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PRELIMINARY SCIENTIFIC RESEARCH ON ENZYMATIC ACTIVITY DURING SUBORBITAL ROCKET FLIGHT - AMBER PROJECT

Abstract

In order to explore space, we need to advance science and draw conclusions that will help us do so. One of the key areas of science is astrobiotechnology, which, among other things, focuses on creating recombinant proteins in vitro or in silico. These enzymes are the fundamental matrix of all kinds of molecular science used in terms of: biotechnology, enzymology, pharmaceutics, genetic engineering, medicine or bioinformatics.

When exposed to conditions in space, enzymes behave differently than on Earth. In an effort to carry out research of an astrobiotechnological nature, i.a. on the activity of enzymes, we have created a platform capable of performing such research during the flight of sounding or suborbital rockets. We called it AMBER - Autonomous Modular Biotechnological Experiment on a Rocket.

It is through enzymes that we can lead the development of science, medicine or biomedical engineering. Enzymes are responsible, for instance, for the production of drugs (biopharmaceuticals) such as hormones and peptides (insulin), cytokines (interferons) or even thrombolytic agents (tissue plasminogen activator). As biocatalysts, enzymes are characterized by unique features and have become widely used in medical diagnostics as markers in various disease states, where they allow visualization of the course of the illness or the body's response to treatment. In biotechnological terms, enzymology leads to the production of DNA vaccines, monoclonal antibodies or hormones.

Knowing how the activity of the aforementioned recombinant proteins is affected by the conditions of rocket flight, we will have the ability to study molecular interactions, perform genetic modifications or apply cloning. With enzymes in space, scientists will be able to advance science independently by producing lifesaving drugs for humans, animals and plants, minimizing the necessary weight of rocket loading, thus saving money and not worrying about the expiration date of medications taken from Earth.

The experimental setup of the AMBER 2.0 project allows remote initiation of the enzymatic reaction of some of the most widely used enzymes in molecular science, such as proteinase K, DNA polymerase and horseradish peroxidase (HRP). The research is essentially divided into two stages: pre-experimental studies, sending enzymes suspended in a formulation buffer with a sounding rocket, and experimental studies, exposing real-time reactive enzymes to the entire flight profile of a suborbital rocket.

In conclusion, all the mentioned applications of enzymes as well as their bioreactor production itself will not be possible without enzyme activity/stability investigations, and this is what we are doing.