PhD project: *Application of Omics profiling for oocyte maturation and developmental competence of preimplantation embryos in Polish Holstein-Friesian and Chinese Swamp buffalo (bubalus bubalis)*

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4. **Disciplines within project will be realized (basic and supplementary):** agriculture science (specialization: Veterinary Medicine (reproductive biology, animal genetics)

Artificial reproductive techniques, as in vitro fertilization and embryo culture, are potentially precious tools in cattle breeding, however the commercial aspect of the technology of *in vitro* embryo production (IVEP) is being hampered due to poor pregnancy rate following embryo transfer (ET). Pregnancy development depends on the developmental competence of the embryo, and obtaining sufficient number of embryos qualified for embryo transfer depends on the developmental competence of the oocyte, defined as the ability to undergo nuclear and cytoplasmic maturation. The molecular mechanisms of oocyte maturation and embryo development are still poorly understood. Planed studies are aimed to characterise these processes in Polish Holstein-Friesian cattle (HF) and Chinese swamp buffalo – breed important for dairy production in Poland and China, respectively. Obtained results may be used to improve the ruminant fertility traits and to wider implementation of advanced artificial reproduction techniques in bovine breeding. This PhD research will focus on oocytes and embryos of Polish HF cattle and Chinese swamp buffalo on the level of RNA (transcriptome), and DNA (epigenome). The use of this high throughput techniques (so called "Omics") and bioinformatics will allow to perform complex analysis of hundreds or thousands of factors, which allows for deep explanation of the regulation of gene and protein expression during acquiring of developmental competence by oocytes and embryos. The hypothesis is that oocyte maturation and developmental competence of embryo during early phase of its development is modulated by a strategic complex of stimulatory and inhibitory factors directed by gene and protein expression activity, which can be detected by omics methods.

The proposed PhD study will answer the following questions:

1. What is the physiological omics profile of oocytes and preimplantation embryos in Polish HF and Chinese swamp buffalo?
2. How omics profiles differ in oocytes and embryos showing proper and improper developmental competence and if this high throughput technique may be applied for the assessment of oocyte and embryo quality, and further introduced into evaluation of bovine fertility and other reproductive traits?
3. If omics profiling can indicate candidate genes and proteins which may be used as biomarkers for fertility of two divergent ruminant species - Polish HF and Chinese swamp buffalo – which play similar role in the European and Asian milk and meat production.
Moreover, we assume that comparison of two divergent ruminants (cattle and buffalo), will allow to point out basic similar and dissimilar changes in gene/protein expression during prenatal developmental life. The results of this research will not only fill the knowledge gap regarding omics profiling of oocytes maturation and early embryonic development in Polish HF cattle and Chinese swamp buffalo, but also focusing on molecular basis of reproductive biology may provide a baseline for future research on bovine reproduction and fertility traits.