TOWARDS IMPROVING CANADIAN B4 GRADE CLASSIFICATION FOR BEEF CARCASSES: CONSUMER SENSORY EVALUATION

Patricia L. A. Leighton[a], Zeb Pietrasik[b], Oscar Lopez-Campos[a], Argenis Rodas-González[c], Jennifer Aalhus[a], Nuria Prieto[a*]

[a] Lacombe Research and Development Centre, Agriculture and Agri-Food Canada, Lacombe, Alberta, Canada, T4L 1W1
[b] Food Processing Development Centre, Ministry of Agriculture, Forestry and Rural Economic Development, Leduc, Alberta, Canada, T9E 7C5
[c] Department of Animal Science, University of Manitoba, Winnipeg, Manitoba, Canada, R3T 2N2

[*]E-mail: nuria.prietobenavides@agr.gc.ca

Introduction: Dark-cutting beef is less visually appealing and more prone to spoilage than normal beef (Gill & Newton, 1979; Killinger et al., 2004). In Canada, dark-cutting carcasses from youthful beef (under 30 months of age) are graded as Canada B4 based on the colour of the ribeye compared to a visual colour chit (CBGA, 2010). The B4 carcasses have a reduced value of up to $1.10 per kg (Bruce, 2020) and are segregated into food service or manufacturing (Prieto et al., 2018). In contrast to the large penalties for dark cutters in Canada, in the United States dark-cutting carcasses enter the retail chain and are only penalized one quality grade based on marbling scores (for example dropping from Prime to Choice) plus an additional dark cutting discount (Prieto et al., 2018). Youthful beef carcasses in Canada with normal ribeye muscle colour are graded based on marbling score, and the marbling standards of Canada Prime, AAA, AA and A are equivalent to those of USDA Prime, Choice, Select and Standard, respectively (CBGA, 2010). Hence, if the Canadian grading system was more aligned with the USDA system (i.e., no B4 grade), then B4 grade carcasses with AAA or AA marbling would be moved to normal carcasses with AA or A marbling quality grades, respectively, to recover additional value from these carcasses. The objective of this study was to determine whether consumers would consider raw and cooked ribeye steaks from dark-cutting carcasses of different colour intensities (moderately dark B4 – B4MD or dark B4 – B4DK) to be equivalent in quality to ribeye steaks from normal (N) carcasses of a lower marbling score.

Materials and Methods: One hundred twenty left youthful beef carcass sides (60 N, 30 B4MD and 30 B4DK) were selected during 6 collection days from a commercial slaughter plant in Alberta (Canada) following colour assessment (CBGA, 2010) of the ribeye between the 12th–13th vertebrae at 48 h post mortem by certified beef graders. Within the colour groupings (N, B4MD, B4DK), marbling was subjectively assessed using USDA pictorial standards (USDA, 2016) as references to select 15 A, 30 AA (two different data sets of 15 carcasses each) and 15 AAA from N, and 15 AA and 15 AAA from each B4 grade (MD and DK). Ribeyes were then removed from the carcasses, aged (6-21 d) and frozen/thawed prior to consumer testing. After raw steaks were bloomed for 1 h at 4 °C, consumers evaluated amount of marbling, colour uniformity and intent to purchase on 5-point scales (1 = no marbling, not uniform, definitely would not purchase; 5 = extremely marbled, extremely uniform, definitely would purchase). Marbling acceptability and overall colour acceptability were assessed using 9-point hedonic scales (1 = dislike extremely, 9 = like extremely). For cooked steak evaluation, steaks were grilled to an internal temperature of 72

°C, cut into quarters and kept at 60 °C until the time of serving. Unsalted crackers and room temperature water were provided to consumers for palate cleansing. Consumers evaluated appearance, tenderness, juiciness, flavour, and overall acceptability of the cooked steak samples using 9-point hedonic scales (1 = dislike extremely, 9 = like extremely), as well as intent to purchase on a 5-point scale (1 = definitely would not purchase, 5 = definitely would purchase). The effects of colour and marbling grade on raw and cooked steak consumer evaluations were determined by one-way analysis of variance (ANOVA), using the MIXED procedure in the Statistical Analysis Software (SAS) system (Version 9.4, SAS Institute Inc., Cary, NC). Treatment (i.e., colour/marbling level combinations) was used as the main effect, and consumer, day, consumer (day), animal, steak (animal) and ageing time were used as random effects.

Results: Raw steaks from NAA carcasses received significantly lower scores for amount of marbling than all AAA grade steak groups, and the B4DKAAA steaks had the greatest amount of perceived marbling ($P < 0.05$; Table 1). Similarly, NA samples had significantly less marbling than the steaks from all AA grade groups ($P < 0.05$; Table 2). The B4(MD/DK)AAA and B4(MD/DK)AA were perceived as having similar marbling acceptability and colour uniformity as NAA and NA steaks, respectively ($P > 0.1$; Tables 1-2). Colour acceptability scores were similar for B4MDAAA and B4MDAA compared to N steaks of a lower quality grade/marbling score ($P > 0.1$; Tables 1 and 2), but tended to be lower for B4DKAA steaks compared to NA steaks ($P = 0.08$; Table 2) and were significantly lower for B4DKAAA than NAA steaks ($P < 0.05$; Table 1). These differences in results could be due to the fact that the higher marbling in AAA and AA steaks produces greater contrast with the lean colour than in AA and A steaks, respectively, making the dark lean colour in B4DKAAA and B4DKAA more noticeable to consumers. Purchase intents of B4MDAAA and B4(MD/DK)AA were similar to those of NAA and NA steaks, respectively ($P > 0.1$; Tables 1-2); however, purchase intent was lower for B4DKAAA than for NAA steaks ($P < 0.05$; Table 1), probably due to the darker colour and higher amount of perceived marbling in B4DKAAA steaks.

The cooked B4MDAAA and B4(MD/DK)AA steaks were comparable to NAA and NA steaks, respectively, for appearance, tenderness, juiciness, flavour, overall acceptability and purchase intent ($P > 0.1$; Tables 1-2). The B4DKAAA were similar ($P > 0.1$) in cooked appearance, flavour and overall acceptability but higher in tenderness and juiciness than NAA steaks ($P < 0.05$; Table 1), likely due to higher marbling, pH (6.14 vs. 5.58) and water holding capacity (Prieto et al., 2018). Despite the higher tenderness and juiciness acceptability reported for B4DKAAA compared to NAA, purchase intent scores were similar ($P > 0.1$) between steaks from both groups (Table 1).

Conclusion: Based on the consumer ratings in this study, B4MDAAA and B4(MD/DK)AA carcasses could potentially be downgraded one marbling quality grade to receive similar grades as NAA and NA carcasses, respectively. Despite equivalent (or better) eating quality of B4DKAAA compared to NAA steaks, raw appearance would negatively impact consumer purchase decisions. Therefore, there is merit for continuing a segregated B4DKAAA grade. Consumer education could increase acceptance and purchase intent for B4DKAAA meat. There may also be an opportunity to direct darker coloured beef to the food service industry, where consumers do not evaluate raw appearance of steaks like they do in retail stores. Further, packaging strategies to mitigate colour differences at retail and extend shelf-life may have future merit in reducing the visual impact of B4DKAAA.

References:

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Table 1. Hedonic scores of the raw steak appearance, cooked steak attributes and purchase intents from moderate and dark B4AAA and normal beef with AAA and AA marbling levels.

Attribute	Carcass colour and marbling				SEM	*P*-value
	Normal AAA	Normal AA	B4 Moderate AAA	B4 Dark AAA		
RAW STEAK APPEARANCE EVALUATION						
Amount of marbling[1]	2.9[c]	2.4[d]	3.3[b]	3.7[a]	0.08	<0.01
Marbling acceptability[2]	6.3	6.2	6.4	6.0	0.16	0.40
Colour uniformity[3]	3.6	3.7	3.6	3.4	0.08	0.21
Colour acceptability[2]	6.8[a]	6.7[a]	6.7[a]	5.9[b]	0.16	<0.01
Purchase intent[4]	3.6[a]	3.7[a]	3.5[a]	3.1[b]	0.13	<0.01
COOKED STEAK EVALUATION						
Appearance acceptability[2]	6.5	6.3	6.4	6.4	0.18	0.80
Tenderness acceptability[2]	6.7[a]	5.9[b]	5.4[b]	6.8[a]	0.19	<0.01
Juiciness acceptability[2]	6.7[a]	5.8[b]	5.9[b]	6.7[a]	0.18	<0.01
Flavour acceptability[2]	6.7[a]	6.3[ab]	5.7[b]	6.2[ab]	0.16	<0.01
Overall acceptability[2]	6.7[a]	5.9[bc]	5.5[c]	6.4[ab]	0.18	<0.01
Purchase intent[4]	3.6[a]	3.2[bc]	2.9[c]	3.4[ab]	0.17	<0.01

[1] Amount of marbling: 1=no marbling, 2=slightly marbled, 3=moderately marbled, 4=very marbled, 5=extremely marbled.
[2] Acceptability attributes: 1=dislike extremely, 2=dislike very much, 3= dislike moderately, 4=dislike slightly, 5=neither like/dislike, 6=like slightly, 7=like moderately, 8=like very much, 9=like extremely.
[3] Colour uniformity: 1=not uniform, 2=slightly uniform, 3=moderately uniform, 4=very uniform, 5=extremely uniform.
[4] Purchase intent: 1=definitely would not purchase, 2= probably would not purchase, 3= might/might not purchase, 4= probably would purchase, 5=definitely would purchase.
Different letters (a-d) within rows indicate significant differences ($P < 0.05$). sem: standard error of least square means.

Table 2. Hedonic scores of the raw steak appearance, cooked steak attributes and purchase intents from moderate and dark B4AA and normal beef with AA and A marbling levels.

Attribute	Carcass colour and marbling				SEM	*P*-value
	Normal AA	Normal A	B4 Moderate AA	B4 Dark AA		
RAW STEAK APPEARANCE EVALUATION						
Amount of marbling[1]	2.9[a]	2.4[b]	3.0[a]	3.1[a]	0.09	<0.01
Marbling acceptability[2]	6.0	5.9	5.9	6.1	0.17	0.68
Colour uniformity[3]	3.3	3.6	3.5	3.5	0.13	0.17
Colour acceptability[2]	6.3	6.3	6.3	5.7	0.19	0.08
Purchase intent[4]	3.4	3.5	3.3	3.2	0.14	0.29
COOKED STEAK EVALUATION						
Appearance acceptability[2]	6.5	6.1	6.6	6.3	0.20	0.11
Tenderness acceptability[2]	6.9[a]	6.3[ab]	5.6[b]	5.6[b]	0.20	<0.01
Juiciness acceptability[2]	6.5[a]	5.6[b]	5.8[b]	6.0[ab]	0.19	<0.01
Flavour acceptability[2]	6.2[a]	5.4[b]	5.7[ab]	5.8[ab]	0.18	<0.01
Overall acceptability[2]	6.5[a]	5.6[b]	5.6[b]	5.6[b]	0.19	<0.01
Purchase intent[4]	3.6[a]	3.0[b]	3.0[b]	3.0[b]	0.17	<0.01

[1] Amount of marbling: 1=no marbling, 2=slightly marbled, 3=moderately marbled, 4=very marbled, 5=extremely marbled.
[2] Acceptability attributes: 1=dislike extremely, 2=dislike very much, 3=dislike moderately, 4=dislike slightly, 5=neither like/dislike, 6=like slightly, 7=like moderately, 8=like very much, 9=like extremely.
[3] Colour uniformity: 1=not uniform, 2=slightly uniform, 3=moderately uniform, 4=very uniform, 5=extremely uniform.
[4] Purchase intent: 1=definitely would not purchase, 2=probably would not purchase, 3=might/might not purchase, 4=probably would purchase, 5=definitely would purchase.
Different letters (a-b) within rows indicate significant differences ($P < 0.05$). sem: standard error of least square means.