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SmartCow: an integrated infrastructure for increased research capability and innovation in the European cattle sector



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EXECUTIVE SUMMARY

<p>Background</p>	<p>In the frame of SmartCow project, Teagasc has made access it Research Installation “Grange” through Trans National Access (TNA).</p>
<p>Objectives</p>	<p>This Deliverable aims at describing the TNA provided by Teagasc Grange during the SmartCow project.</p>
<p>Methods</p>	<p>The Deliverable is composed of a table summarising the TNA provided by the Research Installation (RI) and by the reports of activities provided by the TNA users who accessed this RI.</p>

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1 TNA provided

Name of the TNA project	Name of TNA user	Organisation of TNA user	Country of TNA user	Installation from the RI	Start date	End date	Number of units of access provided
The effect of feed restriction on RFI ranking in beef steers	Krum Vladimirov Nedelkov	Trakia University	Bulgaria	Teagasc Grange	23/06/2021	30/11/2021	1,100 cow.weeks

2 Final reports of the each TNA provided

2.1 TNA 1: Krum Vladimirov Nedelkov

Introduction: Improving animal feed efficiency (FE) may contribute to the sustainability of the beef cattle sector. Beyond well-defined nutritional strategies, the improvement of FE could also be achieved through genetic selection. Alternative definitions of FE are used within animal breeding programmes, with growth-related (feed conversion efficiency [FCE] and residual gain [RG]) or intake-related (residual feed intake [RFI]) indices the most prevalent in the literature (Cantalapiedra-Hijar et al., 2018). Previous research has pointed to appetite as one of the most important true determinants underlying between-animal differences in RFI in beef cattle (Lines et al., 2014). However, more research is required to confirm this, and to determine whether it applies to other measures of FE.

The main objective of the project: To compare the feed efficiency ranking under ad-libitum and restricted feeding conditions on the same sixty young bulls with analysis of blood parameters, reflecting energy and N metabolism, and rumen microbiota composition under both feeding conditions.

The hypothesis that are tested:

- i) Variation in residual feed intake observed during ad-libitum conditions would almost disappear when the same animals are restricted and fed at similar feeding levels
- ii) Some biological mechanisms are related to feed efficiency ranking only because they co-vary with feed intake
- iii) Appetite is the major determinant of feed intake when measured as residual feed intake but not as feed conversion efficiency or residual gain.

Material and methods: Sixty Charolais crossbred young bulls (427 ± 20.4 kg body weight, BW) were tested twice for FE in a crossover design with 2 test periods of 70-d each. After an initial adaptation period of 3 weeks, animals were blocked on BW, and within block randomly allocated to one of two groups of 30 individuals. For the first 70-d test period, one group was assigned to restricted (R1) and the other group to ad libitum (A1) feeding levels. For the second 70-d test period, the groups switched feeding level and group R1 was this time fed ad libitum (A2) and group A1 was restricted (R2). Animals were offered a grass silage and barley-based concentrate total mixed ration on a 50:50 dry matter (DM) basis. Feed restriction level was chosen at 1.45 % BW for all restricted animals, a level promoting a theoretical average daily gain (ADG) of 0.5-0.6 kg according to INRA (2018). Backfat depth measurements were conducted by ultrasound at the beginning and end of each test period. The RFI and RG values (kg/d) were calculated for each condition (R1, A1, A2, R2) independently, as the difference between observed and predicted DMI or BW gain (kg/d), respectively. The DM intake and BW gain were predicted from a linear model including the block effect, mean metabolic body weight (MMBW), changes in ultrasound backfat depth, and either ADG for RFI or DM intake for RG calculations, respectively. The FCE (kg/kg) was calculated as the observed ADG (kg/d) by unit of observed DMI (kg/d).



Main preliminary results: DM intake was 6.70 and 8.55 kg/d for animals undergoing feed restriction in the first (R1) and second (R2) period, respectively. Corresponding values for ad-libitum animals were 9.55 (A1) and 10.50 (A2) kg/d. This represented a mean feeding level of 1.42% and 1.85% BW for the restricted and ad-libitum groups, respectively. The ADG for R1, R2, A1 and A2 groups was 0.74, 0.92, 1.59 and 1.49 kg, respectively. For RFI, the between-animal variability (coefficient of variation, CV) was, on average, 6 times higher for the ad-libitum (4.5% CV) compared to the restricted (0.7% CV) feeding group, in both test periods. In contrast, with RG and FCE, the CV almost twice as high in the restricted (15% and 23%, respectively) compared with the ad-libitum (8% and 13%, respectively) feeding group during the first test period, but was similar (approximately 14%) for both feeding groups in the second test period. Spearman correlations (r_s) between the two feeding periods (A1 vs. R2 or R1 vs. A2) for RFI, FCE and RG measured on the same animal were low and not statistically significant ($-0.25 \leq r_s \leq 0.14$; $P > 0.05$). Within-condition, the RFI ranking was correlated or tended to be correlated with RG ($P < 0.05$) and FCE ($P < 0.10$) in ad-libitum but not in restricted feeding levels ($P > 0.05$). In contrast FCE and RG were highly correlated with each other ($0.63 \leq r_s \leq 0.82$; $P < 0.05$) within each feeding condition (R1, A1, A2 and R2).

Impact of the results: Restricting the feeding level of young bulls severely decreased the observed variability in residual feed intake (RFI) compared with animals fed ad-libitum, regardless if feed restriction preceded or followed ad-libitum feeding level. However, for feed conversion efficiency (FCE) and residual gain (RG) this pattern was the opposite, such that between-animal variability almost doubled when feed restriction preceded, but did not differ when followed by ad-libitum feeding level. Our findings support the concept that appetite is a primary determinant of RFI variation in bulls but not of variation in growth-related traits such as FCE or RG. These results also suggest that feed efficiency measured under restricted feeding situations may be a different animal trait compared with that measured under ad-libitum feeding conditions.

Any other achievements of the visit: Unfortunately, no visits were planned because of the sanitary context.

How do you expect to disseminate the results?: A first abstract (Cantalapiedra-Hijar et al. 2022) with preliminary results has been submitted to the ISEP congress (12-15 September, Spain). Ongoing analysis on plasma metabolome and isotopes will be finished before summer 2022 and the submission of a first paper reporting performance and metabolic data is planned before the end of 2022 to an open access journal. A second paper could be also proposed based on actions and results concerning the analysis of rumen microbiota composition on these same animals.

Any suggestions to improve the TNA procedure: Nothing to suggest, because communication was good and expected outcomes were achieved.