SHORT TERM SCIENTIFIC MISSION (STSM) – SCIENTIFIC REPORT

The STSM applicant submits this report for approval to the STSM coordinator

Action number: CA15134

STSM title: Evaluation of the possibility to collect molecular and body phenotypes at birth to predict piglet survival and welfare

STSM start and end date: 08/01/2018 to 16/02/2018

Grantee name: Oceane Schmitt

PURPOSE OF THE STSM/

(max.500 words)

Genetic selection for sow hyper-prolificacy led to greater number of piglets born, but was also accompanied by a greater mortality of neonates, due to higher competition for milk intake and discrepancy in siblings weight at birth. In particular, large litters have a greater number of small and immature piglets born, which are at higher risk of dying because they have lower body energy reserves and reduced ability to compete littermates. Therefore, there is a need to promote survival of piglets, thus their robustness, in order to ensure the ethical production of pig meat. One of the aspects of piglet robustness is their capacity to regulate their body temperature shortly after birth. Indeed, hypothermia is one of the main causes of piglet neonatal mortality and is caused by failure to ensure thermoregulation. Therefore, more robust piglets should be more able to increase their body temperature shortly after birth, compare to weak piglets.

The research groups involved in this STSM share common research interest as they both focus on piglet survival, but they use different techniques to approach the problem. The GENOROBUST research team at INRA (GENPHYSE, Castanet-Tolosan, Toulouse) is currently conducting a project (SuBPig) on the identification of genetic markers related to piglets' survival and robustness. The Pig Development Department at Teagasc (Fermoy, Ireland) is about to conclude a project (OptiPig) where the effectiveness of early life interventions to promote piglet pre-weaning survival was investigated. Preliminary work on using Infra-Red Thermography (IRT) technique to measure piglets' thermal status at 3h post-partum was carried out at Teagasc by the applicant. It was decided to use IRT to assess thermoregulatory abilities of piglets as an extra measure of piglets' robustness in the SubPig project.

Thus, the first purpose of this STSM was to start collaboration between the two institutions and to share knowledge about their different expertise. In particular, the applicant discovered the field of genetic studies and methods (genomics, transcriptomics and metabolomics). The host institution benefited from the applicant's expertise in using Infra-Red Thermography technique.

The scientific aim of the STSM was to identify markers to predict survival and maturity in neonatal piglets, in order to define objectives for the genetic selection to improve piglet robustness. It was expected to find a

relationship between the genetic markers and the thermoregulatory abilities of piglets, and ultimately a relationship with their survival chance. Data were collected on piglets which belonged to two genetic lines (11th generation) obtained from divergent selection for feed efficiency (selection based on residual feed intake).

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

(max.500 words)

The first week of the STSM was dedicated to gathering knowledge about SubPig project, which aims at enhancing survival at birth in piglets. In particular, knowledge about techniques of genomics, metabolomics and transcriptomics analyses was essential to understand the work of the research team and the analysis of the data collected. Then the protocol was discussed and the measurement sheets were produced. The SuBPig is proof-of-concept project of 18 months with the aim to propose a new strategy 1/ to develop and evaluate biomarkers to overcome the problem of piglet high mortality at birth and the quality of survival as potential of growth and behaviour/welfare and 2/ to determine the metabolic status of the newborn. A technical outcome will be an ease of use procedure to collect blood samples at birth.

On the second week, the experimental work was conducted on the INRA research facility of "Le Magneraud" (Surgeres, France). Over the week, 62 piglets were phenotyped (weight, rectal temperature, body measures, vitality scores and blood samples from the umbilical cord) and a total of 220 images were acquired over the first hour following birth. The dataset was fairly balanced between the two genetic lines and the genders.

The third week, thermal images were analysed using Thermacam Researcher Pro 2.0. The dataset compiling phenotypes and thermography measures was produced and data were analysed statistically using SAS. Firstly, Pearson correlation test was performed on the data to identify and quantify possible relationships between the thermal data and phenotype measures (weight, length, width…). Then, General Linear Models (GLM) were used to analyse temperature data, accounting for the random effect of sow and the repeated effect of time (picture number).

The fourth week, preliminary results of the SubPig project were presented to other collaborators of the project, during the "50eme Journees de la Recherche Porcine" (6th and 7th February 2018, Paris, France). The attendance to the conference was funded by the COST-Action grant and allowed the applicant to gather knowledge about pig research projects conducted in France. A report about the conference was produced for the home institution to share knowledge about pig research conducted in France.

Results of the project were presented to the Genorobust research team and a report (in French) was produced for the researchers and the staff at the experimental unit. In addition, an abstract was written to present the results of the study at the EAAP conference, in August 2018.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

(max. 500 words)

Phenotypes and infra-red images were obtained from 62 piglets: 34 piglets from 3 sows in the genetic line G10- (most efficient, M:F ratio = 1) and 28 piglets from 4 sows in the genetic line G10+ (least efficient, M:F ratio = 0.87). At birth, piglets were weighed, measured (crown-to-rump length, width and circumference) and their rectal temperature was recorded. In the weighing scale, piglets were also scored for the quality of their mobility (0 = no movement to 2 = movement in the box), respiration (0 = no problem to 2 = deep and difficult breathing) and vocalisation (0 = no vocalisation to 2 = high and frequent vocalisation). Then, the first thermal image was taken (i.e. t0, approx. 8 min post-partum) and piglets were returned to their pen. Thermal images were then acquired 15, 30 and 60 minutes post-partum. The locomotor and suckling

activity of piglets and their proximity to the heat lamp were observed. After collection, temperature data were extracted from the thermal images at different locations of a piglet's body: the ear base, the ear tip and the back surface (i.e. from the shoulders to the rump). Direct readings of temperature were obtained the ear locations, and the minimum, maximum and average temperatures of the back area were calculated.

Table 1. Phenotype measurements of piglets that were selected for having a high (G10+) or low (G10-) residual feed intake.

	G10+	G10-	P-value
Birth weight (kg)	1.4 (±0.07)	1.3 (±0.08)	NS
Official weight (kg)	1.6 (±0.07)	1.4 (±0.08)	NS
Average weight gain (g/h)	7.1 (±1.27)	3.6 (±1.34)	< 0.001
Length (cm)	28.4 (±0.74)	27.0 (±0.80)	NS
Width (cm)	13.2 (±0.17)	13.5 (±0.18)	NS
Circumference (cm)	25.0 (±0.22)	25.3 (±0.23)	NS
Ponderal Index	68.0 (±0.91)	69.2 (±0.80)	NS
Body Mass Index	18.1 (±0.13)	18.3 (±0.12)	NS
Rectal temperature (°C)	37.1 (±0.26)	37.2 (±0.28)	NS
Mobility score	1.3 (±0.21)	1.4 (±0.23)	NS
Vocalisation score	1.0 (±0.34)	0.9 (±0.35)	NS
Respiration score	0.3 (±0.13)	0.1 (±0.14)	NS

Phenotype measures did not differ between the two genetic lines (Table 1).

Overall, the reflected temperature increased overtime for each of the locations selected (ear base, ear tip, and back). Therefore, thermal imaging was able to assess the thermoregulation of piglets. In addition, the birth rectal temperature of piglets was moderately correlated with the initial (t0) temperature of the ear base and the maximum temperature of the back (rho = 0.36 and 0.35, respectively, $P<0.05$), which validates the selected areas to approximate piglets' temperature.

Overall, the most feed efficient genetic line (i.e. G10-) had higher minimum (28.0±0.16 vs. 26.8±0.16; $P<0.001$) and average (35.5±0.20 vs. 34.5±0.13; $P<0.001$) back temperatures than the least feed efficient genetic line (i.e. G10+). There were also significant effects of the interaction between line and time on the reflected temperature of the ear tip and the minimum back temperature ($P<0.05$), but pair-wise comparisons were not significant after adjustment. However, ear tip temperature decreased in G10+ piglets between 8 and 15 min post-partum while it increased in G10- piglets (-1.1±0.42 vs 0.5 ±0.45, $P<0.05$).

FUTURE COLLABORATIONS (if applicable)

(max.500 words)

This work was preliminary in that the sample size is quite small. However, the results obtained are very encouraging for the use of thermography as a non-invasive measure of thermoregulation in neonatal

piglets. Therefore, there is a mutual interest from the two research teams (Teagasc and INRA) to continue the collaboration and maybe to continue the data collection in May/June 2018, thanks to another COST-Action grant (if successful).

The analysis of transcriptomics and metabolomics data will take few months to be performed, but ultimately it is hoped that all the results of the study, including thermography data, will be presented in a scientific paper and submitted to an international peer-reviewed journal.

Independently of the possibility to collect additional data, the results already obtained on thermoregulation abilities of the piglets were summarised in an abstract and submitted to the EAAP 2018 conference.