



Project Title:

Developmental consequences of heat stress on pre-elongating and gastrulating pig embryos

Research Cluster:

Heat Resilient Agriculture – Sustainable Agriculture & Food

School:

School of Biosciences

Partner Organisation:

[Topigs Norsvin Research Center B.V.](#)

Project Description:

Epidemiological evidence in humans and farm animals indicates that acute heat exposure around the time of mating results in pregnancy loss, with potential long-term consequences for offspring health, wellbeing and fertility. Identifying underpinning mechanisms requires the use of appropriate animal models. Pig and human embryos share many aspects of early development including gene regulatory networks, developmental timing, and signalling requirements for cell-lineage establishment. Thus, in addition to being species of commercial importance in their own right, these animals represent excellent models for the study of human embryogenesis.

This PhD will test the hypothesis that an acute period of heat stress around the time of mating epigenetically alters embryo development in a manner that can compromise pregnancy establishment, and the health and wellbeing of offspring derived from surviving embryos. This proposal will undertake detailed morphokinetic, histological, metabolic and molecular analyses of pig embryos up to and including gastrulation. In so doing, it will complement *in vivo* assessments of porcine embryo development (extending to F2 embryos) and measurements of cardiometabolic health in offspring (F1), which will be undertaken in parallel by other members of the team.

Specifically, this PhD will address the following three objectives:

- (1) Establish morphokinetic, cytogenetic and epigenetic effects of acute heat stress in pig embryos.
- (2) Establish consequences of such effects on cell fate in ‘gastruloids’ formed from stem cells derived from control or heat-stressed pig blastocysts.
- (3) Establish consequences on gonadal populations of germ cells in sexually mature male and female F1 offspring.

A range of temperatures (representing extremes of core-body temperature) will be assessed during in vitro embryo culture. State-of-the-art techniques include morphokinetic assessments undertaken using time-lapse microscopy complemented by immunohistological quantification of cell-lineage fate. The study will then characterize (lineage markers, karyotype) and sex stem-cell lines from Control and Hyperthermic treated embryos using established in-house protocols. Epigenetic status will be determined which will provide some insight into potential long-term developmental consequences of short-term heat stress during the study period. These lines will undergo induced gastruloid formation and molecular characterization for lineage mapping. Finally, germ-cell quantification following immunostaining will be undertaken in fixed ovarian and testes sections of sexually mature F1 offspring.

Whilst most of these experiments will be undertaken at the University of Nottingham, this PhD CASE studentship will be undertaken in collaboration with Topigs Norsvin, the second largest pig breeding company in the world. Some of the experimental work will, therefore, be undertaken in their laboratory in Norway, with the opportunity to gain experience of working in a commercial environment. A subsequent placement period at the company (The Netherlands) will provide the student with the opportunity to get an insight into the commercial operations of this global company.

Lead Supervisor:

[Kevin Sinclair](#)

Please email the lead supervisor to find out more about this project.

Terms & Conditions:

Home and international students are welcome to apply for this opportunity. Funding is available for four years from October 2025. The award covers tuition fee (£4,712) at the home rate plus an annual stipend which was (£19,273) for 2024. This is set by the Research Councils.

Please note that successful international candidates will be put forward for a University Fees Difference Scholarship to cover the difference between the home and international fee.

<https://www.nottingham.ac.uk/bbdtp/apply/apply-online.aspx>

Closing Date:

12 noon (UK time) 31 January 2025