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Integrating Activities for Starting Communities

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

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

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EXECUTIVE SUMMARY

Background	The animal and grassland Innovation centre in Moorepark through Trans National Access (TNA) made available its research infrastructure to a number of other research organisations.
Objectives	This Deliverable aims at describing the TNA provided by Teagasc Morrepark during the SmartCow project.
Methods	The below Table summarises the TNA supported by the host infrastructure during the time of the project. Two TNA projects were supported by the Teagasc Moorepark research infrastructure during the course of the project.

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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
1. VitalCow	Martina Jakob	Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB)	Germany	Teagasc Moorepark	01/10/19	15/11/19	56
2. Consequences of the grazed pasture diversity on annual variability of nutritional value and technological properties of milk, and nutritional status of Holstein-Friesian and Jersey Holstein-Friesian crossbred dairy cows (GRAMIQS for GRAzing – MIlk –QualitieS)	Anne Boudon	INRAe	France	Teagasc Moorepark	15/3/2021	15/3/21	576

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2 Final reports of the each TNA provided

2.1 TNA 1: Martina Jakob

1. Was the experiment delayed between the mid-point and end?

Facility Manager Yes: yes No: Explain why: Due to the lockdown the experiment stopped half way.
User: Any comments:

2. Were there any deviation from the plan from mid-point until the end

Facility manager: No: Yes: Explain what, why and consequences: Instead of running two consecutive trials in March as intended, we had to stop the trial before beginning again in July. There was an attempt to measure the same cows after the lockdown was eased in July. However, very few original cows were available from the first trial (March) due to lactation stage or culling.
User: Any comments: as above

3. Is all data handed out to the user?

Facility manager: Yes: yes No: Explain why and when this will happen User: Any comments:

4. How often have you been in contact?

Once a week: Once a month: about or slightly more often Other interval:

5. What was the character of the contact?

Email: x Phone/skype meeting: With minutes written yes: No:
Visit of the experiment by the user:

6. Any suggestions for good practice on communications between user and facility manager

User:
Facility manager: emails and phonecalls worked well

7. From start to end – what was the three most difficult issues to deal with?

User: The cooperation worked very well. Apart from the lockdown there were no difficulties. In the beginning, the hardware for the sensor did not work properly and a cable had to be replaced.
Facility manager: There were few issues other than the stopping of the trial due to public health measures. There was some practice time needed for staff to ensure they were confident with the equipment, but this was factored into timetables.

8. Any other suggestions for improvement

User:
Facility Manager:

9. Did you have a meeting at the end of the project for evaluation?

Yes: No: no, only email contact. In person visits were not possible due to global travel restrictions.
If yes please give the main points:

10. Do you expect to follow the plan for publication as in the proposal?

Yes: End of 2020
No: Please explain why and add the new plan
Please remember the user are obligated to publish results from the TNA

11. The main scientific outcome of the projects

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Please include a 2-3 page report including:

The main objective of the project
The hypothesis that are tested
The main scientific outcome, innovation/impact of the results
Any other achievements of the visit
How do you expect to disseminate the results
Any suggestions to improve the TNA procedure

Final report from the User:

The main objective of the project: A sensor based on multiple spatially resolved reflection spectroscopy (MSRRS) developed to scan the palm skin of humans was tested on cows. The measurement results of the sensor display the carotenoid content of human skin within a range of 0 to 15. The carotenoid content of human skin provides information about the health status and stress level. The aim of the study was to find out if a similar range is achieved from the skin of cows. Since the skin measured needs to be without hair and non-pigmented, the teats were chosen to be measured.

The hypothesis that are tested: The hypothesis was to see if the sensor gives plausible feedback. If successful, the sensor could be used to develop an early warning system, mainly for inflammatory diseases such as mastitis. This kind of warning system could enable a farmer to react early and hopefully prevent a severe illness, and at the same time reduce the application of antibiotics.

The main scientific outcome, innovation/impact of the results: All trials displayed plausible results. The Scottish cows were measured twice on two teats every day for three weeks in a row. This procedure was repeated four months later due to the Scottish lockdown including the same cows. The repetition per teat was used to see how reliable the measurements are. According to the developer, the variation between two measurements is ± 1. This was mostly achieved for the measurements of the teats in Dumfries. Apart from a general value displaying the carotenoid content of the skin, a value describing the measurement quality was available. For a successful measurement it is necessary, that the sensor is covered completed and no disturbing light falls onto it. Because of the flat shape of the sensor, the teats were gently pressed on it to achieve full coverage of the light emitting area of the sensor. As some teats were fairly thin, this may not always have been successful and therefore may have influenced the measurement quality. Overall, the measurement quality in Dumfries was excellent. 1500 samples (nearly 75 %) achieved the highest quality. A decrease in quality was mostly coupled with a decrease in the value displaying the carotenoid content. The overall sample size was 2080 measurements. The average value for all cows in Scotland was 10.7. The French average value, based on 2467 samples, was 14.1 and the Irish average, based on 468 samples was 9.4. The achieved results show, that the sensor has potential to be used for cows. The carotenoid content of humans and cows seems to be similar, but cows have a slightly higher value. The values of the French sample exceeded the calibrated range of 15. The main limitation therefore is that the sensor is calibrated for human skin. Further trials with contemporaneous blood analysis for the blood carotenoid content of the cows are needed now, to adjust the calibration for cow's skin and check the plausibility. Overall, the dynamics of the carotenoids are little researched for dairy cows. For the French sample a dependency on the

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fodder was statistically proven with higher values for those cows that were let outside on a paddock grazing. Fresh grass but also sunlight are able to increase the level of carotenoids in the skin. Nutrition is generally the main influencing factor on the carotenoid content in the skin, and it is therefore plausible to observe a raise in the value between fresh grass and silage.
There was only one incidence of mastitis in all samples. The affected cow showed a slight drop in the value (-1), but the day the mastitis was diagnosed was not measured due to the fact that it was a weekend,
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and on weekends, no measurements took place. Therefore the acute phase of the mastitis was missed. Two days after the start of the antibiotic treatment the value was at the same level as it was before the mastitis.

Any other achievements of the visit: The visit was valuable to show and explain the measurement procedure. It was also valuable to the herd and the parlors.

How do you expect to disseminate the results: Parts of the results have already been presented on a conference in September 2020, but the Scottish sample was not included. This is the conference link:
https://www.agroscope.admin.ch/agroscope/de/home/aktuell/veranstaltungen/akal2020.htmlIt is planned to publish the whole sample in a peer reviewed journal as soon as possible.

Any suggestions to improve the TNA procedure: The cooperation with the Scottish partner worked really well

2.2 TNA 2: Anne Boudon

1. Was the experiment delayed between the mid-point and end?

Facility Manager Yes: No: **X** Explain why: User: Any comments: **No delay between the mid-point and end for sampling.**

2. Were there any deviation from the plan from mid-point until the end

Facility manager: No: Yes: Explain what, why and consequences: User: Any comments:

3. Is all data handed out to the user?

Facility manager: Yes: No: Explain why and when this will happen User: Most of the data were transmitted. Some results that required analyses at the end of the experiment are still in progress at Teagasc Food Research Centre.

4. How often have you been in contact?

Once a week:	Once a month: **X**	Other interval:

5. What was the character of the contact?

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Email: **X** Phone/skype meeting: **X** With minutes written yes: No: Visit of the experiment by the user:

6. Any suggestions for good practice on communications between user and facility manager

User: Regular exchange at key point of the protocol are vary useful. Maybe an agreement on this at the beginning of the protocol could be useful. Facility manager:

7. From start to end – what was the three most difficult issues to deal with?

User: Sending samples required coordination between the technicians on both side. We underestimated this little difficulty at the beginning of the project. Facility manager:

8. Any other suggestions for improvement

User: See above. Facility Manager: Covid was difficult to handle during this project, but the work got completed. It would have been usefult o have had a visit from our French collegues.

9. Did you have a meeting at the end of the project for evaluation?

Yes: but it will have to be plan soon after the transmission of the last data. Most likely in the new year.No: If yes please give the main points: The objective will be to discuss the result and to concretize the communication plan.

10. Do you expect to follow the plan for publication as in the proposal?

Yes: Several communications will be proposed next Spring in the congress listed in the report and a first publication will be prepared for a journal in the first semester 2022. Add the time schedule. Mid Januar Zoom meeting and then paper discussions. No: Please explain why and add the new plan Please remember the user are obligated to publish results from the TNA

11. The main scientific outcome of the projects

See next page

Please include a 2-3 page report including: The main objective of the project The hypothesis that are tested

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The main scientific outcome, innovation/impact of the results Any other achievements of the visit How do you expect to disseminate the results Any suggestions to improve the TNA procedure

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Consequences of the grazed pasture diversity on annual variability of nutritional value and technological properties of milk, and nutritional status of Holstein-Friesian and Jersey Holstein-Friesian crossbred dairy cows (GRAMIQS for GRAzing – MIlk –QualitieS)

Anne Boudon, Luc Delaby, Jocelyne Flament, Marine Gelé, Benoît Graulet, Sophie Lemosquet, John Tobin, Mike O'Donovan, Brendan Horan and Catherine Hurtaud

Main objective and hypotheses that were tested

In a context of increasing societal issues around animal production, a significant part of consumers asks for products coming from more sustainable and ethical production systems. In Europe and specifically in France and in Ireland, grazing dairy systems benefit of a good image and more and more, dairy companies segment their collection rounds to offer milk specifically from these systems. A consequence is a higher seasonal variability of milk composition at the scale of the collection round that cannot be compensated by the diversity of systems. The reasons for this seasonal variability are multiple. The effect of the breed on milk composition is relatively well known.

The objective of the study was to characterize the variability of milk fine composition and technological properties in grazing dairy systems, as well as that of the nutritional status of cows of two breeds. Our hypothesis is that the effects of the grazed species on milk composition and functionality annual variability, as well as that of the interaction of the plant species and cow breed, can be important and need a better characterization.

The project compared the performances of perennial ryegrass (PRG) only, PRG and white clover (PRG-WC), or diverse multispecies (MSS) swards and Holstein-Friesian and Jersey Holstein-Friesian crossbred cattle on dairy system performance, milk composition and functionality and biomarkers of nutritional status of the animal within intensive pasture-based grazing systems.

The main scientific outcome, innovation/impact of the results

Context of the study: feed allowance and pasture composition

Herbage, milk and blood were sampled 3 times on 8 cows per breed and sward. The dates were for period 1, April 13th and cow average stage of lactation was 70 days in milk (DIM), for period 2, May 18th (105 DIM) and for period 3, June 28th (146 DIM). Herbage allowance was on average 12 kg/cow/during the experiment. Herbage allowance and consequently dry matter intake decreased in period 2 for the three compared swards, because of low height and high density in the paddock. However, sward mineral composition differed between swards, with higher Ca, P and Zn contents in MSS than in PRG or PRG-WC ($P<0.05$). It was also numerically the case for Cu, Fe, K, S, and Mg. The higher Ca, P and Zn in MSS was related to the high content of Plantain and Chicory in those elements, especially in the last period when the contribution of these species to the MSS sward was high. The cows were also supplemented with 1 kg of concentrate. The contribution of the concentrate was major for Cu, Zn and Mg supplies because the concentrate contents in those elements was more than 10 times higher than the pasture mineral contents. Concentrate Cu and Zn contents were even 30 to 70 times higher than those of pasture. For some modalities of sward and period, the contribution of the concentrate was major for Mn.

Mineral status of cows

The plasma mineral contents of cows was not affected by the breed but it was systematically affected by the period with higher Ca, K, Mg, Na, P, S, Cu, and Zn in the last period than in both first periods. Plasma inorganic P only increased in the last period with the MSS sward and plasma Fe content was lower in the last period. The increase of plasma Mg, P and Zn was also higher with MSS sward than for PRG and PRG-WC, this tended to be significant also for plasma Ca. For most elements, the plasma

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mineral contents in the first period were lower than the considered physiological range (Boudon et al. 2018). It remained true to a lesser extent during the second period. Only plasma Cu contents were higher than the physiological range.
The effect of period was confounded with the effect of lactation stage (69 days in lactation in period 1 in April and 145 days in lactation in period 3 in June), herbage allowance, and botanical and chemical pasture composition. This made the dissociation between the stage of lactation and the seasonal evolution of sward difficult to dissociate. The low plasma contents of many minerals at the period 1 could be expected considering it is the first sampling point after calving. However, the average of lactation at period 1, i.e. 70 ± 8.8 DIM was too important to consider that these low plasma contents could be linked to *peripartum* troubles. It can be considered that from a combination of relatively high milk production with limited herbage allowance, the mineral supplies could have been suboptimal for some elements. However, we did not observe a clear single link between herbage mineral content and animal mineral status indicating that interaction between elements will have to be carefully considered.

Milk production and composition
There was no effect of breed on milk yield, lactose content and SCC, but milk fat and protein contents and yields were significantly higher with JFX as in Auldist et al (2004) and Poulsen et al (2015). Milk citrate was also higher as in Poulsen et al (2015) and milk chlorine content was lower with JFX. Except with PRG, cheese making aptitude was improved with JFX: RCT tended to be shorter (p=0.094) and firmness (a30) tended to be higher (p=0.079) as in Auldist et al (2004) and Poulsen et al (2015). At standardized pH, RCT depends on colloidal Ca / casein ratio or more simply from the sole content of colloidal calcium (Hurtaud et al, 2001). Breed had no effect on heat stability of milk. Plasma NEFA tended to be higher (respectively p=0.057) and plasma glucose was higher with JFX.
The sward did not affected on milk yield and most parameters of milk composition. Only milk urea content was higher with MSS and firmness of curd measured as a30 were higher with PRGCW and MSS.
Period significantly affected almost all the measured parameters. Milk yield, milk fat and lactose contents decreased from April to June. Milk urea largely decreased in May and increased after. However, this trends were sensibly different according to the sward. Milk yield linearly decreased from April to June with MSS while it decreased from April to May with PRG and PRGWC and stabilized, or even increased after. Milk lactose had an inverse behavior: it's quite stable with MSSS and largely increased in May with PRG and PRGSW. Plasma urea decreased from April to May with the 3 swards, after stabilized with PRG and PRGWC but increased with MSS. SCC largely increased in May and decreased after. Milk heat stability increased from April to June whatever the sward, whereas milk RCT decreased in April whereas curd firmness increased during the same month.
Analyses of milk mineral contents are still in progress at this stage.

Any other achievements of the visit
Unfortunately, because of the sanitary evolution, the visit from French researchers to Moorepark facilities was not possible during the experiment. Videoconferences will be organized for the finalization of the results. Some results remains to be analyzed at the time of this report for the first publication, especially the milk mineral content. Other results, related to vitamins milk composition, or the use of lactose as a bio indicator of energy status of cows will be treated later which will allow a long term collaboration between our organisations.

How do you expect to disseminate the results
Data from this study will be published in several papers in A rank international journals (Grass and Forage Science, Journal of Dairy Research or Journal of Dairy Science). The first paper will be related to the variability of milk fine composition and functionality in relation mineral status of cows.

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Another one should be related to vitamin and antioxidant status of cows and a last one to the use of lactose as a bio indicator of energy status of cows. This will be accompanied by quick diffusion of the results in an international scientific meetings (EAAP 2022 Porto). An objective will be also to include the data of herbage composition in the INRAE databasis of forage composition that is free of access on (http://www.inration.fr). Given the important interest of some dairy companies for the topics of the variability of milk composition in grazing system, results will be disseminated during annual meeting of French milk inter profession (3R 2022) but also in international congress related to dairy processing (ADSA 2023).

Any suggestions to improve the TNA procedure

Depending on the nature of the project, a deadline of 30 days after the end of the experimental phase is very short to achieve all laboratory analyses and give a good overview of the main results of the project. A latitude on this delay at the submission of the project will allow to better respect the deadlines.

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