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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

Background	In the frame of SmartCow project, UREAD has made access it Research Installation “CEDAR” through Trans National Access (TNA).
Objectives	This Deliverable aims at describing the TNA provided by UREAD 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.

Table of contents

1	TNA provided	5
2	Final reports of the each TNA provided.....	6
2.1	TNA 1 Georgina Chapman ED&F MAN.....	6
2.2	TNA 2 Nicolaj Nielsen SEGES	8



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
Increased N-utilisation in dairy cows by phase feeding of protein	Nicolaj Nielsen	SEGES	Denmark	Applied Unit.	01/07/2019	01/08/2020	540
The effect of a molasses based liquid feed on in vivo fibre digestion and nitrogen use efficiency	Georgina Chapman	ED&F MAN	Ireland	Applied Unit. Respiration Calorimetry & Digestibility	19/06/2019	31/08/2019	94

2 Final reports of the each TNA provided

2.1 TNA 1

The main objective of the project

Previous *in vitro* rumen fermentation studies found increased nitrogen efficiency, fibre digestion and improved pH when a molasses based liquid feed was added to a dairy cow diet. The objective of the current study was to investigate the effect of incremental diet inclusion of a molasses based liquid feed (Regumix) in a lactating dairy cow ration on fibre digestibility, nitrogen utilisation and rumen pH. In addition to digestibility measurements, various production parameters were also measured including milk production and composition, dry matter intake and diet sorting. The rationale for this project is based on supporting sustainable farming by increasing the efficiency of home-grown forage utilisation and so reducing the reliance on bought in feeds. The improvement of fibre digestion can allow greater energy extraction from home grown feeds and improving nitrogen retention can lower the environmental impact of animal production by potentially reducing the amount of nitrogen excretion therefore, supporting long term sustainability on farm. If positive results are obtained, this will encourage further research to determine the extent to which molasses based liquid feeds can enable lower protein diets to be fed commercially.

The hypothesis tested

The hypothesis is that the treatment diet will improve whole tract fibre digestion and efficiency of nitrogen capture. Consequently, animal health performance will be improved in the treatment group in terms of milk yield, milk components and a more optimum rumen pH maintained. Sorting of feed will also be reduced in the treatment group due to the addition of a molasses based liquid feed.

The main scientific outcome, innovation/impact of the results

Sixteen cows were blocked in groups of four based on milk yield and stage of lactation then randomly assigned to one of the four dietary treatments in a 4 x 4 x 4 Latin Square design balanced for first order carry over effects. Three squares were used for production measurements and the fourth square was used for both production and digestion measures. Treatments periods were four weeks in duration and cows were incrementally adapted to new diets over four days at the beginning of each period.

Measurements for the fourth square consisted of milk yield and composition, diet intake and digestion, and urinary N excretion were obtained using total faecal and urine collection over the last five days of each period. Reticular pH was measured using a wire-less rumen pH bolus. Cows were fed a control diet composed of grass silage, maize silage and concentrate blend. Treatments were three levels of Regumix included to achieve intakes of 0.7, 1.4 and 2.1kg as fed, proportionally diluting the other diet components. This resulted in isonitrogenous and iso energetic diets with differing



concentrations of carbohydrate fractions. Regumix is a high protein molasses based liquid feed with a typical dry matter specification of 68% dry matter, 27% crude protein, 53% sugar and 13.1 ME.

The digestion results found that increasing inclusion of Regumix increased neutral-detergent fibre ($P<0.024$) and acid-detergent fibre ($P<0.088$) digestibility in a quadratic manner, with an increase in NDF and ADF digestibility over control of 33 ($P<0.052$) and 29 ($P<0.043$) g/kg respectively for the 1.4kg/d Regumix inclusion. N retention increased numerically with increasing Regumix and milk N output numerically decreased, but the effect was not significant. Milk yield and composition, digestion of other diet components and rumen pH were unaffected by Regumix inclusion in this square. In conclusion, adding 1.4kg of Regumix to a lactating dairy cow ration significantly increased fibre digestion without negatively affecting the rumen environment.

The production results were not as expected as dry matter intake decreased numerically with increasing Regumix, although the effect was not significant. Both energy corrected milk yield and fat corrected milk yield significantly decreased over control of 1.05 ($P<0.05$) and 1.09 ($P<0.05$) kg respectively for the 1.4kg/d Regumix inclusion. However, the original plan was for the increasing inclusion of Regumix to replace a proportion of the concentrates in the diet and the forage level to remain constant. However, the diets that were formulated proportionally diluted both the forage and concentrate components of the TMR thereby removing an increasing proportion of fibre from the diet with increasing Regumix. This is likely the cause for the different production results compared to other nutrition studies which have found the addition of a molasses based liquid feed to increase milk production, milk fat yield and dry matter intakes.

The digestion results show that the inclusion of a molasses based liquid feed can significantly increase fibre digestion and maintain an optimum rumen pH even when fed at high levels. This is a promising start to highlighting the benefits of a molasses based liquid feed as part of a long-term sustainability strategy on farm and utilizing less carbon expensive by-product feeds. Further research is warranted to investigate further the effects on N utilisation in lower protein diets as a strategy to encourage lower protein diets to be fed commercially without negatively affecting animal performance.

Dissemination of the results

The findings have been submitted as an abstract to EAAP 2021 and will also be presented at both internal and external conferences around the UK. Further abstract submissions will be made to Total Dairy to take place in October 2021.

We work with most agricultural merchants within the UK, these results will be shared with all and passed on to customers. The findings of this study will also be distributed through key agricultural journals and press, including Feed Compounder, British Dairying, Dairy Farmer, Farmers Weekly and Farmers Guardian.

The findings will also be communicated globally through our internal company portal to be shared with our international teams, this is including 15 European countries, each will receive a copy of the research results and this can be distributed through our network into the EU farmer base.

2.2 TNA 2

The main objective of the project

The objective of this study is to increase feed N-utilisation and milk yield in dairy cows by the targeted use of quantity and quality of feed protein during early lactation.

The hypothesis tested

Cows getting high supply of metabolisable protein the first few weeks after calving will have higher milk yield and better N-utilisation than cows fed a common TMR with 17% crude protein.

The main scientific outcome, innovation/impact of the results

The results was not as clear as we had expected. There was tendency towards higher ECM-yield for phase fed cows compared to control, however only in a few weeks and not for the whole trial period of the first 15 weeks of lactation. Therefore, the effect of N-utilisation was not that clear either. There is a need for further test of feeding high AAT should happen immediately after calving in contrast to what we did, namely supply the high AAT 4-5 days after calving. Furthermore, there was a surprisingly big difference in milk yield in period '1' between 2 tretmeants, that was fed the same diet. This difference is despite a lot of effort and work still unexplained.

The results will be a part of the foundation for new feeding and grouping strategies that will increase N-utilisation and milk yield in dairy cows. The results from this trial and other trials will form the basis for implementation of phase feeding on a number of commercial pilot farms in Denmark.



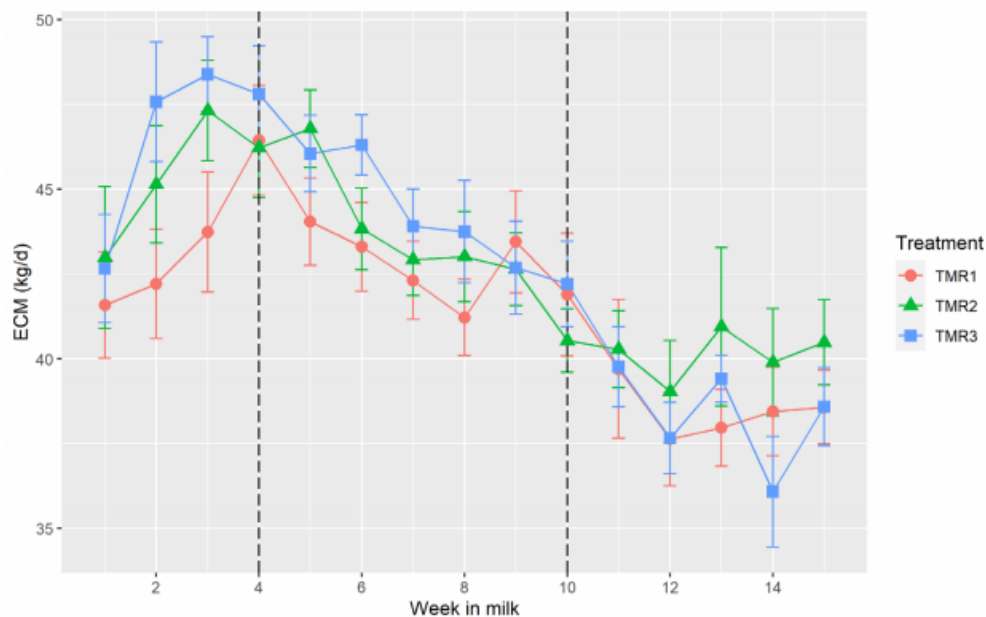


Figure 3. Weekly means of energy corrected milk (ECM) (Sjaunja et al., 1991) for each experimental week over the whole experimental period with \pm SE. Dashed lines distinguish between periods 1, 2 and 3. TMR1 has diet 17 AAT (g amino acids absorbed per MJ NEL) in all periods, TMR2 has diet 20 AAT in period 1 and 16 AAT in periods 2 and 3, TMR3 has diet 20 AAT in period 1, diet 17 AAT in period 2 and diet 15 AAT in period 3.

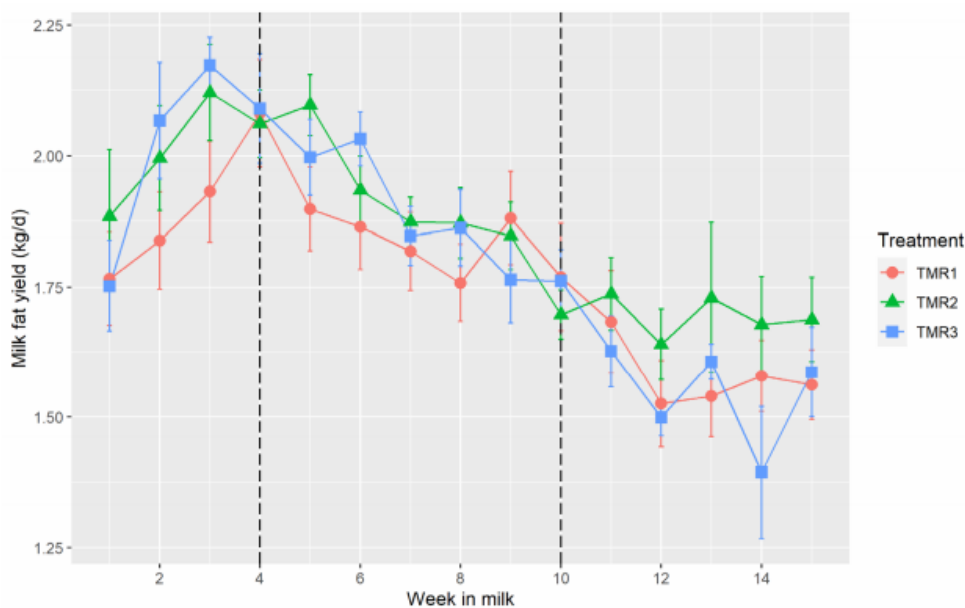


Figure 6. Weekly means of milk fat yield of the treatments with \pm SE. Dashed lines distinguish between periods 1, 2 and 3. TMR1 has diet 17 AAT (g amino acids absorbed per MJ NEL) in all periods, TMR2 has diet 20 AAT in period 1 and 16 AAT in periods 2 and 3, TMR3 has diet 20 AAT in period 1, diet 17 AAT in period 2 and diet 15 AAT in period 3.

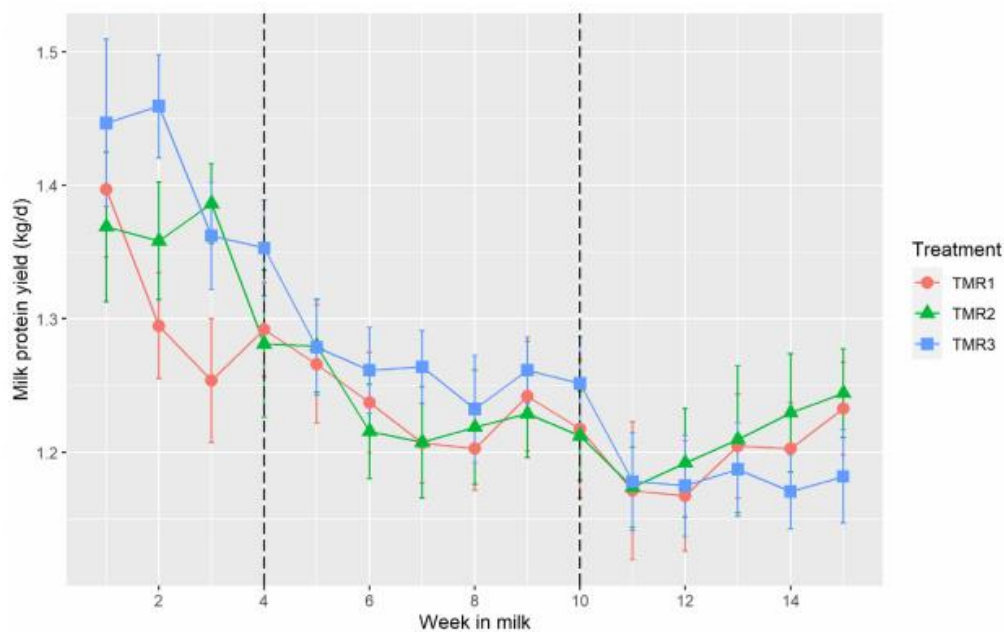


Figure 8. Weekly means of milk protein yield of the treatments with \pm SE. Dashed lines distinguish between periods 1, 2 and 3. TMR1 has diet 17 AAT (g amino acids absorbed per MJ NEL) in all periods, TMR2 has diet 20 AAT in period 1 and 16 AAT in periods 2

Visits

Due to Covid19 there was no visit to Reading University

Dissemination of the results

Report to dairy-advisors and farmers

Presentations of the main findings at Dairy nutrition seminar in September 2021 or Cattle Congress in February 2022

Suggestions to improve the TNA procedure

The TNA procedure is a super and fruitful initiative – due to Covid19 we (SEGES) could not see the facility in Reading which was not ideal. However, the setup with TNA is good!