





Peer Community In Animal Science

Optimizing growth rate of dairy heifers through nutrition to maximize reproduction and production

Luis Tedeschi  based on peer reviews by **Emilio Mauricio Ungerfeld**  and 2 anonymous reviewers

Yannick Le Cozler, Julien Jurquet, Nicolas Bedere (2019) Effects of feeding treatment on growth rate and performance of primiparous Holstein dairy heifers. Missing preprint_server, ver. Missing article_version, peer-reviewed and recommended by Peer Community in Animal Science. <https://doi.org/10.1101/760082>

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The idea of altering the growth rate of replacement heifers to improve reproductive and productive indicators of dairy cattle is not new. In the late 1970s, Gill and Allaire [1] indicated that the first parturition between 22.5 to 23.5 months of age yielded the optimum lifetime performance as long as the heifers had adequate body size [2]. Since 1980s, many studies have been conducted to understand the partitioning of energy between growth and lactation, including the impact of growth rates on the heifer puberty [3] as well as growth and development of the mammary gland [4,5]. The senior author of the recommended study has written previously about this research topic [6]. In the present manuscript, Le Cozler *et al.* studied the effect of feeding programs to increase the growth rate of late-born heifers to catch up with the growth of those born earlier in the calving season on their reproductive and productive performance. The authors analyzed 217 heifers for three consecutive years, split into three dietary treatments: control (C), accelerated growth rate from birth to 6 months of age (ID1), or accelerated growth rate from birth to 12 months of age (ID2). In this study, the late-born heifers receiving the ID2 treatment were able to partially reach the bodyweight of the early-born heifers at 24 months of age. In part, the incomplete understanding of the prioritization of the use of energy (and other nutrients) for different physiological stages (e.g., maintenance, growth, lactation, and pregnancy) of the dairy animal [7] undercuts the development of more robust feeding strategies to improve the reproductive and productive performance of the animal. In the recommended study by Le Cozler *et al.*, although there was no impact on reproductive performance among groups, heifers in the group ID2 produced less milk (about 400 kg for the whole first lactation) than heifers in the groups C and ID1, apparently suggesting that energy

allocation for growth had priority over that needed for lactation. The question then becomes what would have happened with energy partitioning if energy intake was restricted. Studies like this one are important to shed some light on the prioritization of the use of energy and other nutrients in support of growth, pregnancy, and lactation of dairy animals, and how compensatory growth differs between meat versus dairy growing animals, both physiologically and energetically.

References:

- [1] Gill, G. S., & Allaire, F. R. (1976). Relationship of Age at First Calving, Days Open, Days Dry, and Herdlife to a Profit function for Dairy Cattle¹. *Journal of Dairy Science*, 59(6), 1131–1139. doi: [10.3168/jds.S0022-0302(76)84333-0]([https://dx.doi.org/10.3168/jds.S0022-0302\(76\)84333-0](https://dx.doi.org/10.3168/jds.S0022-0302(76)84333-0))
- [2] Hoffman, P. C. (1997). Optimum body size of Holstein replacement heifers. *Journal of Animal Science*, 75(3), 836–845. doi: [10.2527/1997.753836x](<https://dx.doi.org/10.2527/1997.753836x>)
- [3] Cardoso, R. C., Alves, B. R. C., Prezotto, L. D., Thorson, J. F., Tedeschi, L. O., Keisler, D. H., ... Williams, G. L. (2014). Use of a stair-step compensatory gain nutritional regimen to program the onset of puberty in beef heifers. *Journal of Animal Science*, 92(7), 2942–2949. doi: [10.2527/jas.2014-7713](<https://dx.doi.org/10.2527/jas.2014-7713>)
- [4] Sejrsen, K., Huber, J. T., Tucker, H. A., & Akers, R. M. (1982). Influence of Nutrition on Mammary Development in Pre- and Postpubertal Heifers¹. *Journal of Dairy Science*, 65(5), 793–800. doi: [10.3168/jds.S0022-0302(82)82268-6]([https://dx.doi.org/10.3168/jds.S0022-0302\(82\)82268-6](https://dx.doi.org/10.3168/jds.S0022-0302(82)82268-6))
- [5] Sejrsen, K., & Purup, S. (1997). Influence of prepubertal feeding level on milk yield potential of dairy heifers: a review. *Journal of Animal Science*, 75(3), 828–835. doi: [10.2527/1997.753828x](<https://dx.doi.org/10.2527/1997.753828x>)
- [6] Le Cozler, Y. L., Lollivier, V., Lacasse, P., & Disenhaus, C. (2008). Rearing strategy and optimizing first-calving targets in dairy heifers: a review. *Animal*, 2(9), 1393–1404. doi: [10.1017/S1751731108002498](<https://dx.doi.org/10.1017/S1751731108002498>)
- [7] Tedeschi, L. O., and D. G. Fox. 2018. *The Ruminant Nutrition System: An Applied Model for Predicting Nutrient Requirements and Feed Utilization in Ruminants*. (2nd ed.). XanEdu, Acton, MA."

Reviews

Evaluation round #2

DOI or URL of the preprint: <https://doi.org/10.1101/760082>

Version of the preprint: 1

Authors' reply, 04 December 2019

Dear Luis Tedeschi,

It took some hours to boiRxiv to update the online version of our manuscript, it is now the right one: <https://doi.org/10.1101/760082>

Please find the file you asked attached, it is a compilation of our answers to the reviewers' comments together with a version of the manuscript with visible edits highlighted in red and the certificate of English correction.

Sincerely, Nicolas Bédère

[Download tracked changes file](#)

Decision by [Luis Tedeschi](#) , posted 03 December 2019

Revision Round #2

Authors, the file at <https://doi.org/10.1101/760082> seems to be the original version. Please, upload the latest version (Reviewer- and English-revised version) showing all modifications in red in the text without the tracking change. The tracking change makes it hard to read. Thanks.

Evaluation round #1

DOI or URL of the preprint: <https://doi.org/10.1101/760082>

Authors' reply, 03 December 2019

To editor

We have completed all changes and corrections proposed by the 3 referees. We added information in the main text, thanks to the valuable help of the referees. The revised version of the paper has been uploaded in BioRxiv together with a supplemental figure 1 (<https://doi.org/10.1101/760082>)

Here, you will a compiled file with : • The answers to reviewers comments • The new version of the corrected paper, before English reviewing • The previous paper after English correction (with all comments, in French) • The certificate of English correction

Changes were performed on a version we sent after for English correction. Lots of changes were then performed and it was not easy to find changes done after referee proposals. This is the reason why we prefer to send you the different versions.

We wish to thank the reviewers for their advises to improve the present paper and we are now looking forward to receiving the decision.

Sincerely yours Yannick Le Cozler From January the 1st, INRA and IRSTEA merge as INRAE, we updated our addresses accordingly.

[Download tracked changes file](#)

Decision by [Luis Tedeschi](#) , posted 29 October 2019

Revision Round #1

Dear authors; three reviewers have provided comments and suggestions on various aspects of your study. Before a final recommendation by the PCI ANSC can be made, I invite you to revise your manuscript based on reviewers' feedback. Please, read carefully the information provided for authors at https://animsci.peercommunityin.org/about/help_generic#For%20authors.

Reviewed by anonymous reviewer 2, 27 October 2019

The study by Cozler et al. investigates the effects of feeding treatment on growth rates and consequences on performance in primiparous Holstein dairy heifers. Overall, the paper is well-written and the concept studied is very straightforward. The experiments are well-designed and the methodology appears to be appropriate. Findings presented in the manuscript contribute to a better understanding of the long-term

effects of nutritional management on performance traits in Holstein dairy heifers. Some minor points need to be addressed prior to final publication. Minor points: Line 21: "... an experiment was performed..." Line 26: "... although they were still..." Line 46: "... or older." Line 62: "...impact of accelerated growth" Line 66: "...designed and carried out an experiment..." Line 84: "...that, due to the feeding..." Line 139: "...grass, with the exception of..." Line 211: "2 consecutive values were not". Please state the interval between sample collection Line 211: "positive. Reductions in P4 milk..." Line 287: "...difference in the dam's BW..." Line 334: "AFS had minimal effects of fertility. Concerning ovarian..." Line 352: The present study indicates that ..." Line 367: "in a study by Johnson et al..." Line 370: "...probably explains why no difference..." Line 371: "...the amount of milk offered until weaning..." Line 384: Define IGF1 Line 397: In the present study, a negative..." Line 415: "In the present study, fertility was..." Line 415: "...In a previous study on..." Line 434: "Collectively, these results indicate that..."

Reviewed by anonymous reviewer 1, 29 October 2019

The objectives of the study were to assess the effects of feeding rearing programs on growth, reproduction and production performance of Holstein cows at nulliparous and primiparous stages. General comments The manuscript covers a relevant topic for dairy production. The material and methods section could be improved if it was more specific and improving the readability. Materials and methods L90-92: This sentence states that the expected average age at 1st AI was 15 mo. for SD and ID1 groups and 12 mo. what age for ID2. However, if ID1 groups are on an intensive plain diet wouldn't it be reasonable to expect they would reach the breeding age before the SD group? L92-93: When does the 1st season of grazing start and finish? When does pasture season 2 start and finish? Please, elaborate. L94-95: Are you talking about only milk yield or also milk components? Please, specify. L106-108: When did ID1 and 2 calves start to get 15% more since calving or after the pre-experimental phase (i.e., 10 d old)? Please, specify. L107: Table 1: In table 1: - Why is PDIE used as an acronym for metabolizable protein and not MP? I don't understand the term "rumen-degradable nitrogen", did you mean rumen-degradable protein? If so, why not use the RDP abbreviation? I don't understand the UFL concept, please explain. L110: This sentence is confusing. Remove "(i.e. turning out to pasture)" since calves were housed during this period. L227: Where were you recording all the data before uploading it to the R software? L235: Did you check if assumptions of ANOVA were not violated (e.g., normal distribution of residuals, homoscedasticity, etc.)? Results Please correct the caption of Table 4 for "Association of age at first service with growth and reproductive performance of heifers during the rearing period" Discussion L389: remove "in"

Reviewed by Emilio Mauricio Ungerfeld , 28 October 2019

The manuscript by Le Cozler et al. tests the hypothesis that late born heifers can compensate growth and reproduce without any disadvantage in production or fertility compared to their earlier born pals. This is an important research that has relevant implications to dairy production.

The manuscript has a clear objective and the experiment and treatments are well designed to test the hypothesis. It is true that the treatments confound the effects of feeding regime and calving date. However, this is perfectly adequate for the objective of the study. Research seems to have been conducted with care and paying attention to details, but some aspects need to be clarified:

- i) Did the authors conduct proximal analyses of the total mixed rations or feed components? If so, please add to the Materials and Methods and Results section
- ii) Was pasture intake measured?
- iii) The statistical model should include year as a random, rather than as a fixed effect

In general, the document can be followed well. However, there are numerous writing and grammar mistakes that need to be fixed. I pointed out some of them under Specific comments. I recommend the authors to have the manuscript proofread by a native English speaker.

From their results, I disagree with the authors' conclusion that using nutrition to help heifers born later in the season catch up in growth did not impair their productive performance. There was a tendency towards a 6 to 7% loss in milk production in the first lactation (lines 297-298), which is not negligible. To me, it is somewhat risky to conclude that there is no loss in milk production. Certainly, this practice will be profitable for some combinations of milk prices and other costs such as labor and feeding. But while the study provides very useful knowledge, I recommend being more cautious about concluding that heifers born later in the season will not lose milk production if fed more. Plus, there is no information about subsequent lactations in this study, which should constitute another note of caution. Results of fat- and protein-corrected milk production need to be calculated and presented.

The Results section needs to be improved. I could not find Table 5. The same with the Feed intake result in the Appendix. In many instances results are presented in the text but the reader is not referred to a table. In other instances P values are not presented in the text. In the Appendix, the curves either do not follow or do not overlap with the observations. Please correct or clarify.

Specific comments

Abstract

Line 30. "there were no differences"

Lines 30, 36, and throughout. Recommend "milk composition" instead of "milk quality"

Line 32. Insert "or" i.e. "or 15.5"

Line 35. "the whole lactation"

Line 37. Suggest "with the growth of heifers born earlier in the season"

Introduction

Line 52. "Increasing nutrient uptake"

Lines 59-60. Unclear sentence, please re-write.

Line 62. Perhaps "too rapid growth" instead of "too high a growth"?

Line 66. "conduct" instead of "led"

Lines 70-71. I do not understand "and results from autumn groups calving strategy could be used in a non-grouping strategy". Recommend re-writing or eliminating

Lines 71-73. Suggest re-writing as "We examined the possibility for late-born heifers to catch up with the rest of the heifers at 1st artificial insemination (AI) at a minimum BW of 370 to 380 kg, resulting in less than 22 mo at first calving."

Materials and Methods

Lines 77-81. It is not clear which 3 cohorts are the authors referring to. Is it the three treatments? Perhaps a simple table, including years, number of animals, breed and any other aspect the authors judge important could help the reader understand this aspect of the design better

Line 92. "the end"

Line 93. "in season 2" or "in the second season"

Line 94 "milk production"

Line 95. "The experiment"

Lines 98-100. Can be fused into one sentence

Line 101. Piled straw?

Line 104. What is the meaning of "dynamic groups"

Line 112. "concentrate intake"

Line 119. "the SD and ID1 groups"

Line 129. 80 feeders?

Lines 130-131. "competition for feed"

Line 135. "mineral supplements". Please specify composition, product, brand and origin. Same on lines 139-140 and lines 146 and 150.

Lines 155-156. Suggest "A classification based on age at first service (AFS) was created a posteriori in order to better understand which factors could lead to..."

Line 157. Suggest "Three groups were created with equal number of animals in each of them".

Line 161. "would occur"

Line 172. I suggest "Sampling and measurements"

Line 213. "These"

Lines 232 and 239. "overall mean"

Results

Table 3 is not cited in the text for the growth results. Please correct

Line 248. "animals"

Lines 248-249. "did not get pregnant"

Lines 252-253. Please indicate P value and "(result not shown)"

Line 262. Please indicate "(result not shown)" if not shown in any table

Lines 262-265. Please indicate significance and where are these results show, or otherwise "(result not shown)"

Lines 267. "services"

Line 297. Where is this result presented?

Lines 303. Replace "was already shrunk" by "decreased"

Line 309. "patterns"

Line 327. AFS12.5 and AFS14.0?

Line 329. "pic"? (do the authors mean peak?)

Discussion

Line 352. "The present experiment". Delete "down"

Line 354. Delete "down"

Lines 366-367. Re-write as: "The differences in feed allowance resulted in differences in development and size at 6 and 12 mo of age, but had limited effect on BW at weaning"

Line 367. "by Johnson"

Line 368. Do not understand "in size in pre-weaning performance"

Line 370. "total mixed ration"

Line 371. Please re-write "low in most practices"

Line 374. "the present study" "was around"

Line 376. "recommendations"

Line 377. "by Ettema" "about the importance"

Line 378. "achieved the recommended targets weights, which led to economic losses"

Line 380. "the milking phase"

Line 387. Delete "presented and"

Line 388. Delete "achieve the recommended targets and, therefore, this leads to economic losses" and start a new sentence

Line 394. "effects"

Lines 395-396. Please re-write for better understanding

Line 397. But that was the only lactation evaluated

Line 398. "was associated" Also, please explain how it was associated i.e. positively associated

Line 400 seems to contradict what as been said in line 398

Line 405. Delete "is"

Lines 406-409. This is important, although I think that the direction and significance of the finding is what really matters, rather than absolute milk production with 24 mo calving

Line 409. "the present study" "younger heifers"

Lines 411-413. The difference with what? With the meta-analysis discussed above? Please clarify

Line 415. "In the present study"

Line 418. Recommend repeating "Puberty was reached" instead of the more vague "It occurred"

Line 422. Delete "means that it"

Line 425. "future milk production"

Line 426. "by age"

Line 429. "years"

Line 432. "in the present study"

Line 434. Delete "All"

Lines 435-437. Re-write for clarity and to eliminate redundancies

Tables 3 and 4. Could it be "Conception rate at first service" instead of "Success at first service"?

Tables 3 and 4. "Number of services"