Peer Community In
Animal Science

A focus on feed efficiency reproducibility and repeatability of dairy cows fed different diets over the lactation stage.

Alberto Atzori *based on peer reviews by* ***Angela Schwarm***, ***Ioannis Kaimakamis*** *and 2 anonymous reviewers*

Amelie Fischer, Philippe Gasnier, philippe faverdin (2022) Feed efficiency of lactating Holstein cows was not as repeatable across diets as within diet over subsequent lactation stages. bioRxiv, ver. 3, peer-reviewed and recommended by Peer Community in Animal Science. https://doi.org/10.1101/2021.02.10.430560

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The topic of feed efficiency is under discussion in the scientific community and several studies pointed out that lactation stage has to be accounted for when estimates of feed efficiency are carried out, especially for genetic ranking of animals and their performances, as highlighted by Li et al. (2017). Other researchers applied a latin square design to test dietary effects across lactation (Ipharraguerre et al. 2002) but this approach cannot be followed out of experimental conditions and particularly does not allow, nowadays, to valorize precision livestock farm data to get phenotypic information from individual animals at farm level.

The current manuscript by Fischer, et al. (2022a) describes an experimental trial in which cows were first fed a high starch diet-low fibre then switched over to a low starch diet-high fibre and individually monitored over time. Data were analyzed with the objective to investigate effects within diets and across diets. Since all cows went through the same sequence at the same time it was not possible to completely separate the confounding effect of lactation stage and diet as stated by the authors. However, this manuscript adds methodological discussions and opens research questions especially to the matter of repeatability and reproducibility of feed efficiency of individual animals over the lactation stage. These variables are fundamental to evaluate nutritional traits and phenotypic performances of dairy cows at farm level, as highlighted by a paper of the same first author (Fischer, et al. 2022b) dealing to reproducibility and repeatability with a similar approach. My opinion is that this manuscript gives the opportunity to enlarge the scientific discussions on the calculation of repeatability and reproducibility of feed efficiency of individual animals over time. In particular, as in this study, specific mathematical approaches need to be carried out with the final goal to analyze and valorize precision livestock farm

data for cow phenotyping and to propose new methods of feed efficiency evaluations. It also needs complete databases carried out under experimental conditions. In fact it has to be considered that this manuscript makes available to the scientific community all the data and the R code developed for data analysis giving the opportunity to replicate the calculations and propose new advancements in the feed efficiency evaluations of dairy cows.

References:

Fischer A, Gasnier P, Faverdin P (2022a) Feed efficiency of lactating Holstein cows was not as repeatable across diets as within diet over subsequent lactation stages. bioRxiv, 2021.02.10.430560, ver. 3 peer-reviewed and recommended by Peer Community in Animal Science. https://doi.org/10.1101/2021.02.10.430560

Fischer A, Dai X, Kalscheur KF (2022b) Feed efficiency of lactating Holstein cows is repeatable within diet but less reproducible when changing dietary starch and forage concentrations. animal, 16, 100599. https://doi.org/10.1016/J.ANIMAL.2022.100599

Ipharraguerre IR, Ipharraguerre RR, Clark JH (2002) Performance of Lactating Dairy Cows Fed Varying Amounts of Soyhulls as a Replacement for Corn Grain. Journal of Dairy Science, 85, 2905–2912. https://doi.org/10.3168/JDS.S0022-0302(02)74378-6

Li B, Berglund B, Fikse WF, Lassen J, Lidauer MH, Mäntysaari P, Løvendahl P (2017) Neglect of lactation stage leads to naive assessment of residual feed intake in dairy cattle. Journal of Dairy Science, 100, 9076–9084. https://doi.org/10.3168/JDS.2017-12775

Reviews

Evaluation round #2

Reviewed by anonymous reviewer 1, 13 June 2022

I appreciate all the efforts of authors in improving manuscript and addition of a supplemental paragraph in which they tried to advise readers about "limits of the study". They tried to support their point of view also citing an under-review paper wrote by a scientific authoritative authors as Fischer et al. Sincerely, my opinion on this manuscript did not change and, despite I found a lot of merit in other methodological approaches and general idea of this trial, I retained the experimental structure adopted did not permit to the authors to properly respond to the aim of the authors. Consequently, I still believe the adopted statistical approach make this manuscript not suitable for publication in a scientific Journal.

Reviewed by Angela Schwarm, 07 May 2022

the authors have implemented all comments as suggested, or provided a good explanation if not.

Evaluation round #1

DOI or URL of the preprint: **https://doi.org/10.1101/2021.02.10.430560**

Authors' reply, 01 March 2022

Download author's reply

Decision by Alberto Atzori, posted 12 November 2022

Revision

Dear Authors Apologies for the long process of the evaluation of your article.

The reviewers have finally sent their evaluation. Please address the reviewer comments. In particular, reviewer 1 raised a major methodological issue. Please provide a detailed response to this issue. Sincerely, PCI Recommender Alberto Stanislao Atzori

Reviewed by anonymous reviewer 1, 21 April 2021

I read and evaluated the article entitled "Feed efficiency of lactating Holstein cows is less reproducible when changing dietary starch and fibre concentrations than within diet over subsequent lactation stages" https://doi.org/10.1101/2021.02.10.430560. My main concern regards the experimental structure of the dairy cow trial, and I preferred to present it immediately to the authors. In particular, authors declared the main objective of the study was "...analysed the ability of lactating dairy cows to maintain their feed efficiency while changing the energy density of the diet by changing its concentration in starch and fibre", but they failed in verifying this because the adopted experimental design did not permit to properly separated the diet by period effects. I believe authors realized this when declared "The decrease in dietary net energy for lactation and in metabolizable protein was confounded with the increase of lactation stage as the experimentation was based on a sequential design. Therefore when effect of diet is mentioned here, it is confounded with the effect of lactation stage". Sincerely, this confused me because when an experimental design was planned, the main sources of variation in response parameters (at least the expected ones) should be properly controlled to avoid confusion about experimental terms of statistical model. Despite I found a lot of merit in other methodological approaches and general idea of this trial, I retained the experimental structure adopted did not permit to the authors to properly respond to the aim of the trial. Unfortunately, I am unable to suggest a possible solution for properly overcoming this – in my opinion – strong methodological issue.

Reviewed by Ioannis Kaimakamis, 03 October 2021

The background section is cleraly and expalins the motivation and thw challenge of thw sudy. This research deals with a big issue on animal production and efficiency measurement. The experimental and the design of the research establishment well and with details. The variables selection are detailing with a strong references background. Also, the mathematical and statistical analyses are appropriate. The results section is clearly with a high value explainotary data and methods descrite.

The discusion and conclusion analysis are acceptable. The conclusions supported by the results . The references are appropriate and the main references are present.

I fully recommend the publicity of this research article.

Reviewed by Angela Schwarm, 17 December 2021

I enjoyed reading this manuscript on the reproducibility of feed efficiency between an early lactation diet and a later lactation diet fed to 60 cows, and the repeatability of feed efficiency within diet. The authors discuss the sequential design and show that results are valid despite limitations. Two different indicators for feed efficiency were used, the CCC indicator and the errors indicator and the authors conclude that the former is more suitable to be used by animal breeders, whereas the latter is more suitable for farmers.

The title, abstract, and introduction could be improved to better reflect the content of the methods, results and discussion. The title could include the term repeatability (alternatively you could move graphs on repeatability to the supplements) and the use of different indicators for assessing feed efficiency, e.g. Feed efficiency was less reproducible across diets than repeatable within diet using two indicators.

Suggest to rephrase the last sentence of the abstract, e.g. to confirm on different ratios of forage to concentrate. During dry-off period/forage only the rank of feed efficiency can change because feeding costs are lowest.

Introduction, the motivation for the study and the research question could be more clearly presented by indicating the Fischer et al. reference as well as the two indicator methods. Reasoning for measurement of methane and carbon dioxide should be mentioned in the introduction.

Materials and methods, more details should be provided for the methods and analysis:

-nutrients in feed were not analysed by wet chemistry but only assessed by NIR spectra. Suggest to indicate one or more references about the correlation of feed nutrient contents analysed with NIR spectra as compared to wet chemistry. As far as I remember e.g. fiber content might be less accurate than protein content in NIR compared to wet analyses. In wet chemistry, it is differentiated between NDF/ADF and ash corrected aNDFom/ADFom, I guess the NIR spectra would reflect rather the uncorrected NDF/ADF, but then comparisons of fiber contents between diets is restricted to those with similar ash contents. How much did the diets differ in ash content?

Table 1: -add organic matter content (ash was determined, so you should be able to calculate DMI-ash=OM); -is the amount of energy concentrate provided through the GreenFeed included in the energy concentrate listed in Table 1? Indicate in the running text as well (L135+) and state if concentrate feeder additional to GreenFeed was used or if a mixed ration was provided including the energy concentrate.

-why was methane and carbon dioxide measured?, L207 section does not include CH4 energy loss

-Line 172 and carbon dioxide as well, not only methane

-Indicate maximum number of visits per day or give an average of number of visits per day to indicate accuracy of the methane production measured.

As far as I can judge, the statistical analyses appears appropriate. The definition of significance $p<0.05$? is missing, add to the methods.

Results. Reviewers are asked to «check that raw data are available to the reader.», are the raw data available?

Figure 4,5 E+P+ diet defined in the figure legend as high starch-low fiber diet instead of high starch/energy-high protein as the acronym suggests. With metabolizable protein and net energy being only different by 10%, but starch and NDF being different by 19% and 16%, respectively, consider to use acronyms S+F- vs. S-F+ instead of E+P+ vs. E-P- to be consistent with manuscript title, introduction, discussion.

-L331, higher feed efficiency = higher CH4/DMI, cite other studies in the discussion which are in line with this observation.

Discussion. Suggest to rephrase the manuscript title, the heading of the first section of the discussion and the first sentence of the first section of the discussion to be less contradictive:

Manuscript title: Feed efficiency of lactating Holstein cows is less reproducible when changing dietary starch and fibre concentrations than within diet over subsequent lactation stages

Heading of first section of discussion: Feed Efficiency was nearly as reproducible across diets than repeatable within diet

First sentence in first section of discussion: Feed efficiency was less reproducible across diets than repeatable within diet …

-when comparing the sub-period 2 E+P+ with the sub-period 1 E-P-, the adaptation periods are not equally long, but 36 days for sub-period 2 E+P+ and 23 days for sub-period 1 E-P-, please discuss.

L420, where do you depict the cow's ranking in feed efficiency according to CCC? The cow's ranking 1 to 60 could be indicated in a supplemental table.

L506 was the difference in NDF (16%) too small to change milk fat contents? How big was the difference in NDF content between diets in other studies that found a difference in milk fat contents? Suggest to add to discussion.

L548, significant higher DMI and aD?

L554, suggest to move the limitations of the study from the end to the start of the discussion.

I do not want to claim that it is necessary to cite Pekka Huhtanen, but he did pioneering work in feed efficiency estimation. By this mean you would also include a reference from 2021 in your reference list.

Wording/Formatting:

L293, exported -> partitioned

L308, smaller? rephrase

L524, hard -> difficult

Figure 2, indicate Figure 2a,b,c?!

Reviewed by anonymous reviewer 2, 29 December 2021

The manuscript entitled ”Feed efficiency of lactating Holstein cows is less reproducible when changing dietary starch and fiber concentrations than within diet over subsequent lactation stages” reports an interesting work on the evaluation of feed efficiency following the change of the ration in terms of starch level and fiber.
The work is well written with an in-depth description of the state of the art and the methodologies adopted.
Here are some details that deserve to be specified or deepened, for a better understanding of the work:

· Lanes 264-265: to estimate repeatability, state that you have used a fittied within each diet analysis of variance. It would be to provide a more detailed description of this statistical model.
· Lane 266: replace “die” with “diet”.