

## I. Research Group Heading



Department of Animal Biochemistry and Biotechnology  
UTP University of Science and Technology,  
Mazowiecka 28 street, Bydgoszcz, Poland

## II. Name of the Group's Leader with a Short CV

**Marek Bednarczyk**, was nominated professor of Animal Biotechnology and Poultry Science by the President of the Republic of Poland in 2000. He has gained international experience on sabbaticals in INRA France, Slovakia, Ukraine and in University of Molise, Italy. As a head of the Animal Biochemistry and Biotechnology Department at University of Technology and Life Sciences, with 37 years of research experience he created a new and very active research group, and initiated PhD studies at the Faculty of Animal Biology and Breeding. The major emphasis of his current research program is on the development of *in ovo* technology for: bioactives administration; *ex situ* preservation of avian germ plasm and reconstitution of birds threatened with extinction, and for the production of transgenic chickens.

He has a strong background in intensive international cooperation, he is the Member of Executive Committee of the International PhD (Italy – Poland - Slovakia): Welfare, Biotechnology and Quality of Animal Production (since 2008). The Member of Editorial Advisory Board of the Journal of Advanced Pharmacological Research (since 2011), and the Member of Macedonian Journal of Animal Science (since 2011).

## III. Names of the Group's Members, and Their Research Areas/Interests

**Dr hab. Maria Siwek**, professor UTP, genetic bases of immune responses in chickens.

**Dr Anna Sławińska**, stimulation of chicken transcriptome with prebiotic, probiotic and synbiotic.

**Dr Joanna Bogucka**, performance of domestic animals, morphology and microstructure of muscle and intestine of animals.

**Dr Paweł Łakota**, avian cell engineering (in vitro cultures, transfection), animal and human reproduction.

**Dr Katarzyna Stadnicka**, establishment of cellular platform for transfection and production of exogenous proteins, biomolecular analysis.

**Dr Agata Dankowiakowska**, performance of domestic animals, morphology and microstructure of muscle and intestine of animals.

**Dr Adrianna Sobolewska**, effect of green light stimulation of embryogenesis on myogenesis in chicken.

**PhD student Aleksandra Dunisławska**, chicken transcriptome modification.

**PhD student Arkadiusz Płowiec**, microbiome-host interaction in broiler chickens.

**PhD student Agata Szczerba**, methods of chicken primordial germ cells modification.

## IV. Leading Research Topic of the Group

The major emphasis of the current research program is on the development of a novel method of gene transfer for the chicken and the application of avian biotechnology to biomedicine and agriculture.

## **V. Best Realizations of the Main Research Topic**

- Generation of transgenic chickens through chimeric intermediates, produced by the transfer of primordial germ cells (PGCs) has been attempted in our laboratory. The main elements of this strategy involve: plasmid construction, isolation of donor embryonic cells, their transfection *in vitro*, injection into recipient embryos, identification of somatic chimeras, raising chimeras and identification of germline chimeras. These chimeric chickens are then tested for germline transmission and used to create fully transgenic animals through breeding strategies. This PGCs technology has been successfully applied to obtain the transgenic birds that synthesise recombinant therapeutic protein to a secretory tissue in the oviduct of laying hens.
- We developed applicable chicken oviduct cell culture model. We characterized expression of oviduct, epithelial and stem/progenitor markers in oviduct tissue and cell culture in two avian species, hen and quail. We applied this model to test non-viral expression constructs in delivering human exogenes, as a stage in production of avian bioreactors. These results can contribute to further research on creating new biological models from reproductive tissue.
- We address host responses to the microbial intervention with prebiotics and synbiotics performed at the embryonic level (using *in ovo* technology). Such a treatment exerts several measurable benefits to the host, in terms of broiler chickens performance, meat quality, intestinal morphology, microbial digestive tract fermentation, immune system development and morphology, hormonal regulations in the pancreas and immune-related gene expression. We describe the molecular pathways and regulated genes in immune and gut organs that are influenced by the intestinal microbiota. We identify the bioactive compounds that have the most pronounced effects on immune-related gene regulation in cecal tonsils and, as such, can be further used in the poultry industry for stimulating health benefits to the host.

## **VI. General Expression of Interests**

Interest in cooperation at national and international level

## **VII. Specific Interests and Additional Topics of Extended Interest**

- Interest in study on a transgenerational epigenetic effect of *in ovo* chicken embryo stimulation,
- Developing new molecular tools for genetic modification of avian primordial germ cells (design of specific expression vectors to deliver exogenes),
- Genome editing (interest in new tools, eg. CRISPR/Cas9 for engineering specific genome sites to obtain desired phenotype),
- Interest in access to novel expression vectors of genetic factors for establishment of avian cell lines (eg. oviduct) for commercial applications,
- Developing new bioactives for *in ovo* chicken embryo stimulation.

## **VIII. Other Important Characteristics of the Group**

Our laboratory has the expertise to employ molecular biology, transcriptome analysis, immunocytochemistry, fluorescence microscopy, image analysis, tissue and cell culture, cells manipulation (isolation, genetical modification, introduction into recipient) and *in ovo* technology to answer questions related to the application of avian biotechnology to biomedicine and agriculture.

## IX. Main Group's Achievements

1. Team Award of President of Bydgoszcz City for “Excellent Scientific Achievement”, Bydgoszcz, 2006.
2. Fulbright Advanced Research Award, 2015-2016 /dr Anna Sławińska/.
3. Partner on FP7 projects:
  - THRIVE RITE - FP7-SME-2012, Grant Agreement n°315198. Natural Compounds to enhance Productivity, Quality and Health in Intensive Farming Systems,
  - FP7-KBBE-2012-6-singlestage, ECO-FCE, Grant Agreement Number 311794. A whole-systems approach to optimising feed efficiency and reducing the ecological footprint of monogastrics.
4. Patents:
  - Gulewicz and **Bednarczyk M.** Sposób stymulacji korzystnego profilu bakteryjnego wylężonych piskląt. 2008, PL197726.
  - **Bednarczyk M.**, Drewa T., Bajek A., **Stadnicka K.**, Joachimiak R. Sposób otrzymania komórek epitelialnych z jajowodu kury w hodowli pierwotnej *in vitro*. 2014, PL 397040
  - Sirko A., Góra-Sochacka A., Zagórski-Ostoja W., Stachyra A., Sawicka R., Szewczyk B., Gromadzka B., Sączyńska V., Florys K., **Bednarczyk M.**, **Lakota P.**, Minta Z., Śmietanka K. Szczepionka DNA, sposób indukowania odpowiedzi immunologicznej, przeciwciała specyficznie rozpoznające białko hemaglutyniny H5 wirusa grypy i zastosowanie szczepionki DNA. 2014, PL 396415.

## X. Best Selected Publications and/or Other Relevant Accomplishments

1. Dunisławska A., Sławińska A., Stadnicka K., Bednarczyk M., Gulewicz P., Jozefiak D., Siwek M. (2017). Synbiotics for broiler chickens - *in vitro* design and evaluation of the influence on host and selected microbiota populations following *in ovo* delivery. PLoS ONE 12(1): e0168587. doi:10.1371/journal.pone.0168587.
2. Sławińska A., Płowiec A., Siwek M., Jaroszewski M., Bednarczyk M. (2016). Long-term Transcriptomic Effects of Prebiotics and Synbiotics *In Ovo* Delivery in Broiler Chickens. PLoS One. 11 (12): e0168899. doi:10.1371/journal.pone.0168899.
3. Bednarczyk M., Stadnicka K., Kozłowska I., Abiuso C., Tavaniello S., Dankowiakowski A., Sławińska A., Maiorano G. (2016). The Influence of different prebiotics and mode of their administration on broiler chicken performance. Animal 10(8): 1271–1279.
4. Stadnicka K., Bodnar M., Marszałek A., Bajek A., Drewa T., Płucienniczak G., Chojnacka-Puchta G., Cecuda-Adamczewska V., Dunisławska A., Bednarczyk M. (2016). Efficient source of cells in proximal oviduct for testing non-viral expression constructs in chicken bioreactor model and for other *in vitro* studies. Folia biol. /Krakow/ 64: 37-46.
5. Płowiec A., Sławińska A., Siwek M., Bednarczyk M. (2015) Effect of *in ovo* administration of inulin and *Lactococcus lactis* on immune-related gene expression in broiler chickens. Am J Vet Res 76:975-982.