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Data paper

Data paper: Body composition during growth determined with computed tomography, carcass and meat quality, and fatty acid composition of pigs from different sex types



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ABSTRACT

Productive and body composition data from 47 Pietrain × (Landrace × Duroc) pigs from four sexual types (11 entire males, and 12 immunocastrated males, 12 surgically castrated males and 12 females) during growth are provided (Group 1). They were slaughtered at a 120 kg target BW (**TBW**). Additionally, 45 pigs were reared and slaughtered at 30, 70 and 100 kg TBW (Group 2). Pigs of Group 1 were computed tomography (**CT**) scanned at 30, 70, 100 and 120 kg TBW, and those of Group 2 were CT scanned only at the slaughter TBW. From CT images, several fat thicknesses, areas and widths were measured, as well as the volume associated with each Hounsfield value. From the slaughtered pigs' carcasses, organs and viscera weights were recorded and carcass measures were obtained at the midline with a ruler and a tape, and at 6–8 cm distance from the midline with a Fat-O-Meat'er equipment. Meat quality parameters were also obtained in the loin. Additionally, intramuscular fat was chemically determined at three levels of the loin and at three muscles of the ham. From all the left half carcasses, cuts were obtained and weighed. Moreover, from some cuts, subcutaneous fat weight was recorded and, in some cuts, additionally lean, intermuscular fat and bone weight were also obtained. Right half carcasses were minced, and proximate chemical composition, calcium, phosphorus and fatty acid composition were determined. The data and images provided can be used to work on body and carcass composition by sexual type, and to find relations between all the different quality characteristics determined. This can be useful for nutritional studies in order to know differences in pigs' characteristics by sex when they were fed the same diet and raised in the same conditions. Moreover, the use of CT information, together with the chemical composition, can be used to find prediction equations of the carcass characteristics, which can be used in future nutritional works.

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Specification table

Subject	Select one Section for your manuscript from the following list: Quality of Animal Products
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Specific subject area	Body characteristics during growth depend on the sex of the pig and can be followed non-destructively with a computed tomography (CT) device. The mincing and chemical analysis of the carcasses can be useful to determine nutritional requirements by sexual type.
Type of data	Table (Excel file) Digital Imaging and Communications in Medicine (DICOM) format images
How data were acquired	Productive data were obtained at the farm level using scales and an ultrasound

(continued on next page)

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	<p>device. Live pigs' body composition was obtained with a computed tomography equipment after anaesthesia of the pigs. Carcass and meat quality parameters were obtained directly on the carcass and meat using rulers, tapes or specific devices (e.g. pH-meter, conductimeter) or by means of standardised reference patterns. Cutting and dissection of left carcasses was carried out with a saw and knives by trained technicians, and the cuts and tissues were weighed. An industrial mincer was used to mince the right half of the carcasses, and after homogenisation, the samples were chemically analysed using traditional laboratory methods to determine proximate composition, with a microwave and spectrophotometer to measure phosphorus and calcium, and with a gas chromatograph system to assess fatty acid composition. DICOM images from CT were used to determine volumes associated with each Hounsfield value and to determine several thicknesses and areas by means of a Matlab script and specialised software (VisualPork Software).</p>
Data format	Raw and pretreated data and DICOM images.
Parameters for data collection	Datasets contain data obtained from live pigs at the farm level, data and images from anaesthetised pigs obtained from CT images, data from the slaughtered animals, and data and CT images from carcass and meat obtained at the slaughter plant. Moreover, after slaughter, carcasses were minced at the pilot plant and data from the chemical analysis of the minced carcasses obtained at the laboratory are also provided.
Description of data collection	<p>At the farm level, productive data were collected by individually weighing the animals and the feed provided and the non-consumed. Composition data were collected with an ultrasound device and with CT equipment. CT volumes were obtained automatically. CT images were measured manually.</p> <p>At slaughter plant, several sensors were used to collect data on quality traits. All data were checked for outliers and removed when detected. Data recorded manually were checked for minimum and maximum values to detect possible mistakes. Specific reagents and devices were used for the chemical analysis.</p>
Data source location	Fill in the information available, and delete from this list as appropriate: Institution: IRTA - Institute of AgriFood Research and Technology City/Town/Region: Monells, Girona,

	<p>Catalonia Country: Spain Latitude and longitude (and GPS coordinates, if possible) for collected samples/data: 41.97602343210449, 2.997687195885855</p>
Data accessibility	<p>Repository name: Catalan Open Research Area (CORA). Repositori de dades de Recerca (RDR) Data identification number: https://doi.org/10.34810/data2797</p>
Related research article	<p>Zomeño, C., Gispert, M., Brun, A., Carabús, A., Soler, J., Font-i-Furnols, M., 2022. Productive performance and <i>in vivo</i> body composition across the growing and finishing period and carcass traits in pigs of four sex types. <i>Meat Science</i> 192, 108909. Moreover, some of the data has also been used in the following papers: Carabús, A., Sainz, R.D., Oltjen, J.W., Gispert, M., Font-i-Furnols, M., 2015. Predicting fat, lean and the weights of primal cuts for growing pigs of different genotypes and sexes using computed tomography. <i>Journal of Animal Science</i> 93, 1388–1397. Carabús, A., Sainz, R.D., Oltjen, J.W., Gispert, M., M., F.-i.-F., 2017. Growth of total fat and lean and of primal cuts is affected by the sex type. <i>Animal</i> 11, 1321–1329. Zomeño, C., Gispert, M., Čandek-Potokar, M., Mörlein, D., Font-i-Furnols, M. 2023. A matter of BW and sex type: pig carcass chemical composition and pork quality. <i>Meat Science</i> 197, 109077.</p>

Value of the data

- The data, whether as a whole or partly, can be valuable to both the research community and industry, as it may help identify relationships between body and carcass characteristics according to sexual type.
- Information from the animals and carcasses was collected at different growth stages and can be used to understand the development of various tissues according to the pigs' sex type, as well as to model this growth.
- The analyses presented in the manuscripts associated with these data can be repeated with different factors or objectives. For example, CT volumes could be used with variable thresholds to distinguish between lean and fat tissue.
- Professionals in nutrition, physiology, carcass evaluation, and meat quality can use these data to access information that supports the expansion of their knowledge.
- Computed tomography images from live pigs at different weights and from carcasses are provided and can be re-analysed or used to determine body or carcass characteristics that differ from, or come from anatomical locations other than, those included in the dataset, thereby enriching the research.

Data description

There are four data files in.csv format and five zipped image folders containing DICOM files from live pigs and carcasses. Each data file has a Metadata/Dictionary file (.csv) within the same repository with the description, units and ontology of each variable. Additionally, a readme file (.txt) is included with a description of the repository's contents. All the files can be downloaded individually or zipped into one unique file (approximately 25 GB).

Regarding the data files, the data available at each file are described below, given that the columns follow alphabetical ordering:

- (1) Productive data file (IRTA_PRODUCTIVE_AllometryExp2_DATA.csv with the data and IRTA_PRODUCTIVE_AllometryExp2_METADATA.csv with the metadata) with 188 registers:

Columns A to G: Identification of the pigs and information regarding the sex, pen and the experimental design.

Columns H to K: Data and weight (full or empty) of the pigs.

Columns L and M: Ultrasound measures of fat and muscle thickness.

Columns N to T: Productive information regarding feed intake, daily gain, feed conversion ratio and days.

- (2) CT and quality data file (IRTA_CTQUALITY_AllometryExp2_DATA.csv with the data and IRTA_CTQUALITY_AllometryExp2_METADATA.csv with the metadata) with 233 registers:

Columns A to H: Identification of the pigs and information regarding the sex and the experimental design.

Columns I to AO: Cutting and dissection data.

Columns AP to AS: Muscles' weight.

Columns AT to AY: Live and carcass weights at slaughter.

Columns AZ to BI: Carcass quality measures (several fat thickness and muscle depth).

Columns BJ-BM: Cold carcass weight and chilling losses.

Columns BN-BP: Carcass conformation and length and loin length measured on the carcass.

Columns BQ to CF: Meat quality measures (pH, electrical conductivity, marbling, intramuscular fat and colour).

Columns CG to CR: Weight of organs and viscera (white and red viscera, heart, liver, kidney, tongue, flare fat, tail, brain and stomach).

Columns CS to CT: Weight of the reproductive organs (testes and bulbourethral gland).

Column CU: Weight at scan with CT.

Column CV to EE: Measurements taken from the axial CT images at different anatomical positions of the pigs.

Columns EF to CWJ: Volume associated with each Hounsfield value from the images of the whole pig (with viscera).

Column CWK: total volume of the scanned pig.

- (3) CT scans of carcasses data file (IRTA CTCARCASS_AllometryExp2_DATA.csv with the data and IRTA CTCARCASS_AllometryExp2_METADATA.csv with the metadata) with 91 registers:

Columns A–C: Information on the pig carcasses, sex and target body weight.

Column D: Carcass identification.

Column E: Acquisition thickness of the reconstructed image.

Columns F to CXY: Volume associated with each Hounsfield value from the images of the whole left half carcass.

- (4) Chemical analysis data file (IRTA_CHEMICALANALYSIS_AllometryExp2_DATA.csv with the data and IRTA_CHEMICALANALYSIS_AllometryExp2_METADATA.csv with the metadata) with 92 registers:

Columns A and B: Identification of the animal and the carcass. Column C: sexual type.

Columns D to G: proximate composition of the minced carcass.

Columns J to BG: fatty acid composition (in % and in mg) of the minced carcass.

Additionally, there is a folder with approximately 53000 DICOM images from all the live pigs and carcasses (IRTA_COMPUTEDTO MOGRAPHY_AllometryExp2_IMAGES). This folder is composed by five subfolders, one for the images of live pigs at 30 kg TBW (TBW30.zip, with 60 folders (one per pig), average 179 image/pig), one at 70 kg TBW (TBW70.zip, with 64 folders (one per pig), average 162 images/pig), one at 100 kg TBW (TBW100.zip, with 64 folders (one per pig), average 176 images/pig) and one at 120 kg TBW (TBW120.zip, with 47 folders (one per pig), average 184 images/pig) and the last one for carcass images (CARCASS.zip, with 91 folders (one per carcass), average 135 images/carcass). In each folder, there are the files for each animal/carcass, identified as:

- BLXXXXSEX_TBW (e.g. BL1326F_30) for live pigs, where BLXXXX is the animal ID, where F, C, M and I are the sex identification for females, surgically castrated, entire male and immunocastrated, respectively, and where 30, 70, 100 and 120 are the TBW at the moment of the scan.
- BLXXXXSEX_TBWCANX (e.g. BL1326F_120CAN61) for carcasses, where BLXXXX is the animal ID, F, C, M and I is the sex identification, 30, 70, 100 and 120 is the TBW at slaughter, and CANX refers to carcass number X.

For each animal/carcass, there is one file with the image acquisition information (DICOMDIR) and one folder with the images (SDY00000). The folder with the images is composed of one or two folders with the scout (surview) image of the pig/carcass and one folder (the heaviest one) with all the DICOM images, obtained axially (live pigs) or helically (carcasses) every 10 mm. For some animals scanned at 100 kg TBW and some carcasses, the images are split into two folders. Images of live pigs include viscera and organs, as well as the tube in which the pigs were placed for scanning.

Experimental design, materials and methods

Experimental design

A total of 92 Pietrain × (Landrace × Duroc) pigs were used, 24 entire male, 24 female, 24 surgically castrated male and 20 immunocastrated male. Immunocastration was performed with two doses of Improvac[®] at 12 weeks of age (V1) and 18 weeks of age (V2). All pigs were CT scanned and slaughtered at 30, 70, 100 and/or 120 kg target BW (TBW), according to the design presented in Table 1. All the pigs were fed *ad libitum* the same commercial diet in two phases. The feed contained 10.24 and 10.08 MJ net energy/kg, 18.00 and 17.02% CP and 0.91 and 0.90% digestible lysine, for the growing phase and finishing phase, respectively (Carabús et al., 2017).

Materials and methods

At the farm level, the pigs slaughtered at 30, 70 and 100 kg TBW were reared in 3 pens (5.0 × 2.7 m²) with 12–16 pigs of all sexual types. The animals that were monitored along their growth and slaughtered at the end of the trial, at 120 TBW, were kept in individual pens (2.5 × 1.2 m²). For all the animals, pens were fully slatted, with one drinking bowl and one free-access feeder. Productive

Table 1

Number of Pietrain × (Landrace × Duroc) pigs scanned for each combination of sexual type and target body weight (TBW) and type of cutting and dissection performed. The 's' after the number indicates that, after being scanned, pigs were slaughtered.

	TBW (kg)				Total pigs
	30	70	100	120	
Entire male	12+4s	12+4s	11+5s	11s	24
Surgically castrated	12+4s	12+4s	12+4s	12s	24
Immunocastrated	12+0s	12+4s	12+4s	12s	20
Female	12+4s	12+4s	12+4s	12s	24
Total pigs scanned	60	64	64	47	92
Total pigs slaughtered	12	16	17	47	92
Total carcasses scanned	11	16	17	47	91
Productive data	47	47	47	47	47
Chemical data					
Proximate analysis	11–12	15–16	17	44–46	89–90
Phosphorus and Calcium	12	16	17	44	89
Fatty acid composition	0	13	13	42	68
Carcass cutting and dissection	Cuts ¹	Ham ^{1,2}	Ham ^{1,2}	Ham ^{1,2} 39 Simp ^{1,3} 8	

¹ data collection of all cut weights, ham and loin subcutaneous fat plus skin weight, and weight of the *longissimus* muscles and of the ham muscles *semimembranosus*, *gluteus medius* and *biceps femoris*.

² data collection of shoulder subcutaneous fat plus skin weight and ham dissected (weight of lean, subcutaneous fat plus skin, intermuscular fat and bones).

³ data collection of ham, loin, shoulder and belly dissected (weight of lean, subcutaneous fat plus skin, intermuscular fat and bones).

parameters (average daily gain, average daily feed intake and feed conversion ration) were recorded at each TBW only for the animals that were monitored along their growth, and measures regarding several phases were computed. Additionally, fat thickness and muscle depth were measured with the Piglog 105 ultrasound (Frontmatec, Denmark) at the level of the last rib and at 4–6 cm from the midline (both, right and left sides, and the average values were used) (Zomeño et al., 2022).

Scanning of live pigs was performed after intramuscular anaesthesia with azaperone (0.1 mg/kg), ketamine (0.2 mg/kg) and intravenous propofol (0.2 mg/kg, only for 100 and 120 kg TBW pigs), with the General Electric CT HiSpeed Zx/i equipment. Acquisition parameters were 140 kV, 145 mA, axial (1 s), 7 mm thick (30 kg TBW) or 10 mm thick (70, 100 and 120 kg TBW). Using the Visual-Pork software (Boada et al., 2009; Bardera et al., 2012), several measurements were obtained from CT images (Carabús et al., 2015; Carabús et al., 2017):

- Whole body: length and width,
- Shoulder region (when the scapula bone is visible): subcutaneous fat thickness perpendicular to the skin in the centre of the dorsal region, area and perimeter,
- Loin region (between 6th–7th, 11th–12th, 14th–15th ribs and between 3rd–4th lumbar vertebrae): subcutaneous fat thickness perpendicular to the skin in the centre of the dorsal region and at the most ventral part of the right loin, width of the right loin, area and perimeter of the right loin and maximum length of the two loins.
- Ham region (at the junction between pubis and femur, cross section HH of <https://porcine.unl.edu/cross-sections/1>): height at the central part of the ham, subcutaneous fat thickness at the top of the dorsal part, width at the top of the pubic bone and subcutaneous fat thickness at this level, area and perimeter of the whole ham and area of the subcutaneous fat.

Additionally, from all the images, including viscera, the volume associated with each Hounsfield value (from –1100 to +1400) was obtained, and the total volume of the pig was calculated.

When pigs reach the final TBW, they were fasted for 10–12 h, weighed and slaughtered after CO₂ stunning at the IRTA slaughter plant (Monells, Spain). For the immunocastrated male pigs, it was

ensured that slaughtering was around 8 weeks of V2. The same day, warm carcass weight was recorded and, together with the live weight, used to determine carcass yield. Before weighing, carcasses were prepared according to the European Union official presentation, i.e. without tongue, bristles, hooves, genital organs, diaphragm, flare fat, kidneys, tail and spinal cord. The weight of white viscera (including pancreas, stomach, spleen and small and large intestines) and red viscera (including tongue, heart, liver, kidneys, lungs, bladder and trachea) was recorded. Additionally, the individual weight of the heart, liver, kidneys, tongue, flare fat, tail and brain was also recorded. Moreover, in the pigs slaughtered at 120 kg TBW, the full and empty stomachs were weighed, and for the entire male and immunocastrated male pigs, the testes and bulbourethral glands were also weighed.

Several fat thicknesses (including skin) were also determined with a ruler on the warm carcass between the 3rd and 4th lumbar vertebrae, 3rd and 4th last ribs, 8th and 9th last ribs and the minimum fat thickness over the *gluteus medius* muscle. The muscle depth from the dorsal edge of the vertebral canal to the cranial end of the *gluteus medius* muscle was also measured with a ruler. The Fat-O-Meat'er II (FOM, Frontmatec, Denmark) was used to measure the fat and muscle thickness at 6 cm of the midline between the 3rd and 4th last ribs and the backfat thickness at the level of the last rib and between the 3rd and 4th lumbar vertebrae at 6 and 8 cm from the midline, respectively. At 24-h *post-mortem*, the carcasses were weighed (cold carcass weight) and used to determine chilling losses. Conformation was also recorded from 1 (very good conformation) to 4 (very poor conformation), according to a visual pattern from the EC Pig Grading Grid. The loin length (from the 1st lumbar vertebrae to the 1st cervical vertebrae) and carcass length (from the cranial side of the symphysis pubic to the recess of the first rib) were measured with a tape.

A portable pH-meter equipped with a Xerolyt probe was used to measure the pH of the loin at the level of the last rib at 45 min and 24 h *post-mortem*. Also, at 24-h *post-mortem* and at the same location, the electrical conductivity was measured with a Pork Quality Meter device (PQM-Kombi, Germany). Moreover, the colour was scored from 1 (extremely pale) to 6 (extremely dark) by two trained technicians using the Japanese Scale of Colour and the average was used. Luminosity (L*), redness (a*) and yellowness (b*) were recorded after 15–20 min blooming in triplicate by

means of the Chroma-Meter 200 (Minolta Co., Ltd, Japan) equipment. The average values were used. At three loin levels (3rd–4th last rib, 8th–9th last rib and 3rd–4th lumbar vertebrae), and three ham muscles (*biceps femoris*, *gluteus medius* and *semimembranosus*), marbling was evaluated by two trained technicians according to the National Pork Producers Council (NPPC) pattern (NPPC, 1999) from 1 (less marbled) to 10 (highly marbled) and intramuscular fat chemically determined using FoodScan equipment (Foss, Denmark), as detailed in Font-i-Furnols et al. (2019).

Cold left half carcasses without the front and hind feet and the head (but with the cheek) were CT scanned with the same CT and acquisition parameters as live pigs. General Electric CT HiSpeed Zx/I equipment. The only difference was that the acquisition was helical instead of axial. The same software was used to obtain the volume associated with each Hounsfield value.

Then, all the left half carcasses were cut into 15 pieces according to Walstra and Merkus (1995), and some of them were partially or fully dissected as defined in Table 1. The right carcasses were frozen, and after some weeks, they were cut with a guillotine (Model D, Spain), teeth removed and then minced (Grinder Cato-pa160, Spain). Chemical analysis of the minced carcasses was performed to determine protein content (Kjeldahl total nitrogen using Büchi Distillation Unit B-324 and Digester Unit B-414, Switzerland), fat content (Soxtec 2050, Tecator, Sweden), moisture (oven at 100 °C until constant weight) and ashes (muffle oven at 550 °C for 2–3 h). Additionally, Ca and P were determined by mineralisation in a microwave (MARSXpress, CEM, Matthews, USA) and inductively coupled plasma-optical emission spectroscopy (ICP-OES, Spectrophotometer Optima 4300 DV, USA) (Zomeño et al., 2016; Zomeño et al., 2023). Additionally, fatty acid profile was determined as the proportion of total fatty acid and quantity in minced carcasses from pigs slaughtered at 70, 100 and 120 kg TBW, after fat extraction following Folch et al. (1957) method, as described in Zomeño et al., (2023).

Peer Review Summary

Peer Review Summary for this article (<https://doi.org/10.1016/j.anopes.2026.100142>) can be found at the foot of the online page, in Appendix A.

Ethics approval

The experiment was approved by the IRTA Animal Experimentation Ethical Committee and by Generalitat de Catalunya Ethical Committee (DAAM 5298 – 2011AMNGIRAUT0420).

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Author contributions

MFF: Conceptualisation, Writing – original draft, Writing – review and editing, Data curation, Project administrator, Funding acquisition; **AB:** Writing – review and editing, Data curation; **CZ:** Writing – review and editing, Data curation.

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

During the preparation of this work, the authors used Copilot in order to improve the English language and readability. After using this tool, the authors reviewed and edited the content as needed and took full responsibility for the content of the publication.

Declaration of interest

The authors have no conflict of interest.

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