The goal of the project is the development of new nanobiotechnological methods for *in vitro* culturing of poultry meat.

The system of *in vitro* culturing of muscle tissue is limited by the lack of the microenvironment of other cells, tissues and organs. The blood circulatory system, via the vascular network, penetrates tissues, providing nutrients and regulatory factors into the cells. The bone and connective tissue (tendons and bones) provide mechanical support for the muscle cells and a type of a binder and a scaffold for the cells (extracellular matrix). Furthermore, the nervous system is a source of electrical impulses to the muscles. The lack of these systems limits the ability to grow fragments of muscle tissue above the critical thickness of about 0.5 cm.

The project proposes solutions based on nanobiotechnology that utilize unique physicochemical characteristics of nanoparticles caused by their size (<100 nm) and at the same time using non-toxic nanostructures composed of natural elements of living organisms like carbon, calcium and phosphorus. The role of the circulatory system will be resembled by "nano-rafts" constructed from nanoparticles of calcium phosphate, which attached with nutritional and signalling ingredients will penetrate cells and tissues, nourishing and regulating their development. The role of the connective tissue will be resembled by graphene oxide and porous carbon with a graphene structure in the 3D form. The 3D graphenic structures will provide a mechanical support for developing muscle fibres. Graphene will also contain molecules attached to its surface that will be an additional source of functional and trophic substances. Furthermore, the developing cells will be stimulated by low frequency (2Hz) electrical impulses, imitating natural environment of muscle cells.

The studies will be conducted at the Department of Animal Nutrition and Biotechnology, Warsaw University of Life Sciences. The research will be carried out on muscle progenitor cells collected from limb buds of chicken embryos at 7-day of embryogenesis. Culturing of muscle cells to obtained pseudo-muscle tissue will be carried out by the method modified by project authors. The research will elucidate mechanisms of action of different types of "rafts" with attached glucose, amino acids or a complete set of nutrients, and with applied 3D graphene niches and electrostimulation on the morphology and gene expression of muscle cells and tissue. In the studies, the state of the art instrumentation for visualisation of the cells, muscle fibres and potential tissue development, and measurements of gene expression at the mRNA and protein level will be used.

The concept of the project is also imposed by social, economic and environmental issues, related to the further development of human civilization. The project results may have a significant impact on the development of agricultural sciences in the search for alternative methods of food production. It is anticipated that in 2030 the meat consumption will increase by 70 % compared to 2000. According to the FAO, the demand for poultry meat in 2050 compared to 2005 will increase by 120 %.

The application of nano-nutrition and elucidation of the mechanisms of nano-nutrition processes is essential for the further progress of worldwide research on "*in vitro* meat production". The results from the project will also place Poland as a one of the priority countries for culturing „*in vitro* meat". Furthermore, the research will elucidate certain processes regarding culturing of stem cells – muscle cells progenitors as well as matured myocytes and muscle tissue, being important for treatment of muscle atrophy and other pathologies of muscle tissue. Thus, the results can be important for medicine and human development. Moreover, the animal production causes environmental pollution and degradation, is a source of greenhouse gas emission as well as causes problems with animal welfare and risks of infections with pathogenic microorganisms from animal meat. The *in vitro* meat production, as compared to traditional livestock production can reduce greenhouse gas emission by up to 90 %. The proposed research may, therefore, contribute to the development of society in a friendly environment and the progress of civilization.