genetically determined program of ontogenesis.

The following directions of contemporary space life sciences should to be noted: 1) gravitational biology, 2) radiation biology, 3) planetary biology and prebiotic synthesis, and 4) natural and artificial ecosystems. The principal investigations of Ukrainian space biologists have been carried out in the field of gravitational biology. For this reason, a significant number of biological experiments on board the URM are intended to verify the conceptual ideas of Ukrainian scientists in this field. New methodological approaches to performance of the space and ground-based experiments with clinostats and centrifuges are considered as well.

Experiments proposed in the field of life sciences on board the URM are arranged in accordance with divisions of the Program and are presented below.

Division 1

BIOLOGY OF A CELL UNDER MICROGRAVITY; CYTOSKELETON ARRANGEMENT, CALCIUM HOMEOSTASIS, MECHANISMS OF GRAVISENSITIVITY OF LIVING SYSTEMS AT THE CELLULAR AND MOLECULAR LEVELS («Biolaboratory» Project)

Kordyum E. L.

M. G. Kholodny Institute of Botany, NAS of Ukraine
2 Tereschenkivska St., Kyiv 01601Ukraine
tel/fax: (380) +44 +2123236, e-mail: ekord@botan.kiev.ua

Introduction. A discovery of cell gravisensitivity, including plants, has attracted attention to elucidation of the mechanisms of biological effects of microgravity at the cellular, subcellular and molecular levels and understanding how organisms grow, develop and reproduce in the absence of gravity. The conception, which consists in that proliferating and actively metabolizing cells are the most sensitive to the influence of altered gravity, has been assumed proceeding from experimental data on the changes in cell metabolism under microgravity. Simultaneously, this conception propounds the following questions. What are the primary events underlying metabolism changes under microgravity? What are the second messengers taking part in transfer of the primary signals of microgravity? Does the gene expression undergo changes in microgravity? What peculiarities of cell metabolism regulation can be present in microgravity? Why the carbohydrate and lipid metabolism is the most sensitive to the influence of microgravity? Do the parameters of a cell cycle and proliferation activity change in microgravity? How are the changes in metabolism under microgravity integrated into physiological responses in the cells of different types connected directly with realization of their functions?

Trying to provide answers to these questions, a hypothesis of gravitational decompensation was assumed. According to this hypothesis, a change in the surface tension of the cytoplasmic membrane can play an inductor role in rearrangements of its physical-chemical properties under reduction or absence of hydrostatic pressure. The effect of such an inductor increases owing to its heterogeneity over the length of the cytoplasmic membrane. In the gravitational field, the surface tension and gravitational force are summed up, if they act in the same direction and are subtracted if their directions are opposite. In the absence of gravity, only the surface tension is present (gravitational decompensation). Under the conditions of a clinostat, the resulting action of these two forces is continuously changed in

each point of the membrane. The rearrangements in the physical-chemical properties of the cytoplasmic membrane underlie the changes in its permeability, receptors' functioning, membrane-bound enzyme activity. This, in its turn, leads to the subsequent metabolism changes, eventually resulting in physiological responses of cells and organisms to the influence of microgravity. New approaches concerning the ion and water transport examination under microgravity are revealed, due to the currently available data on the presence of mechanically-sensitive calcium channels and highly selective water channels (proteins-aquaporins) in the cytoplasmic membrane. Investigations of the topography of cytoskeleton elements as a supportively motive apparatus are directed to clarifying the role of cytoskeleton (tubulin microtubules and actin microfilament complexes) in cell responses to the influence of microgravity.

Comprehension of mechanisms of pathological changes in excitable cells (nervous and endocrinal) at the subcellular and molecular levels in a space flight, will contribute to a more profound understanding of rearrangements of the physiological processes, which arise in mammals under these conditions. It will also facilitate working out prophylactic recommendations and pharmacological preparations for prevention of pathological changes in human health.

A decrease in bone minerals content in astronauts during the space flight has been established, as well as a tendency to redistribution of mineral substances in the skeleton. The experiments with mammals and birds gave evidence of a reduction in the intensity of growth and osteoplastic processes in skeleton bones, as well as of a loss of bone mass and osteoporosis. So, study of structural and metabolic rearrangements in bone tissue cells, will require further examination of cytological mechanisms of gravi-dependent changes in developing and mature bone skeleton under microgravity.

Study of the influence of microgravity on the immune system of the astronauts and test animals has shown a depletion of immune cells and lowering of the general competence of the immune system. At the same time, it remains unknown, what stages of an immune response that is a complex process, are the most sensitive to microgravity. Revealing the stages of an immune response is planned to be carried out on test animals in vivo and with utilization of cell cultures in vitro.

Diverse model systems were chosen for study of the influence of microgravity at the cellular and molecular levels. Among them are the artificial phospholipid (liposomes) and biological membranes; tip-growing plant cells; photosynthetic cells and photosynthesis process; endocrine cells of different types; neurites and their growth; isolated central and peripheral neurons and their maturing; unicellular and coenobial algae; moss protonema; annual higher plants and small animals; tumor cells of plant and animal origin; proliferation and differentiation processes of transformed nervous cells induced by the nervous growth factor, as well as crown galls induced by Agrobacterium tumefaciens, processes of their induction and efficiency of anti-tumor preparations.

«Calcium-cytoskeleton» Experiment

IMPACT OF ALTERED GRAVITY ON THE CYTOSKELETON DYNAMICS AND CALCIUM HOMEOSTASIS DURING DEVELOPMENT OF GRAVIPERCEIVING AND GRAVIRESPONDING ROOT CELLS

Kordyum E. L.

M. G. Kholodny Institute of Botany, NAS of Ukraine
2 Tereschenkivska St., Kyiv 01601Ukraine
tel. /fax: (380) +44 +2123236, e-mail: ekord@botan.kiev.ua

Research on development and functioning of plant cells in altered gravity is proposed. The following objectives are to be achieved:

— to locate the cytoskeleton arrangement during development of graviperceiving (root cap) and graviresponding (epidermis and cortex) cells under altered gravity (actin, tubulin and myosin components of cytoskeleton);

— to study the calcium homeostasis in graviperceiving and graviresponding cells during their development and to define the role of calcium ions in specification of these cells;