quality and yield grades were equally desirable for 2-OH, I-SCH, and NI-SCH. Therefore, having a calf had no negative effects on these traits.

The SCH had higher ($P<.05$) maturity scores than 1-OH for all eight maturity characteristics (Table 34.3). Also, I-SCH were more mature ($P<.05$) than 2-OH in five of the eight maturity characteristics. However, I-SCH did not differ ($P>.05$) from NI-SCH in any of the eight maturity characteristics. It should be noted that two of the I-SCH and one of the NI-SCH were classified as "C" bone maturity ("hard boned"), causing them to be graded "commercial" and decreasing their carcass values.

Cooking loss percentages and taste panel juiciness and flavor scores did not differ ($P>.05$) among treatment groups (Table 34.4). Tenderness scores were higher ($P<.05$) and WBS values were lower ($P<.05$) for ribeye steaks from 1-OH than from I-SCH and NI-SCH. Additionally, 1-OH had less ($P<.05$) detectable connective tissue than 2-OH. The 2-OH had lower ($P<.05$) WBS values than I-SCH, but not NI-SCH. These results indicate that the combined effects of implanting and having a calf did not decrease ribeye palatability, but increased WBS values. However, increased age increased detectable connective tissue, and the combined effects of increased age and having a calf were detrimental to all tenderness traits. Having a calf or implanting, independently, had no negative effects on taste panel tenderness.

The 1-OH heifers were superior in tenderness to SCH. However, tenderness and other palatability traits of SCH generally were equal to those of 2-OH. Therefore, the SCH system results in meat palatability comparable to that of similar-aged heifers that have not calved.

There were no differences ($P>.05$) in amount of soluble, insoluble, and total collagen or percent soluble collagen among treatment groups (Table 34.5). As expected, the 1-OH had a lower ($P<.05$) percentage of calcium in the thoracic buttons than any of the other treatment groups, which did not differ ($P>.05$) (Table 34.5).

Table 34.1. Least Squares Means for Performance Characteristics of 1-Year-Old-Open-Heifers, 2-Year-Old-Open-Heifers, and Implanted and Nonimplanted Single-Calf-Heifers

	Treatment			
Characteristics	1-OH	2-OH	I-SCH	NI-SCH
Number of Heifers	22	26	33	54
Days in Feedlot	137	112	137	137
Feedlot Gain, lb/d	2.42[a]	2.87[b]	2.21[a]	2.21[a]
Hot Carcass wt, lb	653[b]	745[c]	719[c]	703[bc]
Dressing Percent	63.7[a]	63.0[a]	62.7[a]	60.7[b]

ab($P<.05$).

Table 34.2. Least Squares Means for Qualtiy and Yield Characteristics of 1-Year-Old-Open-Heifers, 2-Year-Old-Open-Heifers, and Implanted and Nonimplanted Single-Calf-Heifers

Characteristics	Treatments			
	1-OH	2-OH	I-SCH	NI-SCH
Lean Color[a]	2.0[f]	2.6[g]	2.6[g]	2.5[g]
Lean Firmness[b]	2.6	2.8	2.5	2.6
Heat-ring Incidence[c]	1.5	1.3	1.4	1.5
USDA Marbling Score[d]	Sm^{21}	Sm^{03}	Sm^{01}	Sm^{14}
USDA Quality Grade[e]	Ch^{0}	Se^{86}	Se^{88}	Se^{88}
Fat Thickness, in.	.28	.32	.36	.36
Adjusted Fat Thickness, in.	.28	.36	.36	.44
Kidney, Pelvic and Heart Fat, %	2.9[f]	1.8[g]	1.7[g]	2.1[g]
Longissimus Area, sq. in.	14.1	14.4	14.3	14.1
USDA Yield Grade	2.0	2.0	2.0	2.2

[a]Color of lean: 2 = cherry red, 3 = slightly dark red.
[b]Firmness of lean: 2 = firm, 3 = moderately firm.
[c]Presence of heat ring (dark coarse band): 1 = none, 2 = slight.
[d]Sm = Small. Minimum Small = Sm^{00}, Maximum Small = Sm^{99}.
[e]Ch = Choice, Se = Select. High Select = Se^{50} to Se^{99}, Low Choice = Ch^{0} to Ch^{33}.
[fg]($P<.05$).

Table 34.3. Least Squares Means for Maturity Characteristics of 1-Year-Old-Open-Heifers, 2-Year-Old-Open-Heifers, and Implanted and Nonimplanted Single-Calf-Heifers

Ribeye Steak Characteristics	Treatment			
	1-OH	2-OH	I-SCH	NI-SCH
USDA Bone Maturity:				
Sacral[a]	75[b]	89[bc]	108[d]	100[cd]
Lumbar[a]	69[b]	83[bc]	101[d]	94[cd]
Thoracic[a]	64[b]	88[bc]	114[d]	99[cd]
Feather Bone[a]	80[b]	101[c]	106[c]	114[c]
Rib Bone[a]	89[b]	100[bc]	114[c]	110[c]
Overall Bone Maturity	74[b]	93[bc]	113[d]	105[cd]
USDA Lean Maturity[a]	55[b]	81[c]	87[c]	79[c]
USDA Carcass Maturity[a]	70[b]	90[c]	108[d]	98[cd]

[a]Scores based on: 0-99 = A maturity, 100-199 = B maturity, 200-299 = C maturity ("hard boned").
[bcd]($P<.05$).

Table 34.4. Least Squares Means for Sensory Traits of Longissimus Steaks from 1-Year-Old-Open-Heifers, 2-Year-Old-Open-Heifers, and Implanted and Nonimplanted Single-Calf-Heifers

Characteristics	Treatment			
	1-OH	2-OH	I-SCH	NI-SCH
Juiciness[a]	5.6	5.7	5.7	5.5
Flavor Intensity[a]	6.0	6.1	6.1	5.9
Myofibrillar Tenderness[a]	6.3[c]	5.9[cd]	5.5[d]	5.4[d]
Connective Tissue Amount[a]	7.0[c]	6.6[d]	6.5[d]	6.5[d]
Overall Tenderness[a]	6.4[c]	6.1[cd]	5.7[d]	5.6[d]
Cooking Losses, %	19.2	19.9	20.9	20.0
Shear Force, kg[b]	6.8[c]	7.3[cd]	8.6[e]	7.7[de]

[a]A score of 7 = very juicy, intense, tender, practically none and tender; 6 = moderately juicy, intense, tender, moderate amount and tender; 5 = slightly juicy, intense, tender, slight amount and tender.
[b]Warner-Bratzler shear force determinations made on 1.27 cm diameter cores.
[cde]($P<.05$).

Table 34.5. Least Squares Means for Collagen Characteristics of 1-Year-Old-Open-Heifers, 2-Year-Old-Open-Heifers, and Implanted and Nonimplanted Single-Calf-Heifers

Characteristics	Treatment			
	1-OH	2-OH	I-SCH	NI-SCH
Number of Heifers	15	15	15	15
Insoluble Collagen, mg/g	1.99	1.91	1.86	2.02
Soluble Collagen, mg/g	0.28	0.26	0.20	0.24
Total Collagen, mg/g	2.26	2.17	2.06	2.27
Soluble Collagen, %	13.53	12.47	10.15	10.91
Button Calcium, %	.52[a]	3.04[b]	3.87[b]	3.19[b]

[ab]($P<.05$).