Project number: 6427
Funding source: DAFM (Stimulus Fund)
Date: January, 2020
Project dates: Nov 2012-Sept 2018

Profitable production of bull beef to market specification while ensuring optimum quality for the consumer

Key external stakeholders:
Beef farmers, beef processors, ICBF, Bord Bia, Teagasc advisory service, agri-consultants, scientific community.

Practical implications for stakeholders:
A wide range of suckler and dairy origin bull production systems and the associated effects on meat quality were examined. The main implications are:

- Grazing can have a significant role in bull beef production.
- Market specifications based on age/weight or carcass fatness are not supported by major differences in eating quality

Main results:

- Spring-born, early- and late-maturing breed suckler bulls produced from pasture at under-16 months of age are unlikely to meet market-specific carcass fat cover (2+) even with moderate concentrate supplementation.
- The carcass fat target is achievable from well-managed pasture at ca. 19-20 months of age without concentrate supplementation for early-maturing breed suckler bulls, and with moderate levels of concentrate supplementation for late-maturing breed suckler bulls.
- Within dairy (Holstein–Friesian) bull production, the 19 month old, grass-based system was generally the most profitable but achieving carcass weight and fat cover specifications at 16 months of age was challenging.
- There is little commercially important difference in tenderness or overall liking of striploins from continental breed suckler bulls slaughtered between 15 and 22 months of age or from dairy bulls slaughtered at 16, 19 or 21 months of age.
- At a similar intramuscular fat concentration, there is little influence of breed type or gender (bulls vs. steers) on the eating quality of beef.

Opportunity / Benefit:

A wide range of systems has been developed to enable producers of bulls to meet current market-specific targets. The data generated facilitates examination of the relevance of meat quality to current market specifications based on age and carcass fatness.

Collaborating Institutions:

University College Dublin (UCD)
University College Cork (UCC)
Institut National de la Recherche Agronomique (INRA)
Irish Cattle Breeding Federation (ICBF)

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1. Project background:

Approximately 910,000 male cattle are slaughtered annually in Ireland. The majority of these animals are castrated and "steers" is perceived to be a unique selling point for Irish beef particularly in European markets where bull beef production predominates. The superior growth and feed conversion efficiency of bulls compared to steers however make bulls attractive to producers. The proportion of the male slaughter represented by young bulls varies from year to year (e.g 13% in 2008, 22% in 2017 and 23% in 2018 (Department of Agriculture, Food and the Marine, Beef carcass classification and price reporting section, Annual Report, 2018)). Traditionally, bulls were reared indoors on a high energy ration which is a relatively expensive production system. Exploiting grazing is one strategy to decrease the cost of production but meeting the abattoir specifications of animal age and carcass fat score and weight is likely to be a challenge. This large, multi-institutional project addressed novel production systems for bulls, the impact on beef quality and whether current abattoir specifications are valid from a meat quality perspective. The over-arching tasks concerned the modification of production systems for sucker and dairy-origin bull beef to increase profitability and the assessment of the resulting beef for market-relevant quality characteristics and environmental impact. Underpinning research tasks focused on elements from "farm to fork" that limit achievement of market specifications. Since carcass fat score is a key market specification, the underlying biology of fat deposition was explored while beef colour, eating quality and shelf-life were comprehensively measured.

2. Questions addressed by the project:

- What is the impact of slaughter age and castration, the duration at pasture prior to slaughter, the need for concentrate supplementation at pasture, the maturity/breed (suckler bulls) and the interaction with carcass intervention strategies on performance and the quality of meat from bulls?

3. The experimental studies:

Bull beef production systems, ranging from high-concentrate diets offered indoors with animals finished at 15 months of age to a grass-only diet and animals finished at ca. 19 months of age were examined. Within selected studies, carcass characteristics and colour together with meat quality variables were examined. The financial and environmental effects of the modified production systems were also assessed.

Main results:

Suckler origin bulls and steers

- When finished from pasture at the same age, ca. 19 months, carcasses from spring-born, suckler–bred early-maturing breeds were lighter, fatter, and had poorer conformation than late-maturing breeds; bulls had greater growth, live weight, better kill-out proportion, a heavier carcass, better carcass conformation score and a lower carcass fat score than steers.
- Early-maturing breed steers were adequately 'finished' at 19-20 months of age from unsupplemented pasture in all experiments, whereas late-maturing breed steers were finished in some but not other experiments likely due to inclement, weather-related, grazing conditions.
- Concentrate supplementation during the latter half of the grazing season (i.e. ca. 4.0-5.0 kg daily for 75-95 days) is a possible strategy for finishing late-maturing breed suckler steers from grass at ca. 19-20 months.
- Compared to late-maturing breed steers, carcasses from late-maturing breed bulls were only adequately finished at 19 months of age when supplemented with concentrates (i.e. ca. 4.0kg daily for 95 days).
- Carcasses of early-maturing breed bulls slaughtered at 19 months of age from pasture were lighter

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but adequately finished, with or without concentrate supplementation during the latter half of the grazing season (i.e. ca. 4.0kg daily for 95 days), whereas the heavier, late-maturing breed bull carcasses were only adequately finished when supplemented.
- Carcasses of both early-and late-maturing breed suckler bulls were inadequately finished from pasture, with or without concentrate supplementation at 15 months of age.
- There was some evidence that production system *per se* may have a small negative effect on eating quality. When suckler bulls from early or late maturing breed sires were slaughtered at 380 kg carcass from an *ad libitum* concentrate diet or grazed prior to finishing on an *ad libitum* concentrate diet, the tenderness rating by trained assessors was lower for the grass-based system. The scale of this decrease is unlikely to be detected by untrained consumers.
- Continental breed-sired bulls and steers were compared within 2 production systems; the striploin from steers was fatter and rated more highly for tenderness and acceptability than the striploin from bulls. The absolute differences in eating quality were however, small.

Dairy origin bulls

- Achieving market specifications is challenging for bulls slaughtered under16 months of age and the profitability of this system is particularly vulnerable to increases in concentrate costs.
- The most profitable production system was finishing as 19 month bulls with supplementation in the final100 days at pasture. However, the possibility of a price discount due to the animals being older than the 16 months currently required in many markets needs to be considered.

General findings

- Finishing both dairy beef and suckler beef offspring at younger ages reduced the greenhouse gas emissions of the system.
- There is little commercially important difference in tenderness or overall liking of striploins from continental breed sired suckler bulls slaughtered between 15 and 22 months of age or from dairy bulls slaughtered at 16, 19 or 21 months of age.

4. Opportunity/Benefit:

A wide range of systems has been developed to enable producers of bulls to meet current market-specific targets. The data generated facilitates examination of the relevance of meat quality to current market specifications based on age/weight and carcass fatness.

5. Dissemination:

M.Agr.Sc. theses (2), Phd theses (4), diverse visiting groups to Grange/Ashtown; Beef Advisory Newsletters; Beef Open days (Grange, 2016, 2018); Project stakeholder advisory group; diverse scientific conferences.

Main publications:

Moran, L., O'Sullivan, M.G., Kerry, J.P., Picard, B., McGee, M., O'Riordan, E.G. and Moloney, A.P. (2017). 'Effect of a grazing period prior to finishing on a high concentrate diet on meat quality from bulls and steers' *Meat Science*, 125: 76-83.

Murphy, B., Crosson, P., Kelly, A.K. and Prendiville, R. (2018).'Performance, profitability and greenhouse gas emissions of alternative finishing strategies for Holstein-FrIesian bulls and steers' *Animal*, 12, 2391-2400.

Mezgebo, G.B., Monahan, F.J., McGee, M., O'Riordan, E.G., Marren, D., Listrat, A., Picard, B., Richardson, R.I. and Moloney, A.P. (2019). 'Extending the grazing period for bulls, prior to finishing on a concentrate ration: Composition, collagen structure and organoleptic characteristics of beef' *Foods,* 8, 278.

Popular publications:

Prendiville, R. and Murphy, B. (2016). 'Alternative finishing strategies for dairy calf to beef systems' *Teagasc National Beef Conference*, pages 6-10.

Prendiville, R., Murphy, B., Swan, B. and Crosson, P. (2016) 'Male dairy calf to beef systems' *TResearch* 11 (2), 26-27.

Moloney, A.P., McGee, M., O'Riordan, E.G and Prendiville, R. (2018) 'Innovative bull production systems and beef quality' *TResearch* 13 (4), 20-21.

Moloney, A., McGee, M., O'Riordan, E., O'Sullivan, E. and Kerry, J. (2018) 'On-farm influences on the eating quality of beef'. In: *BEEF 2018*, '€nhancing Knowledge', Tuesday, 26th June 2018, Teagasc, Grange, Dunsany, Co. Meath, p164-167. Eds. M. McGee and A. Moloney, ISBN: 978-1-84170-646-7.

6. Compiled by:

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