Horizon 2020 Programme

INFRAIA-02-2017

Integrating Activities for Starting Communities

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

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

Project ID: 730924

Deliverable number: D18.1 **Deliverable title : Access provision to the AU installations**

EC version : V1

Due date of Deliverable	**30/04/2022 (M51)**
Actual submission date	**20/05/2022 (M52)**

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement n°730924

DOCUMENT INFO

1. Author(s)

Organisation name lead contractor	Peter Lund

Author	Organisation	e-mail
Peter Lund	**AU**	**Peter.Lund@anis.au.dk**
Mogens Larsen	**AU**	**Mogens.Larsen@anis.au.dk**
Lene Munksgaard	**AU**	**Lene.Munksgaard@anis.au.dk**

2. Revision history

Version	Date	Modified by	Comments
2	20/06/2022	Peter Lund	

3. Dissemination level

PU	Public	X
CO	Confidential , only for members of the consortium (including the Commission Services)	☐

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

EXECUTIVE SUMMARY

Background	In the frame of SmartCow project, AU has made access it Research Installation "Danish Cattle Research Centre" through Trans National Access (TNA).
Objectives	This Deliverable aims at describing the TNA provided by AU during the SmartCow project.
Methods	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.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°730924

Table of contents

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°730924

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

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
From feed composition to animal response by using Near Infrared Spectroscopy	Fransisco Maroto	University of Cordoba	Spain	AU1	28-05-2019	22-07-2019	480
Essential amino acid supplementation	Lahlou Bahloul	Adisseo	France	AU2	30-09-2019 09-02-2020	25-12-2019 09-04-2020	64
Magnesium butyrate in periparturient dairy cows: effect on rumen redevelopment and potential impact on ruminal nutrient absorption	Joan Edwards	Palital Feed Additives	The Nederlands	AU2	01-10-2021	21-12-2021	60

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°730924

2 Final reports of the each TNA provided

2.1 TNA 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.

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

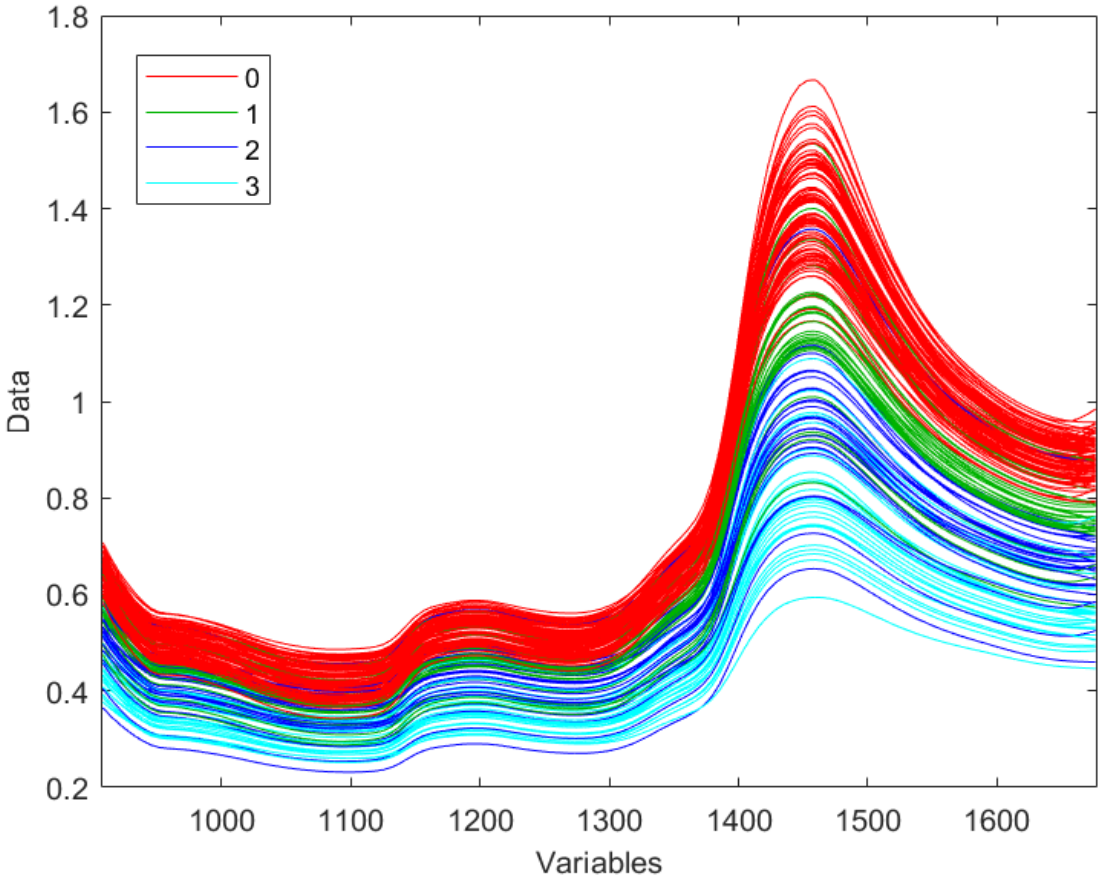
The main scientific outcome, innovation/impact of the results

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 dairy 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 theorical 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.

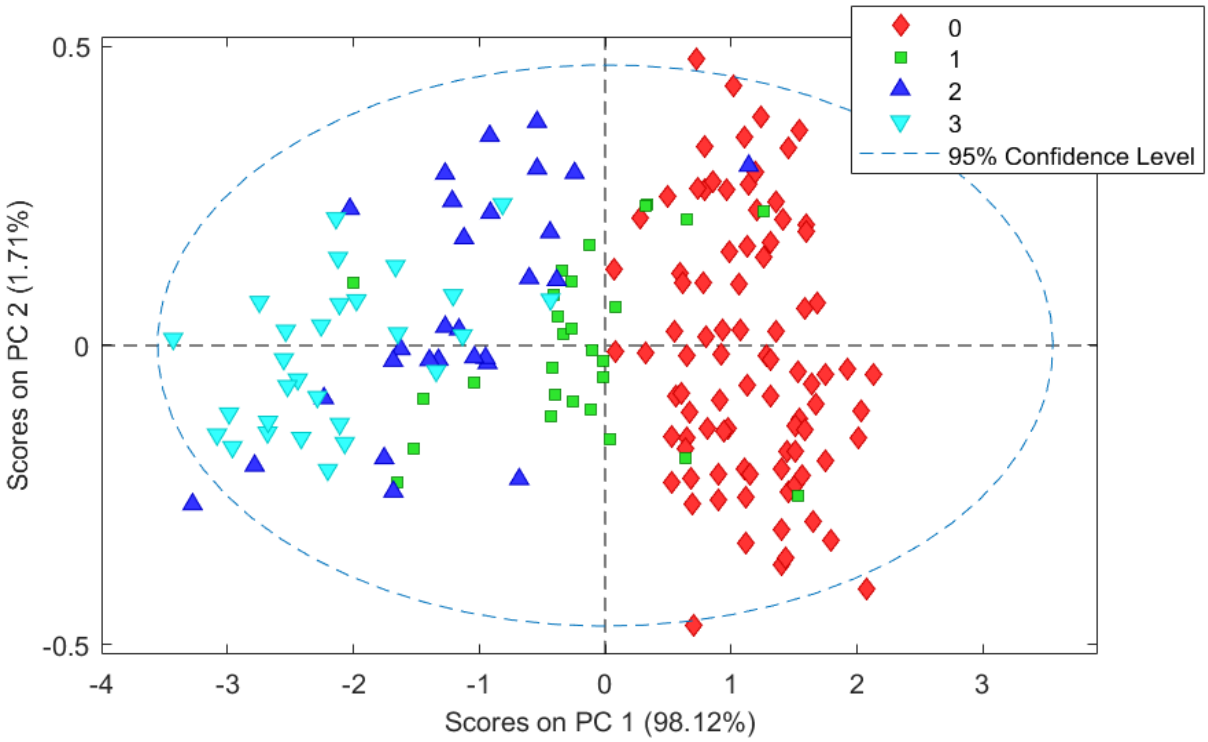
We planned to have 4 TMRs with variable composition during the experiment, in order to have variability in animal response (needed for NIRS calibrations). For that, we replaced a portion of the high-quality forage in the ration with straw (0, 5, 10 and 15% in the different experimental groups). We can see this variability in the spectral signals of the different diets:

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°730924



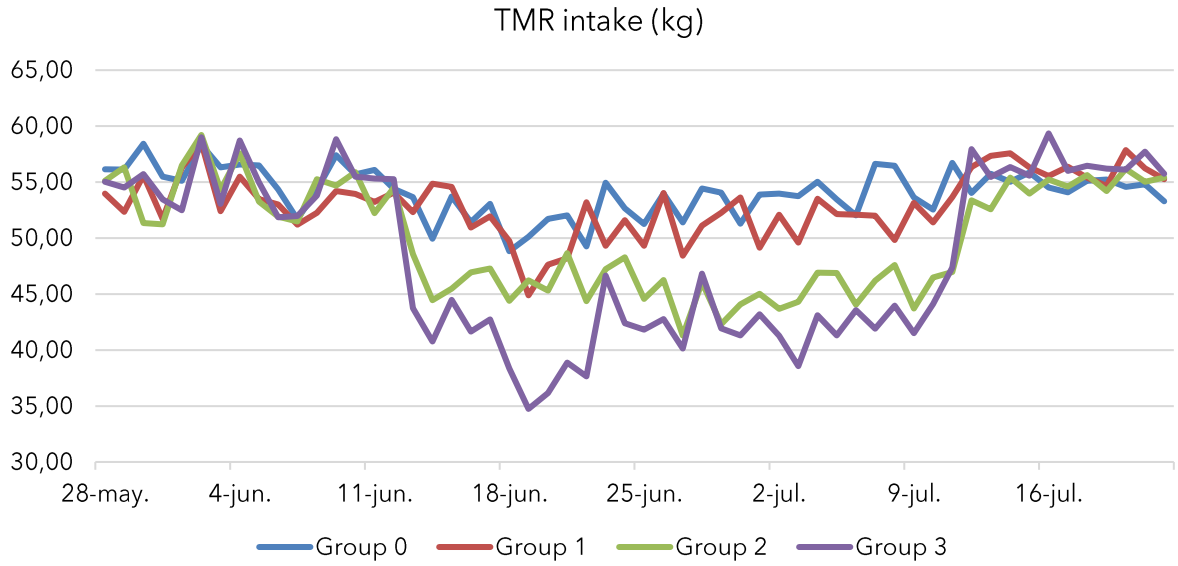
However, in the PCA below, we can see that there is also some overlap between the different types of diets. For example, some samples of diet 1 (5% replaced) are similar to some samples of diet 0 (0% replaced - control) and others to samples of diet 2 (10% replaced).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°730924



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:

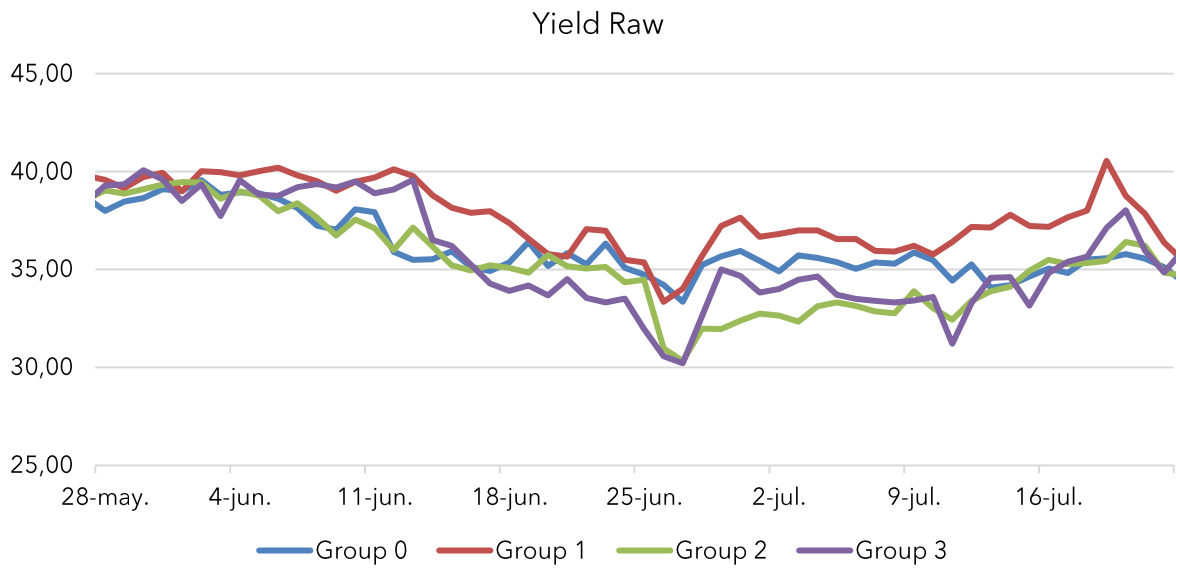


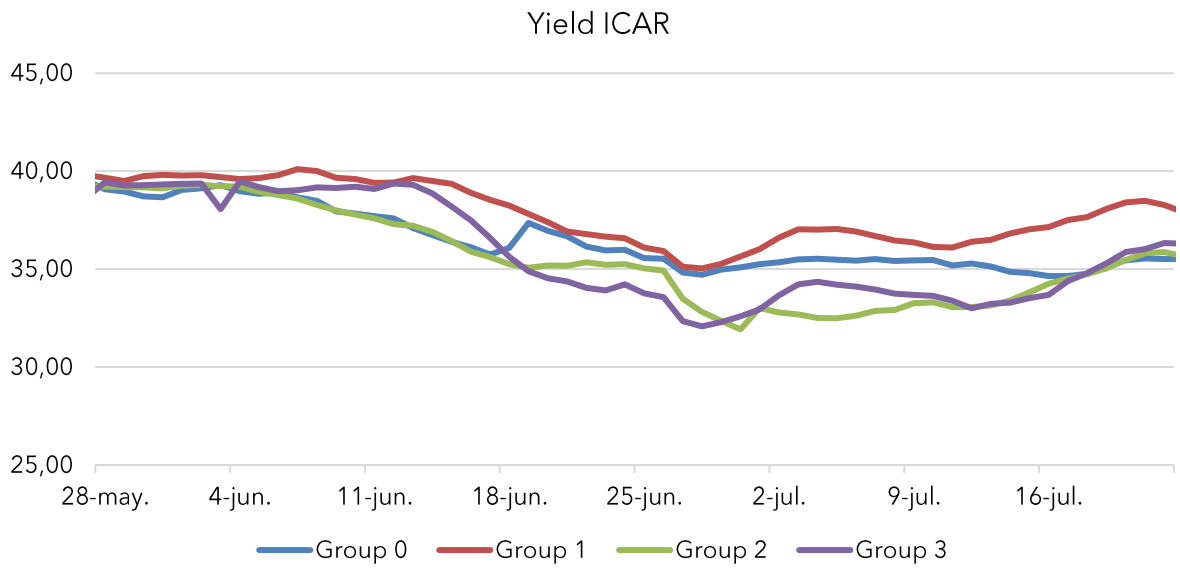
At the beginning and the end of the experiment, all animals were eating the control diet, and they have a similar TMR DM intake. During the experimental phase, cows were divided in four groups, three of them eating altered diets. Cows in experimental diets ate less kg of TMR and the change was bigger 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

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°730924

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):





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 as a co-variable. 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.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°730924

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, etc. 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.

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

2.2 TNA 2

Hypothesis, objectives and results

Combined objective of more cost effective and less polluting dairy farms could be met, without compromising productivity, through a reduced input of dietary protein, with rations balanced for individual essential amino acids (EAA). In recent research, substantial increments in milk yield (MY) and marginal N efficiency were reported with increased supply of digestible protein in early lactation. However, it is not known if this large impact could be obtained by increasing the supply of only a few EAA. Indeed, recommendations for individual EAA were determined mainly from data from mid-lactation cows. Furthermore, the N efficiency would be even higher if MY increases via the supply of targeted EAA rather than supplying all AA. Our hypothesis is that supplementation of

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°730924

targeted EAA in early lactation will increase MY, N efficiency, and decrease metabolic disorder incidence

Our objective was to investigate the effect of continuous abomasal infusion of total AA (TAA) or only essential AA (EAA) in early postpartum dairy cows on performances and metabolism. Nine multiparous Holstein cows were used in a randomized block design with repeated measurements at 5, 15, 29, and 50 days in milk (DIM). At calving day, TAA (n=4; casein profile) or only EAA (n=5; EAA portion of TAA) was initiated. The TAA was graduated with half of full dose at 1 day in milk (DIM), full dose (805 g/d) at 2 to 5 DIM, and followed by daily reductions until 0 g/d at 35 DIM. Cows received the same TMR (NE: 6.85 MJ/kgDM, MP: 102 g/kgDM). Feed intake and milk yield were recorded daily. Milk samples and six sets of tail and mammary venous plasma samples were obtained at sampling days. The DMI did not differ between treatments (P=0.55). Overall, with no treatment × DIM interaction (Trt×d), milk yield was greater with TAA compared with EAA (P<0.01; 47.9 vs 39.3 kg/d, SEM=1.4) as was milk protein yield (P=0.01; 1635 vs 1393 g/d, SEM=50). Milk fat content was lower with TAA compared with EAA (P=0.02; 41 vs 47 g/kg, SEM=1.5), but treatments did not affect milk fat yield (P=0.20). The arterial total EAA concentration was lower (Trt×d=0.01; SEM=0.07) with TAA compared with EAA at 5 (0.97 vs. 1.24 mM) and 15 DIM (0.97 vs 1.13 mM). The arterial total non-EAA concentration was higher (Trt×d<0.01; SEM=0.04) with TAA compared with EAA at 5 DIM (1.35 vs. 1.17mM). Yet, plasma concentration differences across the udder of EAA and non-EAA did not differ between treatments (P>0.88), indicating that the intra-mammary utilization of both EAA and non-EAA was changed. Arterial urea concentration was greater (Trt×d=0.02; SEM=0.21) with TAA compared with EAA at 5 (2.87 vs. 1.75 mM) and 15 DIM (3.06 vs. 1.90 mM) indicating catabolism of some of the AA supplied with TAA in early but not later lactation. Results indicate that some of or all non-EAA are as important as EAA in the early postpartum period. Continued higher milk yield through 50 DIM with TAA after ceasing infusions indicate a carry-over effect.

How do you expect to disseminate the results

These results will be published during 2022.

Any suggestions to improve the TNA procedure

No suggestions

2.3 TNA 3

The main objective of the project

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°730924

The original objective of the proposal was to verify the proposed ruminal mode of action of magnesium butyrate (Rumen-Ready®) using rumen fistulated periparturient cows fed with or without magnesium butyrate for three weeks prior to calving. This involved key measurements of rumen wall surface area. However, due to a limited amount of remaining SmartCow budget this was not possible. Instead, a similar trial approach was planned using intact animals (n=6 per treatment), in conjunction with stomach tubing (one time point per sampling day) and rumen bolus devices, in order to gain mechanistic insights of how magnesium butyrate influenced the rumen, feed intake, performance and blood based markers.

The hypothesis that are tested

It was hypothesized that due to magnesium butyrate increasing the rumen wall surface area prepartum, resulting in the rumen being more effective in absorbing VFA postpartum and having an optimal rumen pH. Associated with this a higher milk yield was anticipated during early lactation without an increase in feed intake – i.e. the increased milk is associated with improved feed efficiency as a consequence of a more optimal rumen pH and VFA absorption.

In the experiment, before (day (d)-21, d-10) and after (d+0.5 to 1.5, d+7, d+14, d+21, d+28) calving, parameters from the rumen (i.e. VFA molar proportion and microbiota) and blood (i.e. NEFA, BHB, glucose, haptoglobin) will be assessed along with feed intake (d-21 to +28), rumen pH (d-21 to +28) and colostrum/milk yield and composition (d0 to +28).

Rumen microbiota samples were collected for potential metagenomic sequencing in order to assess the impact of the magnesium butyrate treatment on the rumen microbiota.

The main scientific outcome, innovation/impact of the results

The main scientific outcome of the study is not known yet as the data is not fully available or analyzed at this point. Due to one of the cows (control group) developing ketosis during early lactation, this animal will have to be removed from the postpartum dataset. As a consequence of two cows (both control group) calving early, the feed intake and rumen pH data will only be analyzed from d-14 to +28, unlike the planned d-21 to+28.

It is anticipated that the trial findings will generate novel insights into the value of feeding of magnesium butyrate to prepartum cows, and the benefits of stimulating earlier rumen redevelopment. This is important as previously published studies looking at the value of butyrate for transition cows failed to find positive effects.

Any other achievements of the visit

As well as facilitating the planning of the experiment, the visit also enabled the range of dairy cow facilities and capabilities at DKC to be fully appreciated and valuable in-person meetings with the

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°730924

researchers involved. This helps build a strong foundation for planning future research projects at Aarhus.

How do you expect to disseminate the results

It is anticipated that the results will be disseminated via a peer reviewed publication as well as related activities by Palital in terms of social media, webinars and articles in dairy industry journals.

Any suggestions to improve the TNA procedure

I would suggest that the users be asked to indicate how they intend to handle the data processing and statistical analysis if this is not being funded as part of the project. I am now finding the execution of the statistical analysis of the trial data challenging as I had not given this enough thought/attention earlier.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°730924