Transdisciplinary approach to improve concrete outdoor runs for organic pigs: Identification of innovations

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Abstract

Across Europe, most organic growing-finishing pigs are kept in systems with outdoor runs. When made from barren concrete, these outdoor runs restrict species-specific behaviour and, together with poor pen hygiene, may lead to high ammonia emissions. While few scientific publications have discussed the effects of such outdoor runs on pig welfare and environment, considerable practical experience exists which could be a valuable source for improvement measures. Therefore, the CORE Organic Cofund project POWER aims for a transdisciplinary approach to identify innovative solutions to improve outdoor runs. Stakeholder workshops with farmers and experts took place in eight European countries resulting in 102 statements regarding innovations and best-practice examples. Researchers of different disciplines evaluated those during a stepwise process based on practical and scientific knowledge. Criteria considered were the potential for welfare improvement and ammonia emission mitigation, innovativeness and feasibility for on-farm experiments. Finally, three innovative elements for outdoor runs were selected: 1) specified rooting areas, 2) improved provision of roughage and 3) strategies for use of showers during summer. Stakeholders from several countries had mentioned these innovations (3, 7 and 6 statements from 3, 5 and 6 countries respectively). While stakeholders and researchers emphasised the potential of these innovations for welfare improvement, they rated the potential for reducing ammonia emissions as less likely, except for showers. Rooting areas were rated lowest for feasibility but highest for innovativeness, while provision of roughage and showers were seen as best-practice. Rating the level of innovativeness varied considerably between countries for various reasons. In conclusion, most of the identified innovations addressed either animal welfare improvement or ammonia emission mitigation. Ensuring feasibility for on-farm experiments caused trade-offs regarding innovativeness. However, combining scientific knowledge and stakeholder involvement is a promising approach to identify practical, relevant and scientifically meaningful research areas, which we now investigate in on-farm experiments.

Introduction

Previous studies revealed potential for improvement of concrete outdoor runs for European organic growing-finishing pigs in terms of animal welfare and environmental impact (Rudolph et al. 2018; Leeb et al. 2019). These outdoor runs restrict aspects of pigs' species-specific

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behaviour, especially as they often lack enrichment. Moreover, the relatively large areas soiled with excrements account for higher ammonia emissions in organic pig systems compared to conventional production (Olsson et al. 2014). Practical solutions for improving animal welfare while reducing ammonia emissions in systems with concrete outdoor runs are therefore required. To identify solutions, experience of farmers may be a valuable source of innovative ideas and will increase relevance of research for practical farming. Therefore, within the CORE Organic Cofund project PrOven WElfare and Resilience in organic pig production (POWER), researchers from eight countries conducted stakeholder workshops and interviews and evaluated the results based on their scientific expertise. The final goal was to identify 2-3 innovative measures to improve animal welfare and reduce ammonia emissions, which could then be tested in on-farm experiments across Europe.

Material and methods

Project participants conducted workshops and individual interviews involving organic pig farmers and experts (consultants and other experts from research or companies in the organic pig sector) in eight European countries. The same protocol, consisting of open questions and key words to structure the discussion, was used in all countries for workshops and interviews. Guiding questions were aiming at identifying best-practice examples (*"What is currently, on your farm, working well"*) and new ideas (*"What would you like to change, which specific measure would you like to test?"*). Stakeholders were then asked to describe benefits and challenges of measures regarding aspects of sustainability, i.e. animal welfare, environmental impact, workload, and economy. Individual statements were sorted according to different elements of concrete outdoor runs (Table 1). Eight researchers from six countries evaluated the statements in a stepwise process based on their expert knowledge following four criteria representative for the project goal: 1) potential for animal welfare improvement, 2) potential for ammonia emissions mitigation, 3) innovativeness and 4) feasibility for on-farm experiments using a five-point scale (1 = positive; 5 = negative). Subsequently, the individual statements were aggregated to specific "innovations". The following dialogue-based selection process prioritized high potential for animal welfare improvement, followed by potential for ammonia reduction. Stakeholder perspectives regarding aspects of sustainability and relevance for different countries (frequency of mentioning) were considered in the selection process. Finally, researchers decided by consensus for three innovations to be tested in the course of the project.

Results

Seven workshops and 49 individual interviews with a total of 78 farmers and 38 experts revealed 102 individual statements on improvement measures. Most of the statements referred to the provision of enrichment followed by roof or floor design, pen structure, manure removal, and cooling facilities (Table 1).

Table 1: Results of workshops and interviews: number of statements related to different elements of concrete outdoor runs with respective examples

Measures related to	Number of statements	Examples
Provision of enrichment	17	Hayrack with waste tray underneath; sand for rooting.
Roof	16	Larger roof to use bedding material; sun sail.
Pen structure	15	Open partitions in the dunging area.
Manure removal	13	Automatic manure scrapers.
Floor	13	No slatted floor; increased area with drained floor.
Cooling	10	Cooling with garden hoses; wallow or bathtub;
Feeder/drinkers	7	Drinkers outdoors; feeders outdoors.
Additives	3	Effective microorganisms.
Pasture access	2	Additional temporary access to pasture.
Other	6	Brushes; light during night.
Total	102	

Results of the scientist's ratings are presented in Table 2. Regarding potential welfare improvement, they prioritised measures referring to additional pasture, cooling and enrichment. Scores for emission mitigation potential were generally higher (negative) and varied considerably. Most positive scores were relating to manure removal. Ratings for innovativeness were best for pasture and "other measures" (e.g. brushes, light) and varied considerably across scientists representing different countries. Feasibility for on-farm experiments was moderate to negative, with most negative scores for floor design and additional pasture access.

Aggregation of the individual statements (e.g. "access to showers" and "cooling facilities like showers or sprinklers") resulted in 49 specific innovations (e.g. "showers"). Sixteen innovations were rejected mostly due to lack of relevance for concrete outdoor runs.

Table 2: Results of scientists' rating (1 = positive, 5 = negative) across different elements of concrete outdoor runs (average score, [min.-max.])

Measures related to	Potential for welfare improvement	Potential for emission mitigation	Innovativeness	Feasibility for experiments
Enrichment	1.8 [1.0-3.3]	3.0 [2.0-5.0]	2.3 [1.2-3.8]	2.2 [1.5-2.8]
Roof	2.2 [1.7-4.0]	2.4 [1.3-4.0]	3.0 [1.3-4.3]	3.6 [2.0-4.8]
Pen structure	2.4 [1.8-4.3]	3.2 [1.3-5.0]	2.8 [1.0-4.0]	3.0 [2.0-4.5]
Manure removal	3.2 [1.7-4.8]	2.1 [1.0-3.4]	2.9 [1.2-4.2]	3.4 [1.7-4.8]
Floor	3.0 [1.7-4.3]	2.6 [1.3-4.4]	3.4 [2.5-4.6]	4.4 [3.8-4.8]
Cooling	1.7 [1.3-2.2]	2.9 [2.2-3.8]	2.5 [1.8-3.0]	2.5 [1.8-3.8]
Feeder/drinkers	2.4 [1.2-3.2]	2.5 [1.4-3.3]	2.9 [2.3-3.8]	2.8 [2.0-4.0]
Additives	4.0 [3.7-4.3]	3.4 [3.3-3.7]	2.8 [2.2-3.7]	2.4 [1.8-3.3]
Pasture access	1.3 [1.0-1.7]	2.9 [2.4-3.3]	1.4 [1.2-1.7]	3.9 [3.4-4.3]
Other*	2.9 [1.4-4.4]	3.4 [2.0-5.0]	1.9 [1.4-3.0]	3.2 [1.5-4.6]

* E.g. brushes, light, track grids for handling pigs, weight-sorting system.

From the remaining innovations, 11 were pre-selected and the following three were chosen for further examination in on-farm experiments:

1) Optimisation of rooting areas, i.e. providing substrate in a defined area (box).

2) Improved location and frequency of provision of roughage, which is not only bedding material but also enrichment with nutritional value (e.g. hay, silage, grass).

3) Strategies for the use of showers to mitigate heat stress during summer.

Stakeholders perceived these innovations as positive for animal welfare. While rooting areas and showers were also considered suitable to mitigate emissions, this was not necessarily the case for roughage. Depending on the implementation of the measures, farmers mentioned benefits as well as trade-offs regarding labour and economy. Provision of roughage and showers were mentioned most frequently (7 and 6 statements from 5 and 6 countries), while rooting areas seemed to be less relevant (3 statements from 3 countries). Scientists' rating was best (lowest) for the potential for animal welfare improvement (average score 1.2-1.5). In contrast, scores were more negative for emission mitigation potential, with best scores for showers, followed by roughage and rooting areas (average scores 2.5, 3.0 and 3.1). Innovativeness ranged from positive for rooting areas (average score 1.3), to moderate for provision of roughage and showers (average score 2.6 and 2.5). Feasibility was best for the provision of roughage, followed by showers and rooting areas (average scores 1.8, 2.1 and 2.7).

Discussion

The measures identified by stakeholders mostly related to animal welfare improvement, which is due to emphasis of the protocol on this issue. Concerns mentioned by stakeholders mostly related to increased workload and costs, which was acknowledged when choosing the three final innovations.

With regard to animal welfare improvement, stakeholder input as well as scientists' rating emphasised measures related to enrichment and cooling, whereas potential for emission mitigation was mainly related to manure removal. This demonstrates a rather low overlap of animal welfare improvement and emission mitigation, which is in line with findings by Herzog et al. (2018) for dairy cows, stating that welfare improvement measures would not increase emissions if manure management and housing design were appropriate. However, pigs' behaviour, especially elimination, could influence the surface soiled with faeces and therefore the potential for ammonia emissions (Salomon et al. 2012). We therefore argue for measures supporting pigs' natural behaviour to separate functional areas for lying, activity and elimination, e.g. by increasing the attractiveness of the outdoor run. The three selected innovations (rooting area, provision of roughage and showers) have the potential to increase pigs' use of the outdoor run and minimise the area soiled with faeces and urine.

Regarding innovativeness, the evaluation process revealed considerable differences between countries, with some measures not existing in one country (e.g. rooting areas in Austria) but already best practice in another (e.g. rooting areas in Denmark). This shows the high potential of such an approach for knowledge exchange and "learning from each other". A major challenge for the final selection was to ensure feasibility for on-farm experiments while considering innovativeness and relevance for farmers. Some of the innovative and most frequently mentioned measures (e.g. additional access to pasture, manure scrapers or varying degree of roofing) are difficult to test in on-farm experiments with limited resources.

Suggestions for research and support policies to develop further organic animal husbandry

If we, as applied researchers, want to enhance sustainable development in practice, we need to consider farmers' situations and perceptions to provide relevant results. Therefore, it is crucial to involve stakeholders already from an early stage of problem framing. This is especially important for projects collaborating with practitioners e.g. in on-farm experiments, where commitment and motivation is essential for the quality of research results (Schodl et al. 2015). However, including stakeholders in the process of identifying research questions demands additional time and effort and may lead to trade-offs: in our case, limited resources of the project restricted the selection of innovative measures suggested by stakeholders. Therefore, thoughtful project planning considering the challenges and additional effort of transdisciplinary research is crucial. Finally, research collaborations across countries and institutions with different specialisations increase the relevance of results for a broad range of systems and cultural differences and enhances knowledge transfer by learning from each other
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References

Herzog A, Winckler C & Zollitsch W (2018): In pursuit of sustainability in dairy farming: A review of interdependent effects of animal welfare improvement and environmental impact mitigation. Agriculture, Ecosystems and Environment 267, 174–187.

Leeb C, Rudolph G, Bochicchio D, Edwards S, Früh B, Holinger M, Holmes D, Illmann G, Knop D, Prunier A, Rousing T, Winckler C & Dippel S (2019): Effects of three husbandry systems on health, welfare and productivity of organic pigs. Animal, 1–9.

Olsson AC, Jeppsson KH, Botermans J, Von Wachenfelt H, Andersson M, Bergsten C & Svendsen J (2014): Pen hygiene, N, P and K budgets and calculated nitrogen emission for organic growing-finishing pigs in two different housing systems with and without pasture access. Livestock Science 165, 138–146.

Rudolph G, Hörtenhuber S, Bochicchio D, Butler G, Brandhofer R, Dippel S, Dourmad JY, Edwards S, Früh B, Meier M, Prunier A, Winckler C, Zollitsch W & Leeb C (2018): Effect of three husbandry systems on environmental impact of organic pigs. Sustainability 10, 1–20.

Salomon E, Rodhe L, Malgeryd J, Lindgren K & Lindahl C (2012): Ammonia losses from outdoor pig fattening at two Swedish organic farms. Open Agriculture Journal 6, 27–35.

Schodl K, Leeb C & Winckler, C (2015): Developing science–industry collaborations into a transdisciplinary process: a case study on improving sustainability of pork production. Sustainability Science 10, 639-651.