A SURVEY COMPARING MEAT QUALITY ATTRIBUTES OF BEEF FROM CREDENCE ATTRIBUTE-BASED PRODUCTION SYSTEMS

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Two branded beef programs based on producer-defined production systems differentiated by intangible credence attributes (Organic and Natural) were compared to Commodity beef to determine meat quality and consumer acceptability. In each of four slaughter seasons (Winter, Spring, Summer and Fall) *Longissimus lumborum* muscle samples were collected from two industry slaughter plants. Samples were vacuum packaged and aged for 16 ± 2 d at 2˚C. Seasonal effects (p<0.01) were evident for mean shear force, composition, drip loss, colour and pH. A lower proportion of Organic steaks were classified as tender (shear value <5.6 kg), compared to the Natural and Commodity beef (55.9 vs. 70.3 and 78.6 %; P<0.01), indicating that even after industry normal ageing times Organic beef had higher tenderness variability. Fat content (SEM=0.23; p<0.01) was lowest for the Organic line (3.98%) with Natural (5.34%) and Commodity being intermediate (5.73%). Some statistically significant differences (p<0.05) in mean scores for aroma, juiciness, flavour, tenderness and overall acceptability of cooked beef steaks were observed when samples were not matched on the basis of intramuscular fat (IMF). Clearly there are measureable differences in quality between "credence" based production systems and commodity beef with an overall better quality in Commodity beef. However, if the consumer is willing to pay for credence-based attributes then there is opportunity to improve quality, specifically in respect to age at slaughter and content of IMF.

I. INTRODUCTION

Current trends indicate consumers are increasingly placing value on intangible quality attributes, or credence attributes, related to animal health and welfare and various features of animal production systems. Verbeke *et al.* (1) defined credence attributes as characteristics that can be neither directly perceived nor verified by consumers. In Alberta, Canada, branded beef products are enjoying retail success yet there is no information on whether this success is based on superior eating quality or on credence factors. If products branded on the basis of credence attributes could be differentiated from commodity beef, on the basis of tenderness or other quality attributes, perhaps management systems could be identified that enhance eating quality and increase consistency while simultaneously satisfying the needs of consumers seeking reassurance about animal production. The objective of this study was to examine the impact of both producer-defined production systems (commodity, natural, organic) and season of harvest (winter, spring, summer, and fall) on measurable eating quality attributes.

II. MATERIALS AND METHODS

In each of four slaughter seasons (Winter, Spring, Summer and Fall) beef strip loin, *Longissimus lumborum* muscle samples, were collected from two industry slaughter plants; Organic (22-29 months of age) n=30, 30, 27 and 31; Natural (14-23 months of age) n=30, 27, 29 and 25; Commodity1 (<30 months of age) n=12 and 18 for Spring and Summer respectively; Commodity2 (<30 months of age) n=14 and 12 for Spring and Fall respectively and held under refrigeration (2°C, wind speed 0.5m·sec-1) until 16 ± 2 d postmortem to ensure consistent product ageing. Two steaks (25 mm) were fabricated from each striploin (one designated for shear force, the other for colour and drip loss) and the remainder prepared for proximate analysis. The sample sections selected for

consumer sensory testing were thawed for 3 days at 2°C, prepared into steaks (25 mm thickness), labeled, and individually vacuum packaged. Each steak was grilled to an internal temperature of 40°C, flipped, and completed cooking to a final internal temperature of 72°C. 82 complete evaluations were collected from trained panelists who evaluated cooked samples for aroma, juiciness, flavour, tenderness, and overall acceptability using 9-point hedonic scales (1= dislike extremely, 9 = like extremely). Purchase intent was scored on a 5-point scale (1 = definitely would not purchase, 5 = definitely would purchase). Panelists were then asked to visually assess raw samples, to consider as if they were available for purchase, and to rank the samples in order of overall preference.

III. RESULTS AND DISCUSSION

Organic beef had the leanest mean fat % at 3.98 (SEM=0.23) ($p<0.01$) (Table. 1). Intramuscular fat (IMF) content can be influenced by type of feed, days on feed, and genetics on both rate of gain and the propensity of the animal to deposit marbling fat Wang *et al.* (2). Warner-Bratzler shear force was significantly ($p<0.01$) greater in the Organic system (5.53 kg) as compared to the Commodity (5.05 kg) and Natural (5.02 kg) (SEM=0.38). Increased animal age Bouton *et al.* (3) and lower IMF content, and its insulating effect during both carcass chilling and meat cooking Aalhus *et al.* (4) provides an explanation for the higher shear value of the Organic beef compared to the other treatments.

Table 1 Meat quality characteristics of beef steaks form different production systems

Meat quality characteristic	Production system						SEM	p-value
	Commodity		Natural		Organic			
	Mean	Range	Mean	Range	Mean	Range		
pH	5.66a	5.55-5.75	5.56c	5.44-5.83	5.58b	5.34-6.12	0.02	<0.01
L*	39.64	34.40-44.97	40.04	31.87-47.43	39.25	29.54-47.62	0.81	0.06
Chroma	24.51a	20.12-28.86	23.78b	18.02-26.97	24.18ab	15.00-28.82	0.20	0.04
Hue angle,°	24.72a	22.45-26.99	24.48a	20.69-27.07	24.13b	19.90-27.55	0.25	<0.01
Moisture, %	71.65b	68.92-74.06	72.00b	68.03-74.39	73.24a	67.28-75.54	0.30	<0.01
Fat, %	5.73a	2.85-9.92	5.34a	2.65-9.59	3.98b	1.76-10.52	0.23	<0.01
Protein, %	21.86	20.15-22.79	21.93	20.23-23.84	21.91	19.67-22.71	0.08	0.75
Driploss, $mg \cdot g^{-1}$	30.06b	18.18-39.47	33.39a	14.29-57.97	25.49c	10.74-48.26	2.28	<0.01
Cook loss, $mg \cdot g^{-1}$	204.51	137.05-270.49	211.86	148.70-314.86	214.65	134.66-305.60	4.20	0.23
Shear force, kg	5.05b	3.19-8.59	5.02b	2.58-9.80	5.53a	2.35-9.10	0.38	<0.01
Proportion of shears, % <5.6 kg (tender)z	78.6	-	70.3	-	55.9	-	-	<0.01

a, b, c Across a row, means followed by different letters are significantly different ($p \leq 0.05$).
z Significance tested by chi-square.

Seasonal effects on tenderness were evident. More variability was found in the spring when we can expect different ages when both short-keep and long-keep cattle come into the system. In the Summer season no differences in mean scores for aroma, juiciness, flavour, tenderness, and overall acceptability of cooked beef steaks were observed amongst the three production systems when matched on the basis of IMF. In the Fall season, when samples were not matched on the basis of IMF, the mean scores for juiciness and overall acceptability of the Natural treatment were significantly greater than those of the Organic treatment ($p \leq 0.05$) (Table 2). A difference in tenderness acceptability was observed with Natural garnering the highest score, followed by Commodity then Organic (Table 2). However, after panelists visually assessed raw samples, the Natural was less preferred most likely due to its' less intense and less red colour.

Table 2 Mean consumer product testing scores for cooked beef steaks from each production system in the Fall harvest season

Production system source	Acceptability of…[z]					Purchase intent[y]
	Aroma	Juiciness	Flavour	Tenderness	Overall	
Fall season						
Commodity source 2	6.8	6.2ab	6.2	6.3b	6.0ab	3.7b
Natural	6.6	6.7a	6.3	6.9a	6.5a	4.2a
Organic	6.6	6.0b	5.8	5.5c	5.6b	3.4b
SEM	0.1	0.2	0.2	0.2	0.2	0.1
p-value	0.56	<0.01	0.07	<0.01	<0.01	<0.01

[z] Scored on 9-point hedonic scales where 1=dislike extremely, 9=like extremely
[y] Scored on a 5-point scale where 1=definitely would not purchase, 5=definitely would purchase
a,b,c Within season and across a row, means followed by different letters are significantly different ($p \leq 0.05$)

Quality grades showed great variation by season and source (Table 3). Although a high degree of marbling can be associated with "superior" meat quality, thus playing a potential role in purchasing decisions and price Chambaz *et al.* (5), like others, this study showed sensory scores appeared to be independent of marbling scores.

Table 3 Summary of the number of striploin samples, and their quality grades, collected from each production system in each harvest season

Production System	Harvest Season	Sample Count	Quality Grade		
			A	AA	AAA
Commodity source 1	Winter	0	-	-	-
	Spring	12	-	-	12
	Summer	18	12	6	-
	Fall	0	-	-	-
	Production System total	30			
Commodity source 2	Winter	0	-	-	-
	Spring	14	-	9	5
	Summer	0	-	-	-
	Fall	12	-	-	12
	Production System total	26			
Natural	Winter	30 n/a	-	-	-
	Spring	27 n/a	-	-	-
	Summer	29	1	11	17
	Fall	25	-	9	16
	Production System total	111			
Organic	Winter	30	4	10	16
	Spring	30	3	15	12
	Summer	27	2	10	15
	Fall	31	31	-	-
	Production System total	118			
	Grand total	285	53	70	105

n/a Quality grade data not available

IV. CONCLUSIONS

Beef from the Organic production system exhibited greater variability overall and across seasons than the Commodity and Natural beef, which could be attributed to differences in the production systems affecting age at slaughter and content of IMF. Commodity beef exhibited an overall better quality in regards to proportion of steaks classified as tender, suggesting more consistency compared to Natural and Organic. However, if the consumer is willing to pay for credence-based attributes, there is opportunity for these production systems to improve the quality of their product, particularly by exploring production practices related to days on feed. The Canadian beef grading system's quality grades do not adequately represent nor predict the sensory traits that consumers desire and warrants review if credence-based beef production systems continue to capture beef market share.

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