Beef palatability and volatile compounds from barley, corn and blended grain-fed cattle: a qualitative approach

Wilson Barragán-Hernández[1], Michael E.R. Dugan[2], Jennifer Aalhus[2], Gregory Penner[3], Payam Vahmani[4], Oscar Lopez-Campos[2], Manuel Juarez[2], Jose Segura[2], Liliana Mahecha-Ledesma[5], Nuria Prieto[2]

[1] AGROSAVIA. El Nus Research Centre, Antioquia, Colombia
[2] Agriculture and Agri-Food Canada, Lacombe Research and Development Centre, Lacombe, Canada
[3] College of Agriculture and Bioresources, University of Saskatchewan, Saskatoon, Canada
[4] Department of Animal Science, University of California, Davis, United States
[5] Faculty of Agricultural Sciences, University of Antioquia, Medellín, Colombia

Introduction: Finishing cattle on barley grain-based diets is the norm on the Canadian prairies [1]; however, corn grain finishing is growing due to development of new varieties adapted to low-luminosity and low-temperature conditions [2]. Additionally, barley and corn blended diets have been proposed to support least cost ration formulation, and take advantage of greater rates of starch bypass from the rumen, which could improve energetic efficiency and marbling fat [3,4]. Nevertheless, there is some controversy over effects of grain type fed on flavour and their association with volatile profiles [5-7], and no data are available for comparing meat from barley, corn, and blended grain-fed cattle. The objective of this study was to evaluate the effect of feeding barley, corn and a barley/corn blend on beef palatability and volatile compounds.

Material and methods: Bone-in ribeyes (6th-12th ribs) from barley (n=29), corn (n=27) and blended (50:50; n=29) grain-fed steers were collected and aged for 15 d at 2°C. After ageing, four 25-mm steaks (8th-12th ribs) were fabricated from each ribeye and assigned for analyses: 1) fatty acids using gas chromatography; 2) volatile compounds using a stir bar sorptive extraction coupled with thermal desorption-gas chromatography-mass spectrometry; 3 and 4) flavour profile and descriptive sensory attributes performed by a 9-member trained sensory panel. Flavour and volatile profiles were categorized as presence/absence and descriptive sensory attributes as negative/positive, and a Multiple Correspondence Analysis (MCA) was performed using the software R-Project. Fatty acid data were conducted using the SAS MIXED procedure.

Results: The MCA (Dim 1 and 2, 53%) separated meat from pure and blended grain-fed cattle. Meat from blended grain-fed cattle was linked to volatile compounds such as (E, E)-2,4-decadienal, hexanal, 1-octen-3-ol, fat-like and rancid flavours, stale-cardboard, metallic, cruciferous, and fat-like aroma descriptors, and negative categories for flavour intensity (FI), off-flavour, and tenderness. A possible combination of linoleic and linolenic acids in the blended diet, lower rumen pH and incomplete biohydrogenation of blended grain-fed polyunsaturates could have increased ($P \leq 0.05$) long chain n-6 fatty acids (LCFA) in meat from blended grain-fed cattle, leading to accumulation of oxidation products. The Dim 3 (8.9%) discriminated meat from corn and barley grain-fed cattle. Meat from barley grain-fed cattle was mainly linked to alkanes and beef positive FI, whereas meat from corn grain-fed cattle was associated with pyrazines in addition to aldehydes related to n-6 LCFA oxidation, and stale-cardboard aroma.

Conclusion: Use of MCA was able to separate meat from barley, corn, and blended grain-fed cattle, the latter being linked to some aldehydes and alcohols from polyunsaturated fatty acid oxidation, undesirable aromas and flavour descriptors, and negative categories for descriptive sensory traits. Meat from barley grain-fed cattle showed better flavour/volatile profiles. Even though feeding blended grain diets may at times be economically feasible, the interaction between grain-fed types leading to oxidative instability may be an unanticipated outcome, and thus deserves further attention.

Acknowledgements and Financial support statement:

Acknowledgments: G. Penner thanks Jordan Johnson, Britney Sutherland and Teresa Binetruy for their assistance in live animal husbandry. AAFC-Lacombe authors thank Mr. Chuck Pimm and the meat processing staff, as well as Ms. Ivy Larsen and the meat technical team for their assistance in meat processing, laboratory analyses and statistical analyses of the data. All authors thank Mr. Ryan Clisdell, Cargill Meat Solutions for tracking the cattle lot and in-plant rib-eye collection.

Funding: The production study was funded by the Saskatchewan Barley Development Commission (Saskatoon, SK, Canada), DuPont Pioneer, the Saskatchewan Cattleman's Association, and the Saskatchewan Ministry of Agriculture and the Canada-Saskatchewan Growing Forward 2.

Literature:

[1] Johnson, J. A., Sutherland, B. D., Mckinnon, J. J., Mcallister, T. A., & Penner, G. B. (2019). Use of barley or corn silage when fed with barley, corn, or a blend of barley and corn on growth performance, nutrient utilization, and carcass characteristics of finishing beef cattle. Translational Animal Science, 4(1), 129–140.

[2] Lardner, H. A., Pearce, L., & Damiran, D. (2017). Evaluation of low heat unit corn hybrids compared to barley for forage yield and quality on the Canadian prairies. Sustainable Agriculture Research, 6, 90–102.

[3] Humer, E., & Zebeli, Q. (2017). Grains in ruminant feeding and potentials to enhance their nutritive and health value by chemical processing. Animal Feed Science and Technology, 226, 133–151.

[4] Nikkhah, A. (2012). Barley grain for ruminants: A global treasure or tragedy. Journal of Animal Science and Biotechnology, 3(1), 1–9.
[5] O'Quinn, T. G., Woerner, D. R., Engle, T. E., Chapman, P. L., Legako, J. F., Brooks, J. C., Belk, K. E., & Tatum, J. D. (2016). Identifying consumer preferences for specific beef flavor characteristics in relation to cattle production and postmortem processing parameters. Meat Science, 112, 90–102.
[6] Jeremiah, L. E., Beauchemin, K. A., Jones, S. D. M. M., Gibson, L. L., & Rode, L. M. %J C. journal of animal science. (1998). The influence of dietary cereal grain source and feed enzymes on the cooking properties and palatability attributes of beef. Canadian Journal of Animal Science, 78(3), 271–275.
[7] McEwen, P. L., Mandell, I. B., Brien, G., & Campbell, C. P. (2007). Effects of grain source, silage level, and slaughter weight endpoint on growth performance, carcass characteristics, and meat quality in Angus and Charolais steers. Canadian Journal of Animal Science, 87, 167–180.