Overview

The strategic approach of the Biodiagnostic Sciences and Technologies Division for the next five years is mainly related with the Smart Specialization Priority: Health-Pharmaceutics, and aims to perform high quality basic and applied R&D targeting specific applications of high scientific, technological, and societal impact and to develop/sustain the respective infrastructure. Over the last decade, the roadmap integrating the main activities of the Biodiagnostics team has been summarized in the key-phrase: *"from chromosomes and genes ... to proteins ... and biosensing devices"*

Major Objectives / Activities

- Cytogenetics and molecular genetics of hematological malignancies
- Molecular analysis of disease-predisposing genes and their products (proteins)
- Discovery, evaluation and validation of disease biomarkers through biochemical, biophysical, physicochemical and immunochemical approaches
- Development of reagents, materials, biosensors and microsystems for detection of biomolecular markers (proteins, DNA), cells, and toxic compounds
- Biodiagnostic platforms and technologies in the field of environmental and food safety

Resources – Critical mass assembly

Participating Laboratories / Groups

- Immunoassay/Immusensors Laboratory
- Immunopeptide Chemistry Laboratory
- Health Physics, Radiobiology & Cytogenetics Laboratory
- Molecular Diagnostics Laboratory
- Biophysics Laboratory
- Protein Chemistry Laboratory

Major accomplishments in this thematic area can be found in the latest Scientific Report of INRASTES.

Cytogenetics and molecular genetics of hematological malignancies

- Conventional (karyotype) and molecular (FISH) cytogenetic analyses of hematological malignancies for the identification and characterization of chromosomal abnormalities in hematologic malignancies.
- Characterization of genomic rearrangements in hematologic malignancies by molecular genetics for diagnosis, prognosis, treatment selection and follow up of the patients.
- Discrimination of early and late leukemia-associated genomic lesions in order to elucidate aberrations responsible for disease evolution.
- Investigation of polymorphisms of detoxifying and DNA repair genes as predisposing factors for the development of human malignancy.
- Epigenetic analysis of malignant hemopathies for the elucidation of genetic mechanisms involved in leukemogenesis.

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Molecular analysis of disease-predisposing genes and their products (proteins)

- Development of new Next Generation Sequencing methods of Partial or Whole Exome Analysis in breast-ovarian cancer patients with strong family history of cancer.
- Development and validation of novel antimicrobial therapeutics exploiting immune modulators (e.g. proteins/peptides) that affect pathogen virulence, disease progression and microbial immune surveillance.
- Evaluation of novel diagnostic and/or immunotherapeutic agents for disease stratification (staging), clinical prognosis or radiotherapy response (e.g. radiomodifying effect of inflammatory agents in therapy-resistant tumors).
- To develop potent and selective inhibitors and activity probes that can be used to follow and manipulate biochemical pathways we are currently investigating (i.e. antigen presentation, lipid metabolism) to provide therapeutic and diagnostic tools.

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Discovery, evaluation and validation of disease biomarkers through biochemical, biophysical, physicochemical and immunochemical approaches

- To validate and complement newly communicated genetic or clinical association studies by providing structure and mechanism-based insight that can establish the diagnostic and prognostic value of protein biomarkers for human diseases. (Specific projects: adaptive immune response, lipid metabolism).
- To develop biomolecular tools (e.g. peptide derivatives capable of being radiolabeled, well-characterized anti-peptide antibodies, etc.) for studying marker-molecules with diagnostic and/or therapeutic potential (e.g. neuroprotective and immunomodulating peptides, proteins related with cardiovascular diseases, etc.)

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Development of reagents, materials, biosensors and microsystems for detection of biomolecular markers (proteins, DNA), cells, and toxic compounds

- Development of immunochemical reagents (special immunizing and coating haptens, anti-hapten antibodies, hapten-dendrimer coating conjugates, etc.) for application to immunosensing techniques for determining low molecular weight substances with diagnostic and/or therapeutic potential (or highly toxic for human health).
- Development and evaluation of fully-integrated Mach-Zehnder interferometers on silicon chips and fabrication of a portable device aiming to on-site detection of food contaminants and specifically of three categories of analytes including pesticides in grapes and wines, mycotoxins in beer and cereals, and allergens in rinse water and baby milk formulas.
- Development of integrated Young interferometers and application for the simultaneous detection of four pesticides in drinking water samples
- Development of label-free sensor system based on White Light Interference Spectroscopy for certain cardiac (e.g. CRP) and thrombotic episode markers (e.g. C3b) determination in human serum.
- Microsystem based on nano-textured polymeric substrates for the isolation and selective growth of rare cells from complex matrices.
- Development and characterization of soft, nanostructured biomimetic materials

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Biodiagnostic platforms and technologies in the field of environmental and food safety

After the convergence of the two Institutes, in line with the strategic objectives of INRASTES, the Biodiagnostics team has managed to develop new synergies and exploit its biodiagnostic platforms and technologies in the field of environmental and food safety. Thus, its portfolio was expanded to include:

- detection of substances harmful for human health and
- study of the effects of hazardous chemicals on the human genetic material.

Indeed, this effort has been already crowned with success as indicated by three research proposals in the aforementioned field recently funded by EU and GSRT.

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Resources – Critical mass assembly

Significant assets and strengths of the group are:

- Over 25 years experience of the staff in the development and production of in vitro diagnostics,
- Comprehensive and highly integrated platform for gene- to-protein biomarker discovery, target validation (disease models) and diagnostics (biosensing devices),
- Exemplary multidisciplinary profile of the team that is unique to the region and has fostered multiple synergies and cross-thematic collaborations with other Institutes and academic partners both in Greece, and abroad, and
- Significant research dissemination and outreach record of highly specialized scientific services directed to the public at large.

More specifically:

- Over 25 years experience in development of immunoreagents, materials, immunoassays and immunosensors for biodiagnostic applications, in cytogenetics as well as in molecular diagnostics gained through coordination/participation in multiple European, National and International projects and networks.
- Appropriate advanced infrastructure complemented by infrastructure available at other institutes of NCSR Demokritos.
- Already approved research funding gained through 5 EU and 8 GRST research projects, which started in 2013 (or late 2012), with a budget for the Biodiagnostics Sciences and Technology Division exceeding 3000 k€.
- Funding through provision of specialized scientific services on Cytogenetics, Molecular Diagnostics and external Quality Control of Radioimmunoassays with a revenue of approximately 200 k€ per year.

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