FEED-A-GENE

Adapting the feed, the animal and the feeding techniques to improve the efficiency and sustainability of monogastric livestock production systems

Deliverable D2.1

A database with information on feeding behaviour in pigs as a trait related to feed efficiency

Due date of deliverable: M30

Actual submission date: M34

Start date of the project: March 1st, 2015 **Duration:** 60 months

Organisation name of lead contractor: IRTA

Revision: V1

Dissemination level	
Public - PU	**X**
Confidential, only for members of the consortium (including Commission Services) - CO	
Classified, as referred to in Commission Decision 2001/844/EC - CI	

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1. Summary

Objectives:

The objective of this document is to provide a description of a database created within the framework of Feed-a-Gene, containing phenotypic performances records of growing purebred Duroc pigs, including feed intake and feed efficiency measurements, as well as a number of feeding behaviour traits.

This database is created with the aim of exploring the phenotypic relationship between performance traits and traits related with the feeding behaviour of the animals. This would be the basic step to propose feeding behaviour traits as new traits informing about the nutrient efficiency of animals. Information on this topic in pig production in literature is scarce and limited to the most common lean meat production breeds. Our aim is to explore these features in a Duroc line selected within a production scheme focused on the meat quality. The animal material we are using comes from a company within a consortium devoted to the commercialization of high quality meat products (e.g. loins and hams). For this reason, a Duroc line is used as a maternal line in their breeding scheme.

The present deliverable is developed in Feed-a-Gene WP2, but has high value for WP5 as well. The database we are describing will be used to explore the genetic component of the putative relationship between feed efficiency and welfare and behaviour traits.

Rationale:

To constitute the data set, we merged historical data, recorded in three previous projects, and three batches controlled within the framework of Feed-a-Gene. Two additional batches will be considered in a later stage, one of which will be realized in 2018 and is funded by a Spanish National Research Project (see below). The procedure adopted in all batches of animals is the same. After getting in contact with the company providing the purebred animals, a sample of the offspring of the currently active boars and sows of the line is identified at birth, and when these animals reach about 60-70 days of age, they are taken to IRTA's experimental farm. Immediately after arrival to the experimental control station, they are allotted by sex and size in homogeneous groups of 13-15 animals. Each of the groups is placed in pens equipped with IVOG® feeding stations (Insentec, Markenesse, and The Netherlands) to start controlled feeding. The information generated by these devices is useful for monitoring feed intake as well as feed behaviour traits. Animals in each of the batches follow the same protocol in the experimental farm.

For the particular case of the animals involved in the three batches of the Feed-a-Gene project, additional behaviour and welfare traits are recorded apart from the standard protocol in the control station. This concerns traits recorded by visual inspection of the animals during the control period, which are described further in the Result section.

Teams involved:

IRTA

The data that in the last 3 years have been included in the database have been funded by the Feed-a-Gene project and the Spanish national project "***Mejora de la eficiencia alimentaria en el crecimiento y la reproducción en especies prolíficas. Determinismo genético de sus componentes y estrategias de selección (GENEF)" RTA2014-00015-C02***. Approximately 350 new individual records have been funded through the Feed-a-Gene project and 300 records are being generated with the Spanish project.

Species and production systems considered:

Growing pigs.

Explanation of the delay

Deliverable D2.1 is submitted four months later than planned. This is a consequence of a delay to start the data collection on the first batch of animals due to internal constraints of the company supplying the pigs. The further execution of the activity followed the original planning.

1. Introduction

In the results section we present first the calendar dates in which the different batches forming the database have been controlled. Here we include in addition to the Feed-a-Gene batches, other batches controlled in previous projects as well as those currently in control funded by RTA2014-00015-C02. The technical details of the database are described below.

2. Results

2.1 Calendar of the batches

Table 1.- Calendar dates of the batches included in the database. Number of animal controlled. Range of ages controlled. Average number of body weight measurements taken for each animal.

TRIAL		Batch 1	Batch 2	Batch 3
CENIT	Month of birth	Oct-2007	June-2008	
	N of animals	97	106	
	Range of age (days)	85-190	62-174	
	N of weights / animal (average)	6.0	5.9	
LACT	Month of birth	May-2011		
	N of animals	102		
	Range of age (days)	68-186		
	N of weights / animal (average)	4		
INIA-FE	Month of birth	Jan-2012	June-2012	Dec.-2012
	N of animals	115	120	121
	Range of age (days)	72-174	79-165	75-160
	N of weights / animal (average)	10.8	9.9	8.9
FEED-A-GENE	Month of birth	Sept.-2015	Febru.-2016	Dec.-2016
	N of animals	67	141	139
	Range of age (days)	69-176	72-181	72-188
	N of weights / animal (average)	5.9	6.0	6.0
GENEF	Month of birth	April-2017	March – 2018	
	N of animals	150	150	
	Range of age (days)			
	N of weights / animal (average)			

As indicated in table 1, a total of 348 animals were finally controlled, distributed over three batches. The size of the first batch was smaller than planned because of an identification

problem at the farm. The animals from Batch 1 of GENEF are still being measured, and this first batch just finished in November 2017. The second batch of this experiment is scheduled to start March 2018. Considering the whole data set, by next year we will have around 1300 animals controlled, with both performance records (body weight, feed intake and backfat and loin thickness) and feeding behaviour data.

2.2 Database table structure.

Once the control period is finished, all the information recorded in IRTA's control station is saved in a MySQL database having the following table structure:

Animals_Historic:
This table includes one record per animal, including all the relevant information to properly identify the animal and the batch where it performed.

FI_Historic:
This table includes one record per animal and control day. In this table the relevant information is the following: i) Number of visits to the feeder, ii) Seconds occupying the trough, iii) Total consumption (grams) of the day, iv) The number of visits considered to be erroneous when applying an algorithm for computing daily feed intake from information on each visit to the feeder. In the case when this variable is different from zero, the feed intake information will be treated as missing when computing the total feed intake through the whole control period. These computations are done using R scripts developed to this end, see section 3.3.

BodyWeight_Historic:
This table includes one record per animal and measurement day, and the relevant information includes: i) Body Weight, ii) Backfat Thickness, iii) Loin Thickness. As shown in table 1, each animal was measured 6 times during the Feed-a-Gene project.

Hourly _FI_Historic:
This table includes one record per animal and control day, having each record in addition to the animal's ID and the date, 24 fields representing for each clock hour of the day the amount of feed (grams) eaten by this particular animal on that day.

Hourly _OT_Historic:
This table includes one record per animal and control day, having each record in addition to the animal's ID and the date, 24 fields representing for each clock hour of the day the amount of time (in seconds) that this particular animal on that date spent in the feeder.

Hourly _VI_Historic:
This table includes one record per animal and control day, having each record in addition to the animal's ID and the date, 24 fields representing for each clock hour of the day the number of visits to the feeder of this particular animal on that date.

Hourly _FR_Historic:
This table has the same structure as Hourly_FI_Historic and Hourly_OT_Historic and Hourly_VI_Historic, but it includes the average eating rate (grams eaten in a minute) for the visits taking place in a given hour of the day. As these quantities refer to averages along the visits during an hour, they cannot be directly obtained from Hourly_FI_Historic and Hourly_OT_Historic.

Hourly tables are the basic behaviour information retained and sorted in the database. This information can be used to define for example the “distance between the animals” with respect to hourly patterns of these feeding behaviour traits.

In addition to this sorted information, all the raw information generated by the feeding devices is kept as plain text files and, from this raw data, further or alternative feeding behaviour records can be retrieved. In our case, all the analyses conducted so far rely on the hourly summaries that are kept in the MySQL database.

Having the information structured in a relational MySQL database allows us to:

1) Automatically add new information to the database, even including other experiments and types of animals (other breeds or crossbred)
2) Easy access to the information using computational tools such as R.

2.3 Software for data processing

As indicated previously, a number of R scripts have been developed for processing the information stored in the database described.

1) Determination of feed intake throughout the whole control period. In this script, feed intake of days with missing records is predicted using an animal nested Legendre Polynomial function. Missing records for daily feed intake are generated when a given animal has visits declared to be erroneous in a given day.

2) Calculation of average daily growth, this is done as the within animal linear regression of body weight on an age range. This script is also used to retain backfat thickness at the end of the age range.

3) Calculation of different feed efficiency measurements from raw performance data: feed conversion ratio and residual feed intake.

4) For the study of feeding behaviour traits, hourly data needs to be summarized in daily feeding behaviour data. The daily information on number of visits, occupation time, feeding rate, and other derived traits (e.g., length of interprandrial periods) is then used to calculate data over the complete control period.

5) Some of the models (social animal models) used in the analyses require to keep track of the pen mates of each animal, i.e. to create database including in a single record not only the identification of the animal generating the measurement but also their pen mates. This transformation of the information in the MySQL database has been implemented in an R script.

All these scripts are relevant to be described here because they can be considered as tools developed within the framework of the database creation to ease the manipulation of the stored

information. Other tools can be added to the chain of data processing (e.g., tools for exploring the longitudinal features of the recorded traits).

2.4 Behaviour traits recorded by visual inspection

As indicated before, a number of visually recorded behaviour traits have been recorded in the animals controlled within the framework of the Feed-a-Gene project and the batch currently under control funded by GENEF.

Feed-a-Gene Batch 1

67 animals were controlled for two types of behaviour/welfare traits:

- Lesions in different parts of the body: Ears, Head, Body, Hams and Forelegs
- Antagonistic behaviours
    1. Number of initiated/received fights.
    2. Number of initiated/received head blow.
    3. Number of initiated/received bites.
    4. Number of initiated/received persecutions

The observation of these traits was done following an established protocol that implies the observation of each pen for 20 minutes, and this was repeated every 3 weeks.

Feed-a-Gene Batch 2

76 animals were controlled for the two types of behaviour traits:

- Lesions in different parts of the body
- Antagonistic behaviours

Feed-a-Gene Batch 3

For this batch, it was not possible to visually control behaviour traits.

GENEF Batch 1

75 animals were controlled for the two types of behaviour traits:

- Lessons in different parts of the body
- Antagonistic behaviours

Considering all the batches, we have a total of 218 animals visually controlled for behaviour traits. This data base seems very suitable to validate the feeding behaviour information recorded with the feeding devices, described in point 3.2.

All this information in contained in table of the data base named ***Visual_records***. It also includes information on physiological traits recorded in blood as well as levels of Cromogranine A, assessed in saliva.

2.5 Access to the database.

A subset of the whole database has been published as an SQL file. This subset comprises all the information that will be generated during the Feed-a-Gene project, as well as the information recorded for the first batch of animals.

The database has been published at the Zenodo platform and can be accessed through the following link: https://doi.org/10.5281/zenodo.1075521. Software for management operations of the data is available upon request from Juan Pablo Sanchez (juanpablo.sanchez@irta.es).

3. Conclusions

1.- The intended information have been recorded, approximately 350 purebred Duroc animals have been controlled.

2.- A MySQL database structure have been created for storing body weight and body composition (backfat and loin thickness), as well as feed intake data, and also hourly feeding behaviour patterns. In addition to this, all the raw information is kept and other features of feeding behaviour information can be retrieved.

3.- A number of tools for data processing have been developed.

4.- The availability of visually recorded behaviour trait allows to assess the relationship of these data with automatically recorded feeding behaviour traits.