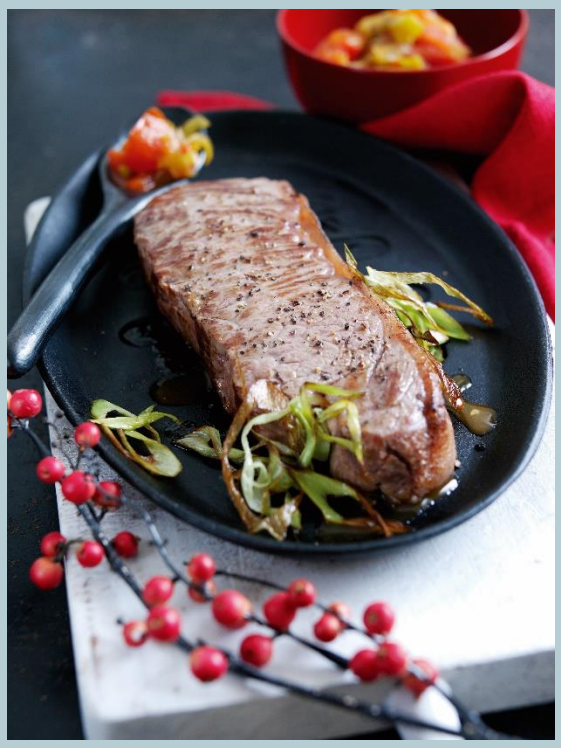
Celtica beef eating quality grading pilot

Aim

A beef eating quality grading pilot study was implemented at Celtica Foods Ltd to provide the broader meat processing industry with insight as to how the BeefQ beef eating quality grading system could be implemented in practice.



Approach

Between November 2021 and October 2022, data, including UNECE[1] carcase eating quality (EQ) assessments, EUROP classification and cattle information such as passport age and breed were collected from 296 cattle on 9 kill dates. Cattle were assessed by an accredited eating quality grader.

Results

Sample characteristics

29 different cattle breed descriptions, the majority representing cross breed combinations, were identified in the sample of 296 cattle, this illustrates the wide range that exists across cattle supply. However, 77% are represented by 6 main breed descriptions (Table 1). These 6 by themselves represent British and European breed types, and most likely, crosses with dairy breeds, creating a significant number of combinations with potential to interact with carcase yield and eating quality.

Table 1 Celtica breed distribution

Breed	Number	%
Limousin Cross	71	24%
British Blue Cross	55	19%
Hereford Cross	33	11%
Charolais Cross	31	10%
Aberdeen Angus Cross	26	9%
Simmental Cross	12	4%
Other (23 breeds/crosses)	68	23%

Within the population of cattle assessed, only 12% were purely dairy breed type but it is assumed that a sizeable additional number may be from dairy breed dams. Table 2 shows

[1] UNECE provides international standards for meat assessment variables UNECE Standards for Meat | UNECE

a majority (63%) were heifers, a similar pattern to the BeefQ survey conducted in 2018 (Nicholas-Davies *et al.*, 2022).

Table 2 Celtica breed type distribution

	Heifer	Steer	Total
Beef	187	74	261
Dairy	17	18	35
Total	204	92	296

The steers were slightly heavier than the heifers and the dairy steers were lighter than the beef steers (Table 3). Heifers were represented at both extremes of carcase weight and exhibited a much larger distribution than steers, possibly reflecting the greater numbers or a very broad description of heifer in relation to age, breed type or finish.

Table 3 Celtica carcase weight (kg) x sex

	Heifer (N=204)	Steer (N=92)	Overall (N=296)
Mean (SD)	311 (33.8)	322 (29.6)	314 (32.9)
Median [Min,Max]	311 [228,401]	320 [233,382]	314 [228,401]

The scoring of ossification (or maturity) provides a scale for the assessment of physiological age of a bovine animal. Measurements are recorded in increments of 10 with the lowest being 100 and the highest being 590. The mean ossification and age are greater for the heifers, with the heifer ossification more extreme than in the steers (Table 4). Age is also more widely distributed in the heifers, but less extreme than for ossification.

Table 4 Celtica ossification (Uoss) and animal age (days) by sex

	Heifer (N=204)	Steer (N=92)	Overall (N=296)
Uoss			
Mean (SD)	206 (43.4)	152 (22.9)	189 (45.5)
Median [Min,Max]	190 [140, 400]	140 [120, 230]	190 [120, 400]
Days age			
Mean (SD)	876 (211)	861 (187)	871 (204)
Median [Min,Max]	822 [395, 1400]	828 [487, 1420]	822 [395, 1420]

While the average age for both heifers and steers was 28 months the steers had lower ossification on average (150 against 200 for heifers). A previous BeefQ cattle survey (Nicholas-Davies *et al.*, 2022) showed a similar large sex effect on ossification development across the cattle population. Compared to the previous survey, Celtica cattle are approximately 80 days older at slaughter, and this is reflected in the slightly higher ossification scores observed. This higher ossification score (which tends to have a negative impact on EQ), is offset by higher marbling scores (see below, Figure 2) in the Celtica cattle.

Rib fat depth at the 10th rib quartering site was recorded. In Australia, a minimum of 3mm is required for a carcase to be Meat Standards Australia (MSA) graded, primarily to reduce internal muscle temperature variation (leading to "two toning" during chilling). The rib fat depth is also considered in the eating quality predictive model in conjunction with marbling score.

Table 5 shows a wide distribution in rib fat depth within the two sex categories. Within the overall population of cattle at Celtica, 19 cattle are below 3mm rib fat, which means

that 6% of carcasses would be outside of the MSA eating quality grading specifications.

Table 5 Celtica rib fat (mm) distribution within cattle type

	Heifer (N=204)	Steer (N=92)	Overall (N=296)
Mean (SD)	9.75 (5.00)	7.50 (4.38)	9.05 (4.92)
Median [Min,Max]	9.50 [0, 36.0]	7.00 [0, 28.0]	8.00 [0, 36.0]

Figure 1 below displays the rib fat depth across EUROP fat classes within the sex categories illustrating reasonable correlation with EUROP fat score. However, the correlation tested between the rib fat depth and the European fat class is 0.58 which is not significant, therefore EUROP fat class is not a suitable substitute variable for rib fat depth in eating quality prediction.

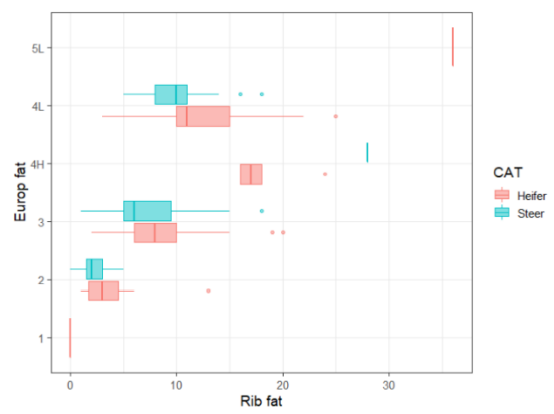


Figure 1 Rib fat depth (mm) across EUROP fat classes within the sex categories

The distribution of marbling scores is presented in Figure 2. Both steers (M) and heifers (F) encompass a considerable and overlapping range of marbling values with a wider distribution for the heifers including several very high values above those recorded for the steer population. These outlier high values were recorded within the beef bred heifers although in general the dairy bred heifers were more different to their steer counterparts than the beef breeds.

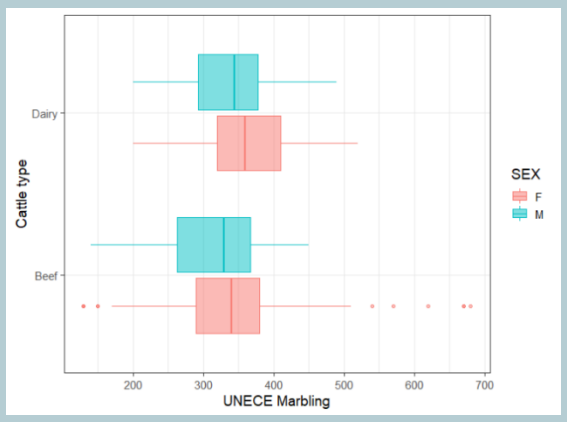


Figure 2 Marbling score across cattle type and sex

The marbling observation distribution is similar but somewhat higher than BeefQ population survey (Nicholas-Davies *et al.*, 2022) where the marbling score average was closer to 300 depending on the season.

Figure 3 displays the ossification score related to the marbling score. The red ring represents grouping for a potential entry level brand where lower marbling and higher ossification align. It is seen that the high outlier marbling values noted in Figure 2 relate to more mature beef females. The blue ring represents suitable relationships for a premium brand related to eating quality. The cut offs could be adjusted to align supply with the proportion and quality level desired within alternative brand categories with commensurate the price differentials.

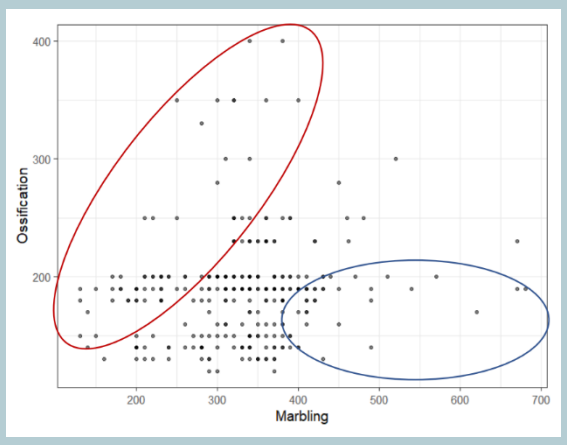


Figure 3 Ossification score in relation to marbling score

Eating Quality Index

The prediction model approach that will support the Celtica program, groups individual cuts within pre-determined eating quality-based settings that support alternative brands for marketing (e.g., good every day, better than every day and premium). This will provide very clear and valuable knowledge to Celtica customers who will be able to select brands that provide a best fit to their price by occasion value points.

As individual cut relationships differ within each carcase, however, the mix of brand/quality will vary across each carcase and its' source animal.

To provide a simple "animal value rating" an index that in effect weights individual cut weight by brand is proposed. Table 6 provides an indicative example related to a standard cut yield with the percentage of each individual muscle weight, relative to total meat yield, multiplied by the eating quality score for that muscle after assigning a standard cooking method to each.

Table 6. Celtica indicative carcase Eating Quality Index score

	Heifer (N=204)	Steer (N=92)	Overall (N=296)
Mean (SD)	57.9 (2.00)	59.7 (1.92)	58.5 (2.13)
Median [Min,Max]	57.9 [52.8, 64.7]	59.8 [52.6, 63.7]	58.6 [52.6, 64.7]

The Index and associated grading inputs including carcase weight, sex, fat depth, marbling, ossification and pH could be provided as valuable "feedback" to supplying farmers to enable animal assessment and to identify changes that could increase Index and carcase value to Celtica. Examples include use of a higher marbling sire, reduction in ossification by reducing age at slaughter, reducing stress to avoid high pH or increasing carcase weight at constant age by adjusting feed programs.

The basis for this Index calculation must be further refined as the branding strategy and value relationships are developed. If yields are sufficiently correlated with EUROP muscle and fat scores, or a more refined yield estimate, the Index could be developed further into a true carcase value estimate reflecting both yield and eating quality.

In turn, after evaluation of the supply and value differentials, a transparent Value Based Pricing (VBP) structure could be trialled as a prospective livestock payment system. In principle this is a highly beneficial approach that could accurately align farmer payment with factory value derived from an accurate consumer driven value.

In Australia, an MSA index score is communicated to all cattle suppliers through mandatory individual animal feedback reports from the slaughterhouses. This system is widely used to guide future management and breeding decisions as it is closely related to pricing structures.

Cost of implementation for Celtica pilot

The costs incurred in implementing the Celtica pilot fell into 3 categories: grader training, standard grading equipment and access to the EQ prediction model. EQ grader training, chiller assessment standard equipment and EQ prediction models and data can all be accessed via the International Meat Research 3G Foundation (IMR3GF). The IMR3GF is a collaborative, independent, not-for-profit foundation in the eating quality research field. It is linked to the United Nations Economic Commission for Europe (UNECE) Specialized Section on Meat.

One employee of Celtica is undergoing EQ chiller assessment training. This employee has been working alongside the external EQ grader who is contracted to collect the data for the pilot. The Celtica employee will in due course complete the IMR3GF training course to become a fully qualified EQ grader. Once qualified, the Celtica employee will need to re-validate their grading every 8 weeks and this is undertaken using the OsCap system. Staff costs in terms of time spent training to become a grader are not included here (Table 7) but should be considered.

To maintain integrity and data compatibility within the IMR3GF DATAbank the IMR3GF Chiller Assessment Standards may only be used by accredited personnel who have successfully completed an IMR3GF chiller assessment course and are current at the time of assessment requiring correlation on the OsCap system (Figure 4) within the previous 8 weeks.

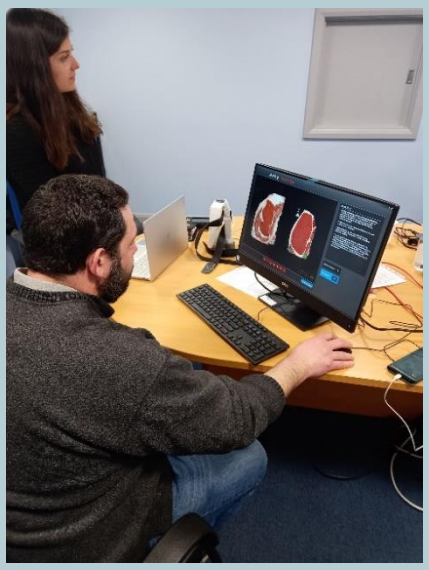


Figure 4. OsCap machine for EQ grader training

The chiller assessment standards themselves consist of an eye muscle area grid, fat and muscle colour chips (Figure 5), marbling and ossification cards and a torch, battery pack and charger. Additional equipment includes a pH/temperature meter for measuring carcase pH decline in the abattoir post slaughter.

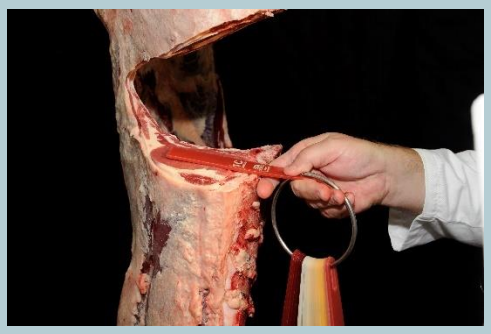


Figure 5. Muscle colour chips for EQ grading

For the purposes of the Celtica case study there was no charge to access the IMR3GF DATAbank to facilitate eating quality prediction as this is a research case study and the BeefQ project has contributed data to the DATAbank. However, if access was required for commercial EQ prediction, then a charge of approximately £0.90/head would be incurred, this is included in the indicative costs in Table 7.

Table 7. Estimate of EQ grading cost to Celtica for pilot

Item	Description	Cost
Grader Training	IMR3GF grader training course	£3050
	OsCap machine delivery and set up	£1050
	OsCap lease (£350/month for 12 months)	£4200
	Qualified grader training input – 0.5 days @ £450/day per grading session (9 kill dates)	£2025
Carcase EQ Grader	0.5 days @ £450/day x 9 kill dates (averaging 33 head/kill date)	£2025
Grading Standards	IMR3GF standard equipment: Eye muscle area grid, fat and muscle colour chips, marbling standard, ossification standard, torch, battery and charger.	£530
	pH/temperature meter	£650
DATAbank access	For EQ prediction – 296 cattle @ £0.90/head	£267
Total		£11,772

Conclusions

The Celtica case study has not only provided detailed data on the range and eating quality potential of cattle sourced by the company but has also provided extremely useful insights into the practicalities and costs associated with implementing eating quality prediction in the business. The prediction model approach that will support the Celtica program will group individual cuts within pre-determined eating quality-based settings that support alternative brands for marketing (e.g., good every day, better than every day and premium). This will provide very clear and valuable knowledge to Celtica customers who will be able to select brands that provide a best fit to their price by occasion value points

Moving forward after the BeefQ project, Celtica intend to continue EQ grading cattle until at least March 2023 during which time they will ensure one member of staff becomes fully qualified to EQ grade cattle. This will provide them with in house capacity to continue EQ grading long term with the aims being to provide feedback to producers on how eating quality consistency can be improved, implement practices in product processing that can improve the eating quality of individual cuts, and ultimately offer eating quality differentiated project to its customers.

References:

Nicholas-Davies, P., Polkinghorne, R., Neveu, A., Cuthbertson, H., Wenyang J., Perkins, L. & N. Scollan (2022) BeefQ – Beef Eating Quality 2018-2022 Final Report. Available at: www.beefq.wales

Authors:

Phillipa Nicholas-Davies
Department of Life Sciences
Aberystwyth University,
Aberystwyth, Wales, UK

Alix Neveu
BIRKENWOOD INTERNATIONAL
45 Church Street
Hawthorn Victoria 3122
Australia

Further information about the BeefQ project can be found at www.beefq.wales.