Biomaterials and Tissue Engineering Studies at METU

METU-BIOMAT - http://www.biomed.metu.edu.tr

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Current Research Activities:

Biomaterials:

Hydrogels, controlled drug (antibiotic and pain reliever) delivery, photodynamic liposomes, tissue engineering (bone, cartilage, retinal pigment epithelial cells, cornea, nerve, cardiac tissue), biodegradable polymers, hard tissue repair, enzyme immobilization.

Biotechnology:

Biosensors, bioreactors, biodegradation of pesticides.

The interest in this field is also growing in Turkey in general and especially at the Middle East Technical University (METU). Our university has always had a pioneering role and intense activities in the fields of Biomaterials and Tissue Engineering in Turkey, and is also quite competitive on an international level. METU-BIOMAT consists of colleagues from the Department of Biological Sciences, Department of Chemistry and Health Center of METU along with collaborators from Yeditepe, Hacettepe and Baskent Universities. Our activities cover teaching, research, conferences and consulting for the dissemination of knowledge.

Research conducted are concentrated on biodegradable hard tissue implants, tissue enginering (bone, cartilage, retinal pigment epithelium, nerve, cardiac tissue, and cornea), controlled release systems, immobilization for the construction of biosensors and bioreactors, and liposomes (photodynamic, for gene transfer and drug delivery).

The Biomedical Science and Technology Symposia (BIOMED's) initiated by us along with some colleagues have reached their 12th year in 2005 and are at international level.

Over the years our group published more than 250 international peer reviewed papers, edited 3 books, and has 3 patents.

RESEARCH ACTIVITIES at METU-BIOMAT

The type of research carried out in the group is concentrated on Biodegradable hard tissue implants, Tissue Engineering Applications, Controlled Drug Delivery, Immobilization (Biosensors and Bioreactors), and Liposomes. The following are the research fields currently in which METU-BIOMAT is active:

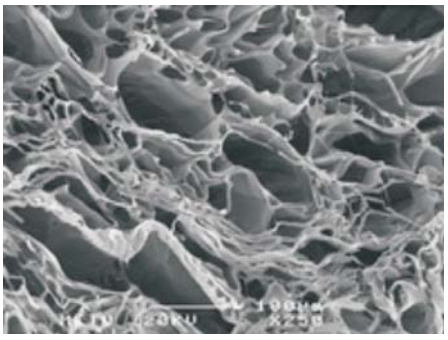
• *Fracture Fixation with Biodegradable Bone Plates*.

In this study biodegradable and biocompatible polyesters are tested alone or in combination with hydroxyapatite (HAP). The aim is to investigate and improve the mechanical characteristic of these plates and when necessary, load them with antibiotics, growth factors and other agents to improve bone healing.

• *Tissue Engineering of Bone and Cartilage*.

The aim of this study group is to produce a novel tissue engineered bone or cartilage by seeding bone cells, especially osteoblasts, and cartilage cells (chondrocytes) on different carriers such as collagen, and synthetic and biotechnological polyesters. The matrix is used to guide osteoblast organization and growth allowing diffusion of nutrients to the transplanted cells. They also provide vascularization. Thus, this strategy may offer many of the advantages of bone and cartilage grafting while avoiding the complications of immune rejection, donor site morbidity, and limited availability.

METU-BIOMAT has a partnership in a Network of Excellence Centre (NoE) project, a project called **ExperTissues.** It is directed towards the production of hard tissues (bones, ligaments). The group's main role in this project is to work on the tissue engineering phases and design controlled release systems that can release small doses of chemical and biological materials into the environment in order for the cells to mature.



Tissue Engineering of Cornea is another project planned to continue between 2004 and 2007 to construct a full thickness cornea and is funded through a European Union FP6 STREP Grant.

Biosensors

Construction of a biosensor is based on inhibition of a biological activity by the analyte. Acetylcholinesterase (AChE) is one of the biosensitive agents attached to the biosensor for the detection of pesticides with anti-cholinesterase activity (eg. carbamates and organophosphates). Examples include membranes made of poly(2-hydroxyethyl methacrylate) (pHEMA) used as the matrix for the immobilization of acetylcholinesterase and choline oxidase. Quantitative determination is based on the decrease in oxygen consumption in pesticide presence.

Bioactive Agent Delivery.

Novel biodegradable and biocompatible polymeric carriers can serve as a new mode of administration of the drugs to improve pharmacodynamic parameters, efficacy and to increase general tolerance of the treatment. Therapeutic microparticles containing various agents of interest have been configured as microspheres, nanospheres, microcapsules, and liposomes. Among these nanoparticules are solid biocompatible polymeric particles into which drugs can be incorporated or to which drugs can be bound. In a typical application anti-leukemic enzyme L-asparaginase was entrapped in poly(hydroxybutyrate-co-hydroxyvalerate) nanocapsules. The half-life of nanoparticulate drug carriers in vivo was modified by increasing surface hydrophilicity, attachment of hydrophilic polymers to create steric barriers. Heparin conjugation and plasma treatments are examples of modification along this line.

Antibiotic, analgesic, anesthetic, anticancer agent and growth factor delivery from extruded fibers and cold-molded rods is another method of controlled delivery being studied along with pH responsive NIPAM based intelligent systems.

Gene delivery via DNA-polyelectrolyte complexes free or entrapped in polyelectrolyte shells are being developed with the aim of improving the transfection capabilities with the ultimate aim of developing vaccines.

Along this line METU Biomat participates in the ***FP6 RTN Project Biopolysurf*** which aims to engineere advanced polymeric surfaces for smart systems for biomedicine, biology, material science and nanotechnology.

Liposomes

Liposomes are being developed for responsive delivery of anticancer and antibiotic agent delivery. Responsive is introduced by introduction of photolabile agents into the liposomal membrane.

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