Peer Community In
Animal Science

An innovative modelling approach to enhance the quality of the quantification of pig resilience during the entire fattening period: Towards an individual pig resilience index

Mohammed Gagaoua *based on peer reviews by* ***Ludovic Brossard***, ***Arata Hidano*** *and 2 anonymous reviewers*

Manuel Revilla, Guillaume Lenoir, Loïc Flatres-Grall, Rafael Muñoz-Tamayo, Nicolas C Friggens (2021) Quantifying growth perturbations over the fattening period in swine via mathematical modelling. Missing preprint_server, ver. Missing article_version, peer-reviewed and recommended by Peer Community in Animal Science.
https://doi.org/10.1101/2020.10.22.349985

Submitted: 26 October 2020, Recommended: 20 December 2021

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The identification of reliable estimates of growth potential and resilience over the fattening period in large populations is a challenge in actual swine breeding conditions. To overcome this drawback, the study by Revilla et al. 2021 in the frame of precision livestock farming aimed to propose an innovative modelling approach, in addition to previous studies from the same group (Revilla et al. 2019), to enhance the quality of the quantification of pig resilience during the entire fattening period.

The authors developed a model that quantifies an "individual pig resilience indicator" based on longitudinal data, for instance body weight, recorded routinely by a commercially available automatic feeding system. Revilla and co-workers considered in their study two mainly commercialised pure pig breeds these being Piétrain including Piétrain Français NN Axiom line (Pie NN) free from halothane-sensitivity (ryanodine receptor gene, RYR1) and Piétrain Français Axiom line positive to this gene and Duroc. Therefore, the authors investigated the potential of improving resilience of swine livestock through inclusion for the first time of an "individual pig resilience indicator" in breeding objectives. A database of 13 093 boars (approximately 11.1 million of

weightings) belonging to Pie (n= 5 841), Pie NN (n = 5 032) and Duroc (n= 2 220) finished under ad libitum feeding, high sanitary level and controlled temperature was used to develop robust models.

The authors checked the three datasets (for each pig breed) independently to explore the variation and gaps (a data pre-treatment procedure) to ensure high quality data for the modelling approach. Then, they applied the Gompertz model and linear interpolation on body weight data to quantify individual deviations from the expected production, allowing the creation of the ABC index. For the modelling, the authors applied a two-step mathematical model approach by first establishing a theoretical growth curve of each animal, while the second step aimed to build the actual perturbed growth curve. The heritability of the index ranged from 0.03 to 0.04, with similar heritability between Piétrain and Duroc breeds. Moreover, moderate genetic relationships were computed between the proposed index and important phenotypic traits in swine production likely BF100: backfat thickness at 100kg; LD100: longissimus dorsi thickness at 100kg; ADG: average daily gain during control and FCR: feed conversion ratio.

Developing models able to capture perturbations during the fattening period is a challenge in swine breeding industry. The model and methodology proposed by the authors in this innovative work (although preliminary and with low heritabilities) would help overcome such limit and facilitate a real implementation at large scale in pig breeding system. The modelling approach further offers an opportunity to develop a selection criterion to improve resilience in swine breeding conditions.

To explore the full potential of this modelling approach, a larger database and other factors such as breed, behaviour and feeding behaviour of the animals, rearing practices, management and environment conditions, age... etc. are worthy to consider. In the future, more in depth measurements of behaviour that can be computed for example using computer vision should be desirable to increase the robustness of the proposed model.

References:

Revilla, M., Friggens, N.C., Broudiscou, L.P., Lemonnier, G., Blanc, F., Ravon, L., Mercat, M.J., Billon, Y., Rogel-Gaillard, C., Le Floch, N. and Estellé, J. (2019). Towards the quantitative characterisation of piglets' robustness to weaning: a modelling approach. Animal, 13(11), 2536-2546. https://doi.org/10.1017/S1751731119000843

Revilla M, Lenoir G, Flatres-Grall L, Muñoz-Tamayo R, Friggens NC (2021). Quantifying growth perturbations over the fattening period in swine via mathematical modelling. bioRxiv, 2020.10.22.349985, ver. 5 peer-reviewed and recommended by Peer Community in Animal Science. https://doi.org/10.1101/2020.10.22.349985

Reviews

Evaluation round #3

DOI or URL of the preprint: https://doi.org/10.1101/2020.10.22.349985
Version of the preprint: 3

Authors' reply, 18 November 2021

Download author's reply
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Decision by Mohammed Gagaoua, posted 27 October 2021

Minor revision

Dear authors,

I am glad to informt you that we received the last comments from the reviewer. Please, can you consider the few comments and return your preprint in one week to make a final decision.

With kind regards

Mohammed

Reviewed by anonymous reviewer 2, 26 October 2021

Review of manuscript

"Quantifying growth perturbations over the fattening period in swine via mathematical modelling"

(Manuel Revilla, Guillaume Lenoir, Loïc Flatres-Grall, Rafael Muñoz-Tamayo, Nicolas C Friggens)

(https://www.biorxiv.org/content/10.1101/2020.10.22.349985v3).

General comments:

The authors accounted for last remarks on the V2 that was already improved.

Introduction, materials and methods, results and discussion give the expected elements.

Only four minor remarks (mainly on reading) are indicated below following this revision.

Specific comments:

Page 5 third paragraph: suggest to replace "is" by "was" in sentences "The standard deviation … each AFS*Group." And ""The objective …a mechanical problem"

Page 7 4th paragraph: in the sentence "The average daily gain…expressed in g/day", I suggest to put "expressed in g/day" just after "(ADG)" to ease the reading.

Page 13: I missed this point in the previous revision (but perhaps asked in the first one, sorry): μ0 and D statistical models are not indicated in the table S1, but they were submitted to analysis as ABC apparently. Add them in table S1? Or indicate the specific models used

Page 18 7th line: replace know by known

Evaluation round #2

DOI or URL of the preprint: https://doi.org/10.1101/2020.10.22.349985

Version of the preprint: 2

Authors' reply, 19 September 2021

Download author's reply

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Decision by Mohammed Gagaoua, posted 07 December 2021

Minor revision

Dear authors,

Here are the comments from the reviewers. Overall, the reviewer is happy of your revision and has further comments that would be addressed before final decision. I invite you please to consider them very carefully and prepare a rebuttal letter.

With kind regards

Mohammed Gagaoua

Reviewed by Ludovic Brossard, 23 June 2021

Review of manuscript
"Quantifying growth perturbations over the fattening period in swine via mathematical modelling"
(Manuel Revilla, Guillaume Lenoir, Loïc Flatres-Grall, Rafael Muñoz-Tamayo, Nicolas C Friggens)
(https://www.biorxiv.org/content/10.1101/2020.10.22.349985v2).

General comments :
The authors largely accounted for preceding remarks. Only few remarks are indicated below following this revision.

Specific comments :
Line 87: suggest to add with before no reallocation
Line 128 : suggest to add « for » before « weights »
Lines 191-192 : cases when ABV parameter results were normalised are not explained. « When required » is not sufficiently explicit.
Line 253 : why more measurements in this version than in the first one ? due to verifications of numbers in table 1 ?
Figure 1 : A3 and B3 panels have not the same scale in Y axis (0 to 100 for A3 and 0 to 70 for B3) (idem for all panels in S1 and S2)
Figure 4 : no modification done apparently. My initial comment was « it is surprising, regarding data on ABC in Table 2 and plot in figure 3, that ABC distribution for Pie and Pie NN are exactly the same (min, max and 3rd quartile are very different in the table but not in the figure 4). Please check ». The response is « The needed verifications have been done, and the suggested modifications added » but no modification is visible. Perhaps I missed something.
Lines 387-391 : I am not sure that hte method of Nguyen-Ba requires the identification of the number of the perturbations, and even less their nature. I thought the number of perturbations was a result of the analysis. But perhaps I am wrong.
Lines 428-431 : sentence a bit difficult to read (repetitoin of need, repetition of include / inclusion)
Line 445 : elaborate a bit more about relation with carcass quality (in relation with FCR ?).
Line 453 : « an economic » instead of « and economic » ?

Evaluation round #1

DOI or URL of the preprint: https://doi.org/10.1101/2020.10.22.349985
Version of the preprint: 1

Authors' reply, 24 May 2021

Download author's reply
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Decision by Mohammed Gagaoua, posted 07 January 2021

Revision required on the manuscript "Quantifying growth perturbations over the fattening period in swine via mathematical modelling"

Dear authors, I am glad to inform you that we received comments on your paper from three experts in the field. Two of them suggest revision and raised important comments that would enhance the quality of the manuscript and one reviewer is very hapy with your paper and accepted it in its current form. My own evaluation of this interesting paper is very positive and I invite you please to consider the comments point by point and address your revision ASAP. Please, I invite you also to consider discuss further the results and update the list of the references by including new citations from the two past years. Thank you once again for submitting your paper to PCI Animal Science. With kind regards Mohammed Reviewer 1: see attached file (pages 1 - 2) Reviewer 2: Honestly, I have nothing to object about this manuscript. Very good description of methods and very good statistical approach to accomplish the objective of the article. Congratulations to the authors Reviewer 3: see attached file (pages 3 - 7) **Download recommender's annotations**

Reviewed by **Arata Hidano**, 07 December 2020

Please find attached document.

Download the review

Reviewed by anonymous reviewer 1, 02 January 2021

Honestly, I have nothing to object about this manuscript. Very good description of methods and very good statistical approach to accomplish the objective of the article. Congratulations to the authors

Reviewed by **Ludovic Brossard**, 07 January 2021

Download the review