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Data paper

Data paper: Behavioural and production data of sows fed tailored diets over three consecutive gestations

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ABSTRACT

This database was created to better understand the long-term impact of precision feeding (**PF**, i.e. delivery of an individualised mix of different diets to meet estimated individual requirements) on the performances of gestating sows, compared to sows fed a conventional feeding strategy (i.e., delivery of a single diet throughout gestation). Two experiments were carried out with feed supplies to PF sows adjusted individually and daily when they were grouped, based on energy and amino acids requirements (trial 1) and additionally on minerals during the last month of gestation (trial 2). Sows were group-housed from day 3 (trial 1) or day 25 (trial 2) to day 108 of gestation. Data were collected from sows over one to three successive gestations cumulating 58 (trial 1) or 77 (trial 2) gestations. The gestation pens were equipped with electronic feeder and water dispensers to characterise the feeding and drinking behaviours, with an automated scale to characterise the BW and with cameras to characterise the behaviour and location of sows, on a daily and individual basis. An automatic video analysis software analysed sows' physical activity at the group scale, on three different stages of gestation. Physical activity was also recorded individually with accelerometers for a few numbers of sows. Social interactions, activities, and pen location were characterised at the individual level on specific periods from video manual analysis. Backfat thickness (**BT**) was measured manually with an ultrasound portable device. Cleanliness, scratches and lameness were recorded weekly during gestation. Each gestation room was equipped with devices which enable to follow ambient temperature, relative humidity, and other parameters such as noise or methane concentration. At farrowing, litter size and birthweight were measured. Data were used to analyse the effect of feeding strategies on feeding behaviour, variation of BW and BT during gestation, health status, social interactions when sows were group-housed, and litter characteristics at farrowing. The database contains a large amount of data including feed composition and intakes, behaviours, ambient parameters, and sow performances of group-housed gestating sows enabling to use unsupervised data mining approaches. Longitudinal database may be used to correlate feeding behaviour with physical activity or ambient parameters. Common phenotypes (BW, BT) collected at different key stages of gestation may be used to extend the existing dataset to have a greater statistical power.

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Specifications table

Subject	Nutrition
Specific subject area	Performances and behaviours of gestating sows fed long-term precision feeding strategies.

(*continued on next page*)

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Type of data	MariaBD database structured in 20 tables containing three areas of data: sow data and experiment characteristics, sensors and automatons measures, and manual measures.
How data were acquired	Data were collected in two different gestation units. Feed intake and feeding visits were recorded thanks to two automatic feeders in each gestating pen. Two automatic drinkers recorded water intake and visit characteristics (time, duration). Physical activity was tracked with accelerometers on the sows' ears and with camera. Social interaction, activity and pen location were assessed through manual video analysis. Ambient condition was recorded with a temperature and humidity device, and an additional multiple sensor device for trial 2. The sows were weighed with an automatic scale when group-housed and with a manual scale at least two times during the gestation. Backfat thickness was measured at the P2 site with an ultrasound portable device at least two times: at the start of insemination and exit of the gestation room. Health data (lameness, scratches and cleanliness) were collected weekly during gestation. Characteristics of the litter were recorded at birth manually in the farrowing room.
Data format	Data are available under two formats:. SQL (database structure and data of each table) and.CSV files (data of each table).
Parameters for data collection	135 sows from two farms were studied over one to three consecutive gestations. Each sow was allocated either to a conventional feeding strategy (i.e. a unique diet throughout the gestation) or a precision feeding strategy (i.e. a blend of different diets to adapt nutrient supplies to requirements estimated daily with a nutritional model on an individual basis).
Description of data collection	All data collected by sensors and automatons during the experiment were first checked for outliers (removed when detected) and organised as a relational database. Consistency of manual data was checked for minimum and maximum values, date and time format. Unicity of data was checked with the cross-referencing of two tables through the foreign key between tables.
Data source location	Trial 1 – Pig Physiology and Phenotyping Experimental Facility (UE3P, INRAE, https://doi.org/10.15454/1.5573932732039927E12), Saint-Gilles (35590), France Trial 2 – IFIP-Institut du Porc, Romillé (35850), France
Data accessibility	Repository name: Recherche Data Gouv, Data INRAE, Pegase Data identification number: https://doi.org/10.57745/POJ8UV
Related research article	Ribas, C., Quiniou, N., Gaillard, C., 2024. On farm precision feeding of gestating sows based on energy and amino acids on farrowing performances and feeding behavior over 3 consecutive gestations. Journal of Animal Science, 102, skae201, https://doi.org/10.1093/jas/skae201. (results of trial 1). Another publication is in preparation concerning the results of trial 2.

Value of the data

- This database presents a range of performances from gestating sows fed either with a precision feeding strategy (i.e. adjusted daily and individually) or a conventional feeding strategy (i.e. fixed diet). It contains individual feed intake, feeding and drinking behaviours, BW and backfat thickness (**BT**), farrowing and lactation data, health status, social interactions, activities and pen location by manual video analysis and physical activity recorded by accelerometers and analysed by automatic video analysis.
- Sows were followed from one to three consecutive gestations providing a rich longitudinal database. Detailed dietary characteristics and daily individual feed intake are available. It allows for example the exploration of correlation between feeding behaviour data and other parameters like physical activity. Feeding behaviour during gestation can also be influenced by the ambient parameters which are available in the database.
- The large dataset may be used for unsupervised data mining approaches. Feeding visits and non-feeding visits are available to characterise sow feeding behaviour. Similar data are available to study the drinking behaviour.
- This database provides a large number of phenotypes commonly studied in sow. It can contribute to future research in gestating sows' behaviour, and nutrition fields. Combined with datasets from other experiments, it can also be used to improve the statistical power in statistical analyses.

Data description

The dataset is composed of 20 tables structured as a relational database with SQL standards (Table 1), separated into three different types of data:

(1) sow data and the experiment characteristics: farm, sow, cycle, batch, pen and feed_content in the diet.
(2) data collected with sensors and automatons: sensor, feed_visit, feed_measure, water_measure, weight_measure, environmental_measure, activity_accelerometers, automatic_activity_video_detailed_measure, automatic activity_video_aggregated_measure.
(3) data collected manually and other types of data: litter_characteristics, health of the sow, performances_sow, video_analysis_focus, video_analysis_scan.

The tables farm, batch and pen gather all the information regarding the farms. The number of batches per farm (farm), the

Table 1
Description of the 20 tables of the database of gestating sows fed tailored[1] diets.

Table's name		Primary key[2]	Foreign keys[3]	Data type[4]	Number of columns	Number of rows
1.		Sow data and experiment characteristics				
1.1.	Farm	ID_farm	none	raw	4	2
1.2.	Sow	ID_sow	ID_farm	raw	3	135
1.3.	Cycle	ID_exp_sow	ID_sow; ID_batch	raw	7	285
1.4.	Batch	ID_batch	ID_farm; ID_pen	raw	5	12
1.5.	Pen	ID_pen	none	raw	4	3
1.6.	Feed_content	ID_diet	none	raw	17	9
2.		Sensors and automatons measures				
2.1.	Sensor	ID_sensor	ID_pen	raw	6	46
2.2.	Feed_visit	ID_visit_feeder	ID_exp_sow; ID_sensor	processed	7	119 000
2.3.	Feed_measure	ID_feed_feeder	ID_visit_feeder; ID_diet	processed	4	347 196
2.4.	Water_measure	ID_visit_water	ID_exp_sow; ID_sensor	processed	8	177 668
2.5.	Weight_measure	ID_visit_weight	ID_exp_sow; ID_sensor	processed	6	138 288
2.6.	Environmental_measure	ID_environmental_measure	ID_sensor	processed	15	243 327
2.7.	Activity_accelerometers	ID_activity_accelerometer	ID_exp_sow	processed	8	45 466
2.8.	Automatic_activity video_detailed_measure	ID_automatic_video_detailed	ID_batch	raw	13	551 300
2.9.	Automatic_activity video_aggregated_measure	ID_automatic_video_agregated	ID_batch	raw	14	7 939
3.		Manual measures				
3.1.	Litter_characteristics	ID_maternity	ID_exp_sow	raw	16	250
3.2.	Health	ID_health_measure	ID_exp_sow	raw	14	5 109
3.3.	Performances_sow	ID_perf_measure	ID_exp_sow	raw	6	827
3.4.	Video_analysis_focus	ID_video_analysis_focus	ID_sensor; ID_exp_sow	raw	12	11 222
3.5.	Video_analysis_scan	ID_video_analysis_scan	ID_sensor; D_exp_sow	raw	10	7 300

[1] Precision feeding strategy (i.e., delivery of an individualised mix of different diets to meet estimated individual requirements) compared to a conventional feeding strategy (i.e., delivery of a single diet throughout gestation) was applied.
[2] Primary keys are unique for each table.
[3] Foreign keys are meant to link the different tables of the database.
[4] The data cleaning procedure for processed data is available in the main text.

dates of entry and exit of each batch from the gestation pen (batch) and the type of gestation pen with a dynamic or a static group (pen) are available. Feed_content table contains the nutritional composition of the formulated diets used in gestation and lactation during the two trials. The sows' birth date, parity, treatment, batch and additional information about their gestating cycle are contained in tables sow and cycle. Sensor table provides characteristics of the sensors (manufacturer, identifier) used during the trials. Feed_visit, feed_measure and water_measure list all the visits to the automatons (sow id, date and time of entry and date and time of exit, amount of feed or water ingested). Weight_measure contains the sow BW measured automatically each day. Environmental_measure gathers the room's environmental parameters such as relative humidity and ambient temperature measured every 20 min, and luminosity, noise and gas concentrations measured every 15 min. Activity_accelerometer, automatic_activity_video_detailed_measure and automatic_activity_video_aggregated_measure contain the physical activity of sows in the pen. Activities are expressed as time spent per posture such as standing or lying down, measured respectively by the accelerometers and by video analysis. For the latter, an automatic video analysis software measures for a tracking period of 2 h per day over three key stages of gestation the posture, location in the gestating pen and key points (nose, neck and tail) of each sow. Data were obtained every half-second for the detailed measures, and every hour for aggregated measures. The criteria recorded manually (BT, BW, dirtiness, health problems) are contained in performances_sow and health tables, respectively. The information about litters (size and weight) are contained in litter_characteristics table. Finally, manual behavioural observations on social interactions and postures, activity and location at an individual scale are gathered in tables video_analysis_focus and video_analysis_scan. The link between the tables is summarised in Fig. 1.

Experimental design, materials and methods

This dataset regroups data collected during two trials through three consecutive cycles of gestation-lactation. The procedure for collecting data within a cycle is shown in Fig. 2.

Experimental place, sows and housing

Trial 1 took place at Pig Physiology and Phenotyping Experimental Facility (UE3P, INRAE, Rennes, France, https://doi.org/10.15454/1.5573932732039927E12), and was approved by the Ethics Committee in Animal Experimentation (APAFiS #24663). It was conducted between June 2021 and September 2022, in accordance with French regulations on pig production and animal care. Two batches of 20 Landrace × Large White sows were initially involved in the study. Around 3 days after insemination, the sows were housed in group pen (7.5 × 8.0 m) with concrete floor and daily straw provision. Each pen housed a maximum of 20 sows, and feeding was managed by two automatic feeders (Gestal 3G, JYGA Technologies Inc., Québec, Canada) that mixed two diets in individualised proportions. The sows also had free access to water via two drinking troughs with integrated scales (Aqualab, Asserva, Lamballe, France). Ventilation rate in the gestation room was set to regulate the temperature around 21 °C. The sows were transferred to farrowing rooms about 1 week before the expected farrowing date (106.9 ± 0.7 days). Ambient temperature and relative humidity were recorded with an EL-USB-2-LCD data logger in each gestating pen at a height of 1.8 m (Lascar Electronics, United Kingdom, precision ±0.55 °C and ±2.25% relative humidity). Three ceiling-mounted cameras (Hikvision DS-2CD2145FWD-I-S) provided a continuous day and night recording. At the start of the trial, sows weighed 199 kg on average with an average BT of 15.4 mm and an average parity of 2.8. A more detailed explanation

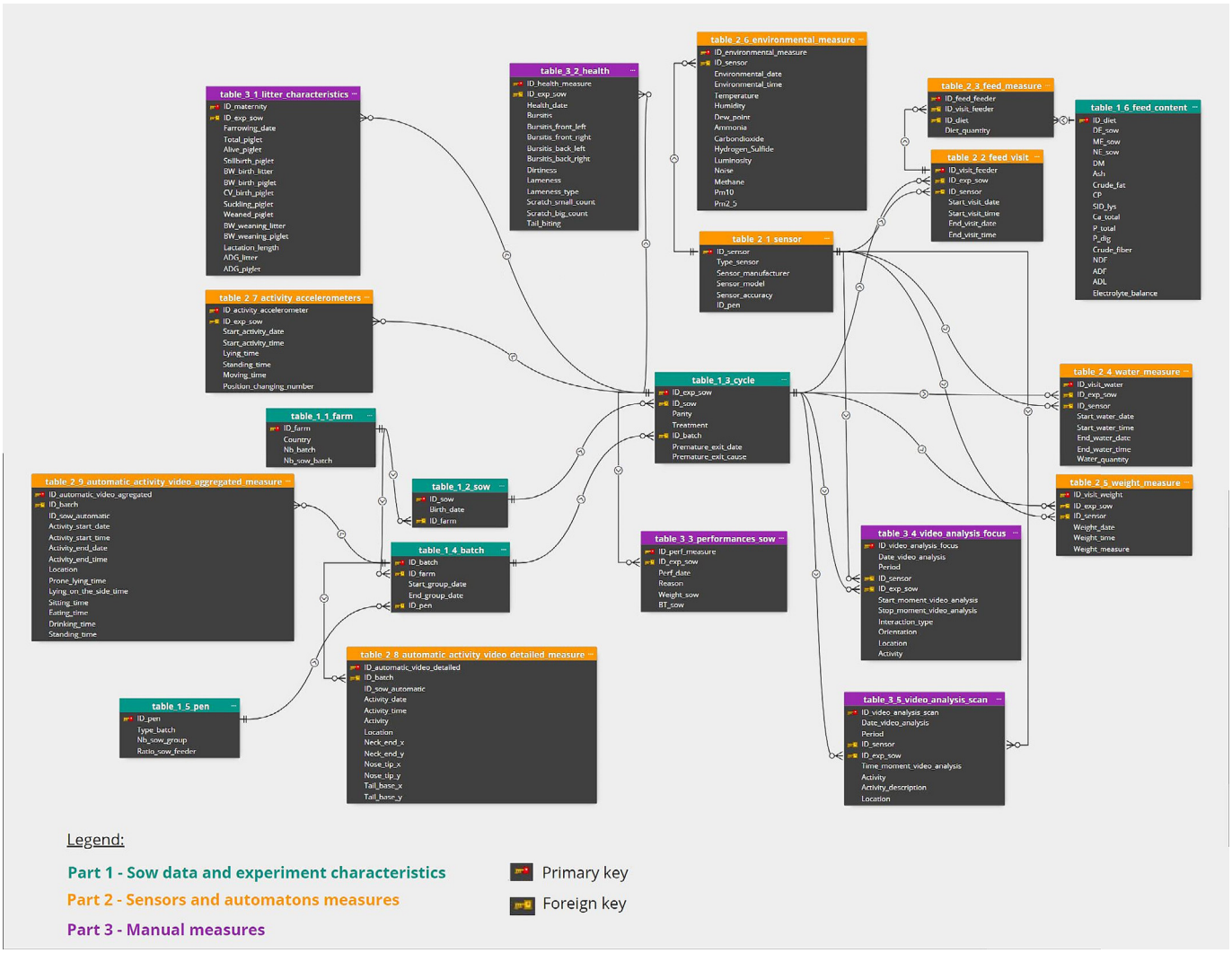

Fig. 1. Schema of the relational diagram of the database of gestating sows fed tailored diets made with Luna modeler (Ideamerit s.r.o., 2025).

of the experimental design was provided previously (Ribas et al., 2024).

Trial 2 was conducted at the IFIP-Institut du Porc in Romillé, France, between February 2023 and April 2024 and was approved by the Ethics Committee in Animal Experimentation (APAFiS #40427). It involved two groups of 24 primiparous and multiparous Landrace × Large White sows, monitored over three consecutive gestation cycles. Initially, sows were housed individually from insemination until day 25 of gestation with manual feeding and free access to water. At day 25, they were moved to a dynamic group-housed pen (22.2 × 9.12 m) with fully slatted flooring. The gestating pen was equipped with two automatic drinking troughs (Aqualab, Asserva, Lamballe, France) and two automatic feeders (Selfimat, Asserva, Lamballe, France) with four hoppers to provide individualised mixtures based on one to four diets. The pen was also equipped with two automatic weighing scales (Asserva, Lamballe, France) located on the automatic feeder exit path. About one week before farrowing, the sows were transferred to the farrowing unit. Ventilation in the gestating pen was set to maintain a temperature of 22 °C. Two IOT devices (CLS-AIR MODULE, Cynomys, Genova, Italy) were fixed on the gestation walls at 1.5 m above the ground. They recorded ambient temperature, relative humidity, ammonia, hydrogen sulphide, carbon dioxide, methane, luminosity, particulate matter, and noise every 30 s and sent the average value to a cloud platform every 20 min. Ambient temperature and relative humidity were also recorded with five EL-USB-2-LCD data loggers located in all areas of the group-housed gestating pen (Lascar Electronics, United Kingdom, precision ±0.55 °C and ±2.25% relative humidity). Six ceiling-mounted cameras (Hikvision Fish-eye - DS-2CD63C5G0E-IVS) provided a continuous day and night recording. At the start of the trial, sows weighed 206 kg on average with a BT of 13.7 mm and an average parity of 3.0.

Feeding protocols

In both trials, the sows were allocated to one of two feeding strategies (precision feeding, **PF** vs conventional feeding, **CF**) based on their parity (1, 2, or 3+), BW, and BT measured at P2 position 3 to 7 days after the first insemination. The same feeding strategy was maintained throughout the experiment unless the sow was culled for health or performance reasons. Then, culled sows were replaced by replacement gilts that completed only one or two gestations.

In trial 1, two gestation diets (**GL** and **GH**) were formulated on an iso-net energy basis (9.8 MJ/kg) with different amino acid concentrations (considering lysine as the limiting amino acid). The standardised ileal digestible lysine (**SID Lys**) content of GL and GH diet was 3.3 and 8.5 g/kg of feed, respectively. For the PF

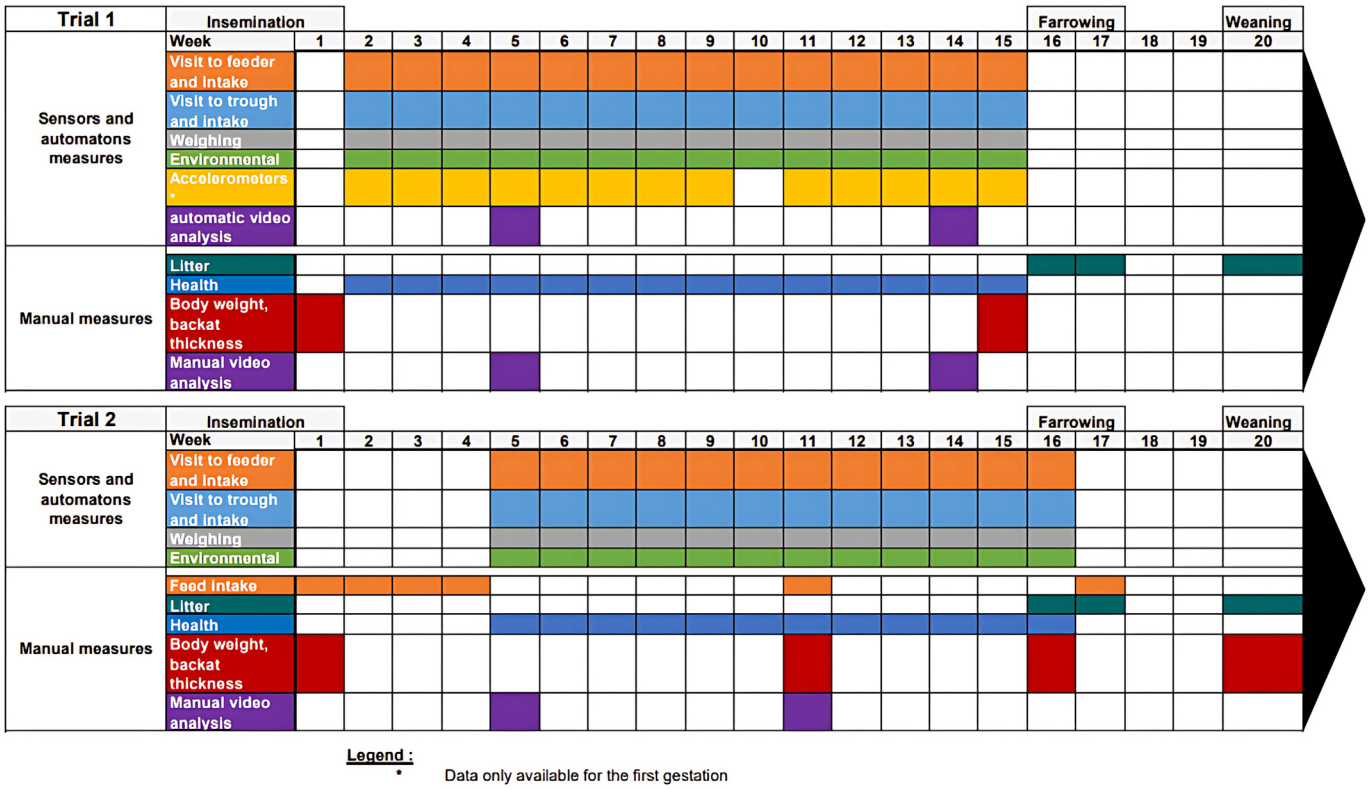

Fig. 2. Summary of the experimental design and data collection on gestating sows for the two trials. Only one gestation-lactation cycle is represented but the data collection is similar between cycles unless otherwise stated.

strategy, diet proportions were adjusted daily based on the estimated SID Lys requirement of each sow. In contrast, CF sows received a fixed 73% GL and 27% GH blend. Feeding allowances were supplied according to a 3-phase u-curve feeding pattern, i.e. the daily feed supplied was constant within each phase and the second phase had a lower daily feed supplied than the others. First phase between insemination and day 35 of gestation was used to let sows recover their maternal reserves used during previous lactation. The second phase was between days 36 and 85 of gestation where feeding supplies were close to energy maintenance requirements. The third phase after 86 days of gestation for both strategies increased feed allowance by 500 g/day from the previous phase to follow the increase in energy requirement for foetal growth.

In trial 2, four experimental gestation diets were formulated to be iso-net energy (9.00 MJ/kg), with different levels of SID Lys (low: 3.3 g/kg or high: 8.5 g/kg) and apparent total tract digestible phosphorus (**ATTD P**; standard: 2.6 g/kg or high: 4.0 g/kg). Diet formulated for a low lysine and a standard phosphorus content was called LLys_SP, the diet with a high lysine and a standard phosphorus level was called HLys_SP, and the diet with a high lysine and high phosphorus level was called HLys_HP. These diets were delivered only to PF sows during gestation, depending on their individual nutrient requirements. Before day 80 of gestation, the blend was decided based on the amino acid requirements whereas after the day 80 and up to farrowing, the daily and individual ATTD P requirement was also taken into account. In contrast, CF sows received a standard diet throughout gestation which was iso-net energy with PF diets and contained 4.7 g/kg of feed of SID Lys and 2.6 g/kg of feed of ATTD P. As for trial 1, feeding allowances were set to follow a 3-phase u-curve feeding pattern. However, the first phase was between insemination and day 9 of gestation, the second one between day 10 and day 80 of gestation and afterwards the third phase up to farrowing.

Data collection and pretreatment

In trial 1, each sow was equipped with radiofrequency identification (**RFID**) ear tags to be detected and identified by the feed and water dispensers and the automatic weighing scales. As preprocessing of raw data, visits to feeders or drinkers with no recorded duration or overlapping data were excluded. Sows were weighed automatically (Asserva, Lamballe, France) and their BT measured manually at P2 position with a portative ultrasound device (Imago, ECM, France) 3 days after insemination and around day 107 of gestation. Weekly health checks were conducted by trained observers in the pen, using the Welfare Quality® protocol to assess health and welfare indicators (i.e. bursitis score, absence of manure on the body, lameness, wounds count on the body and absence of disease). At farrowing, the number of born alive or stillborn piglets was recorded, and they were weighed. Some piglets were cross-fostered based on functional teats available without taking into account the sow feeding strategy. Piglets were given creep feed from week 3 onwards and were weighed the day before weaning. Piglet mortality and BW gain were recorded to calculate the average daily gain for the litter.

Trained observers manually analysed video recordings to track individual social behaviour (positive and negative social interaction, exploration), location, and physical activity (sitting, lying, standing, drinking, eating) on 2 days during a specific 2-h period (days 30 and 103, from 0000 to 0200 h). Each sow was equipped, during the first gestation cycle, with an ear tag accelerometer (Actisow, RF-Track, Rennes, France), which continuously monitored their physical activity, unless the device broke which occurred quite often and early (67% of devices out of service at the end of first gestation). Physical activities were also analysed automatically at a group level (on days 30 and 103, from 0000 to 0200 h) from video recordings using an image analysis software developed by Dilepix (Rennes, France, Gaillard and Simon, 2024).

This time slot was selected because access to the individual daily ration at the automatic feeders was renewed every day at midnight for trial 1.

Data from automatons and sensors were preprocessed to remove raw data that were not linked to the sows involved in the trial, as well as data for which the sensor identifier was not available. Daily sensor files were aggregated into a relational database. Accelerometer data were excluded if the total recorded duration per hour did not equal 60 min plus or minus one minute, or if duplicate entries were found representing 0.3% of raw data removed. Identification codes from automatons and sensors were all linked to each sow's experiment number.

In trial 2, individual sow visits to the automatic feeder were tracked using RFID ear-tags. Visits to the feeder and to the drinking trough were measured and cleaned as done for trial 1. Weekly health assessments, particularly lameness through the sow's gait, were performed by the same trained observer during all the trial. Feed weighed and supplied manually before the entrance into group-housed gestation room and after the transfer to the farrowing room for PF were also recorded and aggregated in the database. Sows were weighed automatically between day 25 and day 108 of gestation and had their BW and BT measured manually at key stages: 1 week after insemination, on day 80, on day 107 when transferred to the farrowing room, on Monday before farrowing, and the day before weaning. Automatic average BW was cleaned for outliers thanks to 3–day rolling average to check its inter-day within-sow consistency. If the daily BW differed by more than 20 kg from the rolling average over the previous 3 days, the associated data were excluded from the database. Piglet data, including birth weight and status at birth, were recorded. Cross-fostering was used to adapt the size of the litter to the number of functional teats with piglets from sows with the same feeding strategy. Piglets were given creep feed from week 2 onwards and were weighed the day before weaning. For the CLS-AIR MODULES, data were merged at the minute time scale. Ammonia values above 100 ppm were removed as well as relative humidity values below 0%, ambient temperature values below −5 °C, hydrogen sulphide values above 50 ppm, methane values above 2% of the volume and luminosity values above 600 lux. These exclusion thresholds have been established on the basis of a graphical view of the data. Trained observers also manually analysed video recordings of this experiment to track individual social behaviour, location, occupation, and physical activity on 2 days during two specific 2-h periods (days 30 and 80, from 1200 to 1400 h and from 1800 to 2000 h). In contrast to trial 1, these time slots were selected because ration was renewed at midday.

Peer Review Summary and Supplementary material

Peer Review Summary and Supplementary material for this article (https://doi.org/10.1016/j.anopes.2025.100105) can be found at the foot of the online page, in Appendix A.

Ethics approval

Ethical approval concerning the French legislation on experimental animal care was approved by the Ethics Committee in Animal Experimentation in Rennes, France (APAFiS #24663 and #40427).

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) did not use any AI and AI-assisted technologies.

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Declaration of interest

None.

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