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

EXECUTIVE SUMMARY

Background	WP2 is about establishing and operating procedures to promote TNA; receive and evaluate TNA proposals, and then establish and monitor TNA projects at infrastructures managed by SmartCow partners.
Objectives	*The objective of Task 2.4 is to ensure that commissioned projects are progressing along agreed timescales and that the TNA services are continuously improved.*
Methods	*Templates including questions for both the TNA users and facility managers to survey user's satisfaction for the reports to the panel were developed. To monitor the progress different reporting periods are defined and questions asked about any delay.*
Results & implications	*Templates are developed for four reporting periods: before starting (report 0), at the start (report 1), mid-point (report 2) and 60 days after the end of data collection (report 3).* *One project, out of the eleven projects agreed from the first call, was withdrawn due to lack of national funding that was needed beyond the SmartCow funding to run the projects.* *All report 0 from the 10 TNA users from the first call were received. Two projects are finished and the final reports are delivered, and two projects are running. Further, three projects are expected to start in 2020 as planned from the beginning. One project is postponed to June 2020 due to infection in the herd at the required facility, one is postponed to January 2020 to obtain enough calving animals and one projects is postponed due to a misunderstanding regarding submission for permission from the ethical committee.* *In the second, call 7 projects were agreed, none of which has started yet.*

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1 1st project Evaluation Report

This is the first project evaluation report including description of the progress in the TNA projects as well as the lessons learned during the process of monitoring and evaluating the commissioned projects. This report includes a description of the process and an overview of the projects initiated. Furthermore, the report includes a summary of the lessons learnt both during the process and from the reports from the TNA users and facility managers. Finally, the report includes a detailed description of the projects that started during 2019.

2 Process and monitoring of the TNA projects

2.1 The selection process

For both the first and the second call initial evaluation of 1st stage proposals for eligibility (participation rules) and feasibility (availability of facilities) was conducted by the Access Management Team – in order to give applicants a rapid response and decision on whether they should work on a full proposal. Applicants were encouraged to maintain contact with Facility Managers whilst they worked up full proposals in order to ensure continued feasibility. Each of the eligible Full Proposals was independently evaluated by one internal reviewer (i.e. from a project partner not involved in the proposed work/facility) and one external reviewer. The Access Management Team allocated reviewers. Proposals were also checked by the Ethics Committee (we had asked reviewers to flag any specific issues, but on this occasion the committee looked at all applications).
Reviewers were provided with a scoring template and this allowed us to score all proposals (out of 100). For the first call, this was done manually, however, for the second call an agreement with Oxford Abstracts was established to keep help track of the proposals and the reviewer comments. Proposals scores were then considered alongside the availability of space at each facility and discussions amongst the Access Management Team identified options for alternative (second preference) facilities in some cases. These options were then discussed with Facility Managers and a final list of approved projects and available facilities drawn up. With some redistribution of capacity between INRA facilities, we were able to accommodate all work.
For the first call out of 13 full applications 11 was funded. Two of the proposals involved a different type of work than was originally envisaged for a specific facility – but both facilities indicated that the work was feasible. For the second call out of 16 full applications evaluated, 6 were agreed for the first choice facility; one was accomodated by offering access at a different site (which will also have to adjust its cow-weeks budget allocated to different facilities) and 9 were not supported.

2.2 Monitoring of TNA projects

After initiation of the funded projects both the facility manager and the TNA user received a template to fill in with questions related to the performance of the TNA. Thus, concise reports will be returned at start, mid-point and end of each experiment for the access management team to monitor the progress and summaries lessons learnt for future actions both from a TNA user perspective and to develop the actions at the facilities. In order for the access management team to get a start date, all TNA users were asked to send report 0 including some basic information about the project such as start date of the experiment etc. All TNA users from call one had to submit the report 0 at June 2019, and for call two, this deadline is March 1th 2020.

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After the first call 11 projects were agreed on, however one project was withdrawn due to lack of national funding to cover expenses not covered by SmartCow finances. Table 1 in the appendix show the projects and the status of the projects at the end of 2019. Two projects are complete and all the reports returned to SmartCow. Table 2 provides an overview of projects that we agreed on from the second call, none of which started yet.

All projects chosen after the first call, except for the one that was withdrawn, have sent the first report to SmartCow, and only a few further reports has been delivered since many projects are still in the initiating phase.

3 Summary of lesson learnt for selection, operation and monitoring of future projects

The summaries are based on the output from the templates provided by the TNA users and the facility managers, as well as the experience from the selection panel.

3.1 The selection process

TNA processes were reviewed during the annual project meeting in Dumfries (March 2019) and the following changes proposed for the second call: 1. Move to using an online tool for submission and evaluation of proposals (to make the process easier to manage and also improve the process for proposers and reviewers; 2. Greater clarity on the way in which ethical review operates (this will also be facilitated by the online submission and evaluation tool); and 3. Provide checklists and templates for use in drawing up agreements for project work.
The Procedural Manual was updated in advance of the second call, mostly to reflect the change to using the online tool for submission and management of applications for the Second Call.
Within the Access Management Team we developed a TNA Term sheet gathering all general principles about implementing a TNA project and explaining both the host facility/organisation and the user(s)' rights and obligations. Once the TNA Proposal is accepted, the term sheet is aimed to help the TNA beneficiary and the facility to plan the TNA project and to agree on important aspects before starting it.

3.2 Monitoring TNA projects

Since only a few projects were finished at the end of 2019, and the majority are starting in 2020, the experiences and the output from the reports from the TNA users and facility managers is so far limited. However, from report (0) it seems clear that the call text was clear. All the applicants, who got funded, found that there were no information missing in the call text at the webpage; they all answered "*no*" to the question *"Are there any information missing in the call text at the webpage?".* Furthermore, we encouraged applicants to contact the facility managers in the answer after the preproposal. This worked out well and should be kept in the procedure, since all the applicants were in contact with the facility managers or a scientist related to the facilities in questions during the process of preparing the full proposal. After the decision, all funded TNA's have had contact with the facilities and some oral communication either by phone, skype or videoconference have been used for all projects. However, in a few cases it has been necessary to include René Baumont and Richard Dewhurst to solve questions and in one case regarding miscommunications between the facilities and the TNA user. Prompted response to questions is mentioned as an important way to support the projects by TNA users. The two projects that are finished and have reached the date for their final report have run without any problems, and both TNA users are content with the process. Close

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contact between the facility and the TNA user have contributed significantly to obtain the success according to both TNA users and the facility managers.

4 Projects

In the following detailed information is reported based on the information received from each project either from the midterm evaluation or from the reports returned at the beginning, midterm and end of each projects.

4.1 Investigating links between beef cattle behaviour, temperament and diet with changes in the rumen microbiome and implications for performance by Gareth Arnott (Queens University Belfast)

The project was planned to start July 2019. However, misunderstanding between the TNA user and the facility manager regarding who has the responsibility for getting the permission from the Ethical committee has led to a delay in obtaining the permission. Thus initiation of this project is still in process and other cows have to be allocated to this project.

4.2 Impact of physically effective fiber concentrations on chewing behavior, rumen microbial protein synthesis, and nitrogen efficiency in cows by Ruth Heering (University of Hohenheim)

The project is starting as planned in January 2020. Ruth Heering, PhD student at University of Hohenheim is hosted at INRA from January to April 2020 to supervise and participate to the experiment. Additional samples will be taken to contribute to WP6 activity in SmartCow. A research agreement between INRA and University of Hohenheim is under signature.

4.3 From grassland biodiversity to animal's microbial ecosystems and cheese qualities by Joël Berard (ETH)

The project is finished, below is the scientific report from the user.

4.3.1 Report from Jöel Berard,

4.3.1.1 Objectives/Hypothesis

Grassland farming systems are increasingly emerging as the strongest future options for ruminant livestock systems. Although the benefits of the grassland-based milk production have been demonstrated, in-depth knowledge is lacking in understanding the underlying mechanisms of interactions between ecosystems, feeds, animals, milk and cheese.
This project proposes to study the effect of the botanical diversity of pastures and forage conservation methods on the rumen microbiota, which will affect the microbiota of faeces, litter, teat skin and subsequently of milk and raw milk cheese. We hypothesize that more biodiverse pastures with elevated levels of plant secondary compounds will increase the abundancy and diversity of rumen microbial species. This will support the proper functioning of the rumen and therefore have a positive impact on animal health and on compositional and sensory quality of milk and cheese. We rely on one of the major paradigms of ecology, namely that stability in natural systems is based on biodiversity and synergy between species or functional groups capable of differential responses. We

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also assume that different feed conservation methods (drying and ensiling) have a strong impact on rumen ecosystem and consequently also on milk and cheese properties.
This project will provide answers to important questions concerning the effects of pasture biodiversity and forage conservation methods on the microbiota of milk and the properties of dairy products. This project will allow to study, at different levels from plant communities to cheese, how farm, milk and cheese microbiota respond to their environment in terms of community structure and orientation of their metabolism.

4.3.1.2 Material and methods

Forty-eight dairy cows (24 Holsteins and 24 Montbéliardes) that calved between October 2018 and March 2019 have been divided into 4 balanced lots in terms of breed and parity (16 primiparous - 32 multiparous), milk production measured during the first week of May, calving date and SCC.

The 48 cows involved in the trial were kept in the same pen from the beginning of April.
Sampling for the "covariate" of the two batches of cows going out to pasture took place on May 6, 9 and 10 when all animals receive a ration of hay and concentrates. Sampling for the "covariate" of the other two lots took place during week 21 when the cows still received the same ration of hay and concentrates.

The rest of the trial is split into two periods.

BIODIV test (June): effect of floristic diversity

The objectives of the BIODIV trial are:
- To study the assembly of microbial communities from the soil to the ripened cheese on two very contrasting plots in terms of plant biodiversity
- To understand the effect of plant biodiversity on the ruminal bio-hydrogenation of grass lipids and on the sensory properties of ripened cheeses.

Twenty-four cows corresponding to two of the 4 groups grazed from May 10 on two plots with very different levels of plant biodiversity; the “Montagne Florac” plot (MF), whose vegetation, particularly diversified, is similar to that of a upland summer semi-natural pasture and a plot of permanent grassland with very little diversity (“Bas Florac” : BF). In both groups, the animals grazed, without any feed supplements other than minerals. On the MF plot, which is later than the BF plot, the cows first grazed at the bottom of the plot and were gradually directed upwards towards the top of the plot where they remained exclusively from 1 June at the latest until 26 June. A part of BF has been mowed on week 18 in order to offer good grazing condition and herbage at a phenological stage comparable to those of the more tardive MF pasture.

Cheese samples and production have been carried out in sub-batches of 4 cows (2 Holsteins, 2 Montbeliardes) balanced according to milk production, which will constitute the statistical unit. Cheese production focused on the study of the assembly of microbial communities of the milk from the cow sub-batches and the corresponding mixing milk: during each manufacturing day, the 3 milks from the sub-batches of 4 cows have been processed in parallel as well as the mixing milk from the batch (4 tanks in parallel). Six days of production have been carried out between June 11 and 25, using a technology similar to that of Cantal.

CONSHERB test (July): effect of the grass conservation method

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The objectives of the CONSHERB trial are:
- To understand the effect of the way the grass is exploited on the ruminal bio-hydrogenation of the grass lipids and on the sensory properties of milk and ripened cheeses.

From May 24, the 24 cows of the two lots remaining indoors will receive feed, either grass silage (brought back from Theix) or hay (Bas Florac from June 2018).
From July 1, silage and hay have been replaced respectively by silage and hay made around end of May on the same plot ("Borie Bas"plot). The two grazing cow lots in the BIODIV trial have been remixed on June 26 to 2 groups by balancing the origin (1/2 MF, 1/2 BF) and considering the other grouping criteria. From 26 June, one group (the PAT group) grazed the regrowth of Borie Bas, after mowing for hay and silage. The other group (Ha) was fed indoor with fresh herbage cut on the same "Borie bas" plot.

As for the BIODIV test, cheese samples and production have been carried out in sub-batches of 4 cows (2 Holsteins, 2 Montbéliardes) which will constitute the statistical unit. Cheese production focused on studying the effect of herbage exploitation: during each day of production, 4 milks corresponding to a sub-batch of each of the 4 diets have been processed in parallel. Three days of production have been carried out between July 16 and 23, using a technology similar to that of Cantal.

For the BIODIV and CONSHERB tests, samples from animals and plots have been taken during the weeks of cheese production. They will be used mainly to describe microbial communities (prokaryotes and eukaryotes) using a high-throughput amplicon sequencing approach. The latter will be analysed on the floor, grass and lying areas in contact with the udder as well as in ruminal fluid (collected by oesophageal tube), faeces (rectal sampling), teat surface (sampled with wipes), mixed milk from each batch (only BIODIV) and each sub-batch and the corresponding refined cheeses. The characterization of these different microbial communities will be completed by analyses of the composition of the forage (botanical composition, nitrogen, walls, tannins and fatty acid profile), ruminal liquid (pH, volatile and total fatty acid profiles), faeces (nitrogen, walls), individual milk (classical biochemical analyses and fatty acid profiles etc), mixed milk (classical biochemical analyses, volatile compounds, fatty acid profiles, sensory analyses) of the corresponding cheeses (classical biochemical analyses, sensory analyses, volatile compounds, colour, rheology).

4.3.1.3 Expected outcomes, innovation/impact of the results

The most innovative expected outcome is the comprehension of the microbial flux form the environment (pasture, litter, water, soil, teats, etc) to the rumen, the milk and the cheese. This flow is still almost unexplored and its investigation represents a relevant scientific innovation. Furthermore, the effect of the pasture biodiversity level and the exploitation mode of the herbage (fresh grazes or fed indoor, and conserved as hay or as silage) will allow to understand how farming practices can affect the microbial flow. A change in microbial flora in the rumen or in the dairy products is expected as well to change the characteristics of derived dairy product. The comparison of chemical composition and sensory properties of milk and cheese as affected by the microbiological flow will another innovative result. The acquired knowledge about the microbiological link between environment and dairy products will help to understand and highlight the link between a *terroir*, the related farming practices and specific characteristics of dairy products.

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4.3.1.4 Dissemination plan

One Ph.D. student, Elisa Manzocchi, from ETH Zurich is directly involved in this experiment. The results will be part of her Ph.D thesis. The data obtained will be published in at least two scientific papers in peer-reviewed journals and will be presented at scientific international conferences (e.g. on animal nutrition, animal production, milk processing and food microbiology). The involved research groups and platforms will be in charge of the dissemination of the results via their websites, leaflets and training sessions they organize for students, technicians and farmers. We anticipate strong interest from the public for this type of innovative research at the interface of basic and applied sciences resulting in direct benefits for farmers, consumers and society. Research highlights will also be communicated to stakeholders and lay persons in end-user meetings, in press releases and by interviews in public media. In addition, our research project will be presented during AgroVet-Strickhof Conference to relevant stakeholders. This project will also be presented and discussed in the boards of GIS "Filières Fromagères sous IG" and RMT "Fromages de terroirs" (gathering all French PDO and PGI cheeses) and results will be disseminated through their website and by training sessions.

4.4 PFA effect on methane production by Poulad Pourazad (Delacon)

The project is starting as originally planned in January 2020.

4.5 Multiple spatially resolved reflection spectroscopy (MSRRS) - carotenoid content of the skin of cows by Martina Jakob (ATB)

The user has completed stages at INRA and at Teagasc, which has resulted in some refinements as to what they require for the study to take place at SRUC. Martina Jakob will visit SRUC at, or just before, the start of the work, to demonstrate the use of the hand-held scanner and recording tablet.

The project at SRUC is planned to start mid-February 2020.

4.5.1 Information from midterm evaluation

Objectives: The carotenoid content of human skin provides information about the health status and stress level. It is successfully measured by multiple spatially resolved reflection spectroscopy. Opsolution, developed a non-invasive, handheld device for measurements of the antioxidant status on the palm of humans. The sensor is available on the market now and will be continually improved. The planned study is designed to find out, whether the carotenoid content of the skin of cows can give similar information using the same sensor. 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 development of this new sensor meets SmartCow's RIs multivariate approach to phenotype health. We will focus on the detection of mastitis and could therefore improve the sustainability of animal resources as well as the profitability and animal welfare.

Experiment planned in 2019 on 3 SmartCow's facilities, INRA Le Pin, SRUC Dairy centre, Teagasc Moorepark with the provision of 100 cows.weeks each.

Work carried out at INRA Le Pin

Course of trial:

The trial started on April 1st, when Dr. Martina Jakob arrived at INRA Du Pin with the sensor and equipment. During her stay, the measurements were carried out during each milking period to train all persons measuring later on. Measurements finished on the 14th of April. Sixteen sets of data were

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achieved during that time. The sensor and equipment stayed with INRA for another two weeks in case of mastitis on one of the cows in the samples. No case of mastitis occurred during this period.

4.5.1.1 Preliminary results:

2427 successful measurements were obtained. The values indicating the carotenoid content of the skin were calculated by the sensor developers. INRA Du Pin research station provided detailed cow data such as breed, feed intake, ratio components, heat events, days in lactation and milk yield. Carotenoid content values and cow data were put together for evaluation and statistical analysis. A total of 80 cows-weeks were provided by INRA Le Pin for this experiment

4.5.1.2 Work planned at SRUC

We have conducted Skype meeting and phone conversation with Dr Jakob to plan the next phase of this work, which will involve 100 cow-weeks work with cows at SRUC dairy facility.

4.6 Impact of oscillating supply of essential amino acids on whole-body nitrogen partitioning, mammary gland metabolite utilization, and milk nitrogen efficiency in lactating dairy cows by Rolland Matthieu (Ajinomoto)

The project is postponed to start June 2020 due to infection of the herd at the experimental facility.

4.7 Effects of Bacillus probiotic on productivity, health and welfare of dairy cows by Noriko Nakamura (Calpis).

The project is expected to start as originally planned summer 2020.

4.8 Amino acids requirements in early lactation dairy cows by Lahlou Bahloul (Adisseo)

The project is still running with a contract between the TNA user and AU that goes beyond the funding from SmartCow. A scientist from AU is involved in the projects and will be co-author on the publication(s) about the results.

4.8.1 Short project description

The project aims to determine whether high protein requirements of early lactation dairy cows can be satisfied with an increased supply of only the essential amino acids (EAA). Recent research has indicated substantial increases in milk yield (MY) and marginal N efficiency with an increased supply of digestible protein in early lactation. However, it is not known if this large impact could be obtained by increasing only the supply of EAA. Indeed, previous research with mid-lactation cows indicates only supplemental EAA are needed. Moreover, N efficiency would also be significantly higher if MY increases were attainable with only targeted EAA rather than supplying all AA. We hypothesis that supplementation of targeted EAA in early lactation will increase MY, N efficiency, and ultimately prove to decrease incidence of metabolic disorders. This project is a first step towards identifying the AA most needed in early lactation and for determining whether or not the non-EAA are needed to induce the large MY responses observed in previous experiments. The expected outcome will allow for significant changes in protein and AA feeding recommendations for cows in early lactation, a critical period for establishing subsequent lactation and reproductive performance and reducing incidence of post-calving metabolic disorders.

Cows are allocated into four blocks and randomly allocated to one of two treatments within block. Cows are blocked according to lactation number and breeding value for milk yield (Y-index). One cow died in connection with calving and one cow had a poor temperament, which made it difficult to take blood samples. Thus an extra bach of cows is running in the beginning of January.

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At the day of calving, the abomasal infusion device will be placed and infusion initiated as soon as possible after calving. Experimental treatments will infusion of either all amino acids (**TAA**) or only essential amino acids (**EAA**) where the non-essential will be removed from the infusion mix. At maximal infusion the daily infused amounts will be targeted to 8050 g/d.

4.9 Increased N-utilisation from dairy cows by phase feeding of protein by Nicolaj Ingemann Nielsen (SEGES)

The experiment was originally planned to start in November 2019, but because more cows are calving in the beginning of 2020, it was decided to postpone the start of the experiment to mid-January 2020.

4.10 From feed composition to animal performance by using Near Infrared Spectroscopy by Francisco Maroto (University of Cordoba).

The project is finished, below is the scientific report from the User.

4.10.1 Report from Fransico Morato, University of Cordoba, Spain

4.10.1.1 The main objective of the project

The objective of this project was to study the feasibility of feed NIR spectra to evaluate animal response, measured as feed intake and milk production

4.10.1.2 The hypothesis that are tested

Near Infrared Spectroscopy (NIRS) has demonstrated to be a precise and cost-efficient tool for the evaluation of feed composition, even in complex matrices like Total Mixed Rations (TMR). Normally, feed composition data are included in feeding models in order to predict animal response. However, it is well known that NIR spectra contain much more information about feed samples than chemical composition, so we hypothesize that feed spectra can be used to directly predict animal response, avoiding prediction errors associated to feeding models

4.10.1.3 The main scientific outcome, innovation/impact of the results

The main scientific outcome of the project is the validation of the possibilities of NIRS technology to directly estimate animal response, in terms of feed intake and milk production. Universal calibrations will not be developed during this project, because of the limited number of cows and rations. However, it can be the first step to raise larger scale projects, which have the potential to highly impact animal feeding in the future. Having real-time information about animal response associated to each diet (not theoretically but measured) has the potential to improve farm profit and reduce livestock environmental impact by means of a better adjustment between diets and animal needs.
By the moment, we are still working on data analysis. Some preliminary results are shown below.
We planned to have 4 TMRs with variable composition during the experiment, in order to have variability in animal response (needed for NIRS calibrations). For that, we replaced a portion of the high-quality forage in the ration with straw (0, 5, 10 and 15% in the different experimental groups). We can see this variability in the spectral signals of the different diets:

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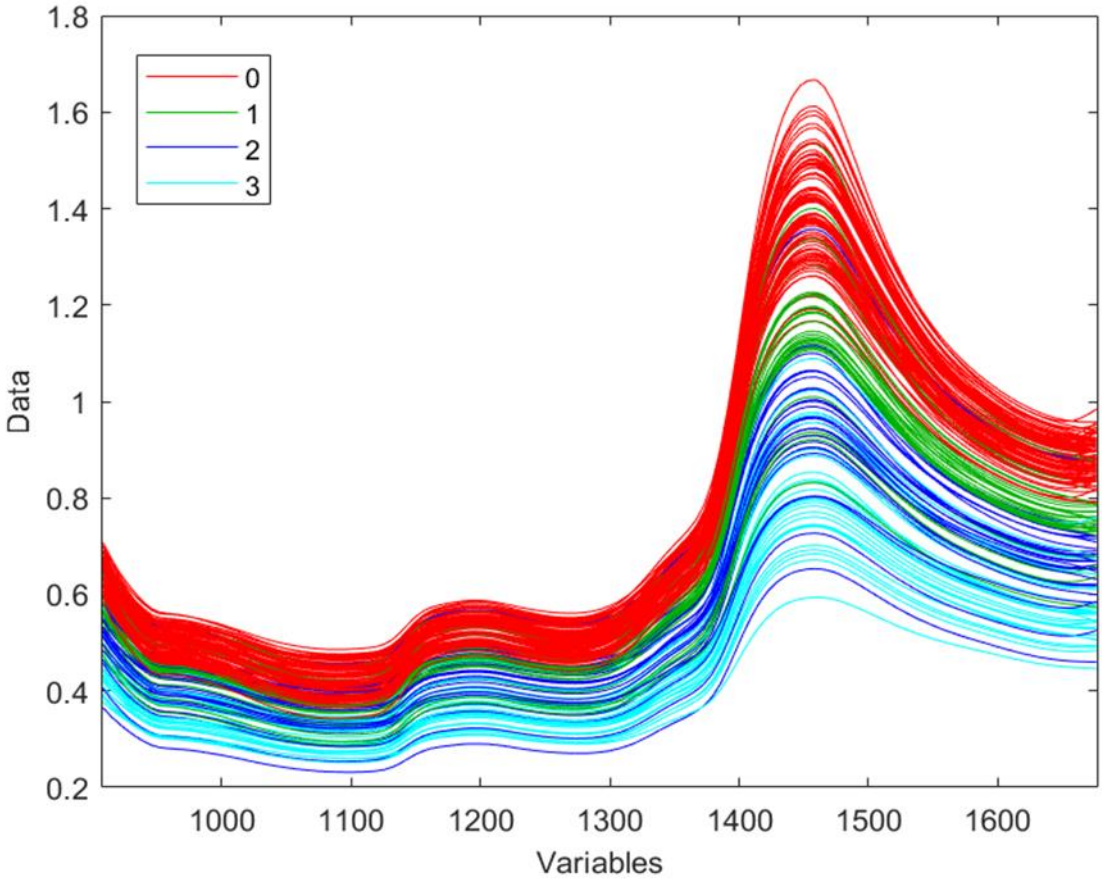

However, in the PCA below, we can see that there is also some overlap between the different types of diets. For example, some samples of diet 1 (5% replaced) are similar to some samples of diet 0 (0% replaced - control) and others to samples of diet 2 (10% replaced).

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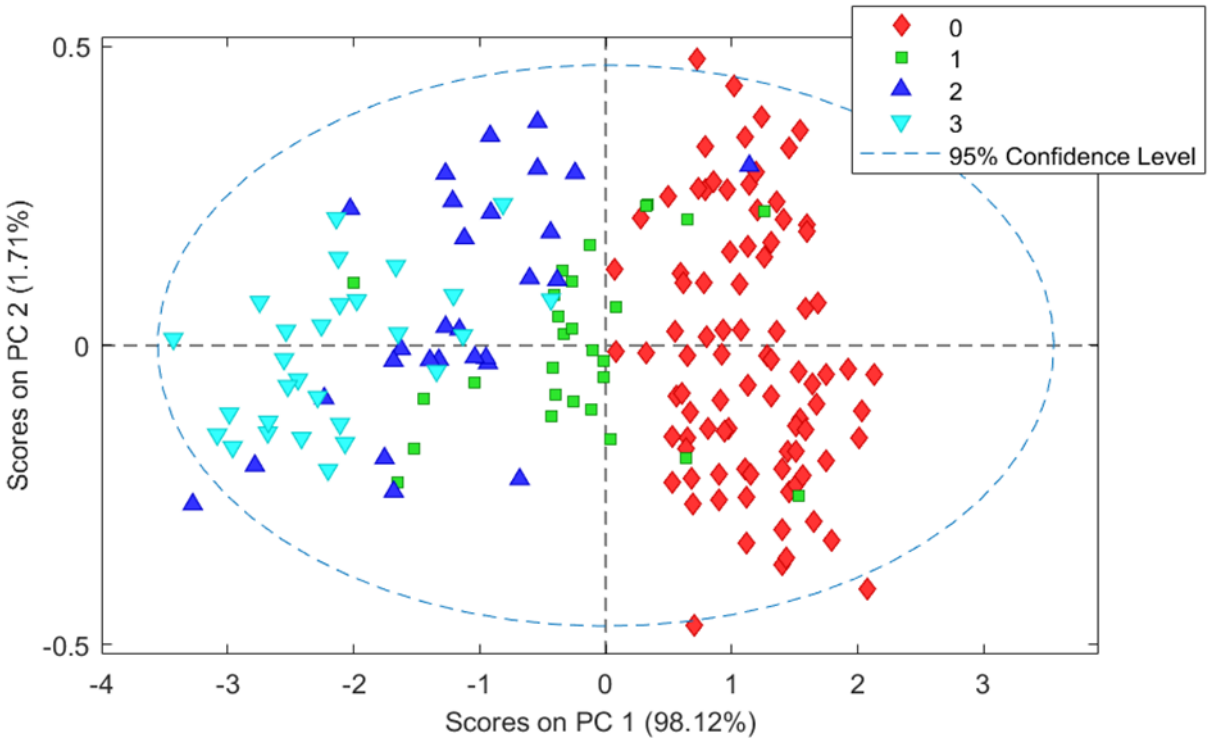
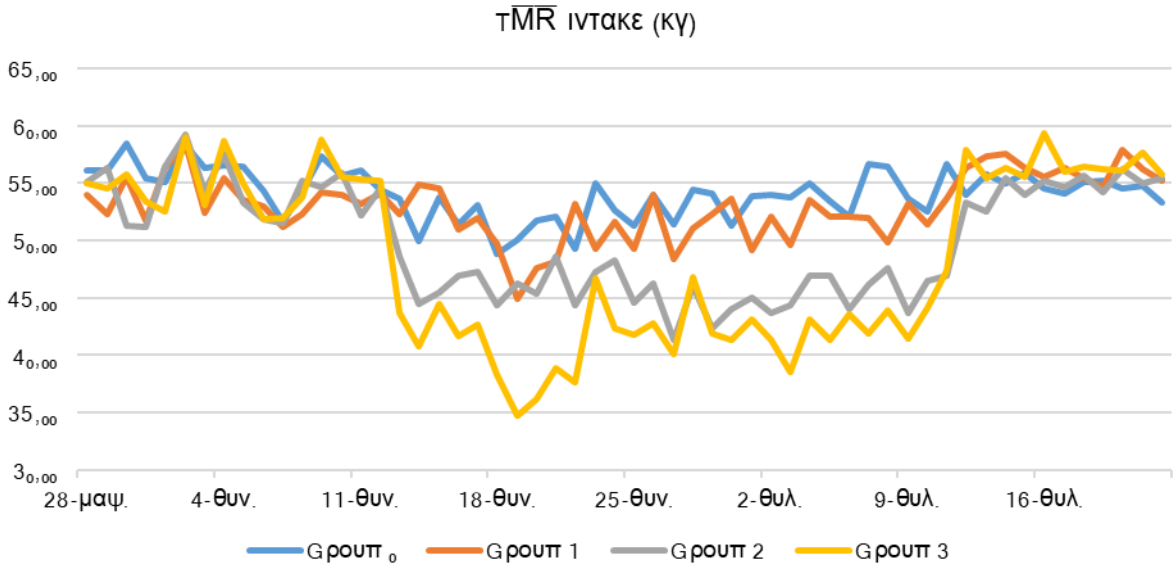


The variability between days for the same diet is important to understand the variability of animal response.
As expected, we also obtained variability in animal response:



At the beginning and the end of the experiment all animals were eating the control diet, and they have a similar TMR intake. During the experimental phase, cows were divided in four groups, three of them eating altered diets. Cows in experimental diets ate less kg of TMR and the change was bigger for the group eating the most altered diet. However, there is an important variability between days in cow intake, even in the control group, and we are currently working on diverse smoothing techniques to obtain an intake value that can be used for NIRS calibrations. On the other hand, some cows had abnormal behaviors or health problems during the experiment, and their data must be cleaned before continuing with data analysis.
We also had a variable response in milk production, which can be smoothed in different ways (some examples below):

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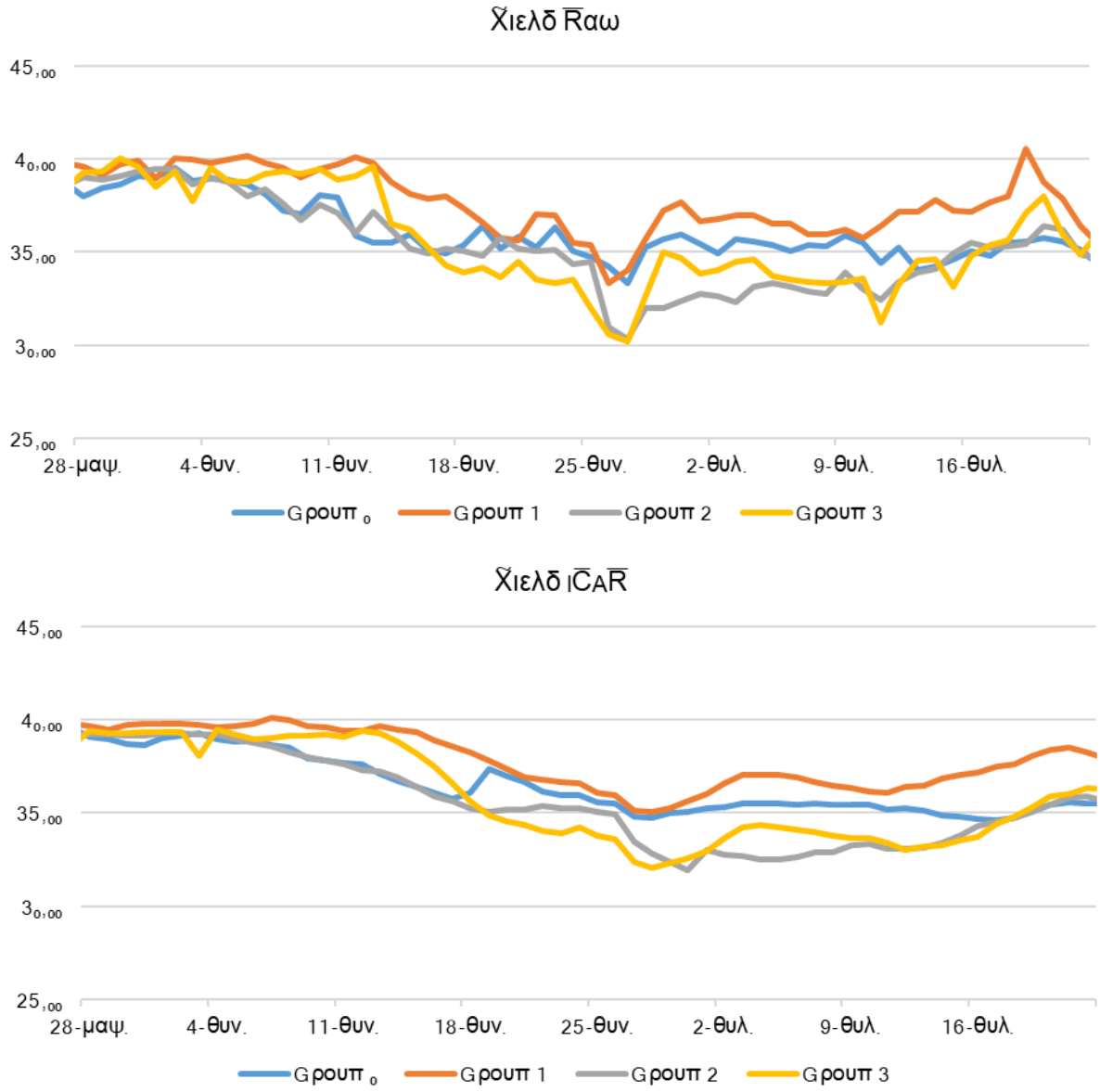

In this case, the original production values were not recovered after the experimental phase (when all cows go back to control diet) so the previous production level need somehow to be included in calibrations. On the other hand, we observed an unexpected decrease in milk production of control group. It is due to the substitution of cows with problems during the experiment and due to an abnormal production response of some cows. For milk production, we are currently analyzing individual cow data in depth

4.10.1.4 Any other achievements of the visit

For the user, the collaboration with the host institution (Aarhus University) during the TNA project was very lucrative, not only because of the research experiment itself, but also in terms of training. During the visit to the research farm, the user learnt some issues regarding animal management, data gathering that must be considered for a successful experiment development. This information will be valuable for the user when establishing other experiments involving animals in his own institution

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4.10.1.5 How do you expect to disseminate the results?

We plan two refereed publications from data obtained in this study. These papers will be published in open journals. Additionally, we will present the main results of the study in at least one scientific meeting, preferably an international congress, such us the EAAP Annual Meeting to be held in Porto (August 2020). On the other hand, a master student is currently working on her master thesis on the basis of the samples and data gathered during the experiment. The results of this thesis will be publicly available. Finally, 172 TMR samples (approx. 0.6 kg each) collected during the experiment has been dried, frozen and stored in the sample bank of the University of Cordoba at -20ºC. These samples, together with their reference data, are available for further studies

Any suggestions to improve the TNA procedure

In general, the procedure is well organized. It would be nice to have more time for the elaboration of the last report. Data analysis can be a heavy task and more than 30 days would be needed to include preliminary results in the report, especially in the case of Universities, where research tasks share time with teaching activities

4.11 Improving the nutritive value estimation of multi-species forages for beef cattle by Sophie Herremans (CRA-W)

The project was withdrawn due to lack of national funding being secured.

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5 Appendix

Table 1. Overview of projects agreed on from the first call. Status at the end of 2019.

Applicant	Country	Title	Facility	Requested cow-weeks	Comments
Gareth Arnott (Queens University Belfast)	United Kingdom	Investigating links between beef cattle behaviour, temperament and diet with changes in the rumen microbiome and implications for performance	Teagasc Grange	960	Delayed due to delay in permission from Etical committee
Ruth Heering (University of Hohenheim)	Germany	Impact of physically effective fiber concentrations on chewing behavior, rumen microbial 4 protein synthesis, and nitrogen efficiency in cows	INRA Theix	48	Planned to start early 2020
Joël Berard (ETH)	Switzerland	From grassland biodiversity to animal's microbial ecosystems and cheese qualities	INRA Marcenat	560	Project finished. All reports delivered
Poulad Pourazad (Delacon)	Austria	PFA effect on methane production	INRA Marcenat	810	Planned to start January 2020
Martina Jakob (ATB)	Germany	Multiple spatially resolved reflection spectroscopy (MSRRS) - carotenoid content of the skin of cows.	SRUC Dairy INRA Le Pin	100 100	Running
Rolland Matthieu (Ajinomoto)	France	Impact of oscillating supply of essential amino acids on whole-body nitrogen partitioning, mammary gland metabolite utilization, and milk nitrogen efficiency in lactating dairy cows	Carus	68	Postponed to 2020 due to infection of the herd at the experimental facility
Noriko Nakamura (Calpis)	United Kingdom	Effects of Bacillus probiotic on productivity, health and welfare of dairy cows	WUR Dairy campus	896	Planned to start summer 2020
Lahlou Bahloul (Adisseo)	France	Essential amino acid supplementation…	Aarhus (AU2)	64	Running
Nicolaj Ingemann Nielsen (SEGES)	Denmark	Increased N-utilisation from dairy cows by phase feeding of protein	Reading CEDAR	540 (different study type)	Start january 2020
Francisco Maroto (University of Cordoba)	Spain	From feed composition to animal performance by using Near Infrared Spectroscopy	Aarhus (AU1)	480	Project finished. All reports delivered
Sophie Herremans (CRA-W)	Belgium	Improving the nutritive value estimation of multi-species forages for beef cattle	Teagasc Moorepark	16 (different study type)	Withdrawn due to lack of national funding being secured

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Table 2. Overview of projects agreed on from the second call. Status at the end of 2019.

Applicant	Country	Title	Facility	Cow weeks
Beatrice Zweifel (Agolin)	Ireland	Impact of Agolin Ruminant on feed efficiency and methane emissions of finishing beef cattle	SRUC, Beef 1 and beef 2	720+48
Luiza Fernandes (Ed&Fman Liquid Feeds)	Spain	An holistic approach on transforming molassess and liquid by-products into more efficient sugar based liquid feeds to increase dairy cattle efficiency	FBN, EFC barn	720*
Angela Schwarm (Norwegian University of Life Sciences)	Norway	Sustainable ruminant production: Methane emission, microbiome and immune function in dairy cattle	FBN, EFC-RespCharm	32
Ignacio Gomez Maqueda (Digitanimal)	Spain	Detection of reproductive events with smart collars suitable for extensive cattle systems	INRA, Le Pin	720
Georgina Chapman((Ed&Fman Liquid Feeds)	Ireland	The effect of a molasses based liquid feed on in vivo fibre digestion and nitrogen use efficiency	Uread, Cedar	64
Valérie Kromm (Animine)	France	Evaluation of zinc sources in dairy cattle	IRTA, Evam	720
Katerina Theodoridou (Quens University)	UK	Investigate the effect of Inclusion of seaweed on milk production, feed efficiency and rumen microbiome, of dairy cattle	IRTA, Evam	480
*** need recalculation**				

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