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Biology in Space (7)

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MEK - MULTIVARIABLES DEVICE DEVELOPMENT FOR ENZYMES KINETICS EXPERIMENT IN  
MICROGRAVITY**Abstract**

The purpose of this experiment was to realize enzymatic bioreactions in microgravity, onboard the ISS, as part of the investigations that are being done by this group, both in soil and on board sounding rockets. Though microgravity effects on some enzymes have been investigated and analyzed by some researchers, results are contradictory, and there is still a long way to go to reach a full understanding of their behavior. The knowledge of the influence of microgravity on enzymatic catalysis may lead to a better comprehension of cellular metabolism principles, and consequently to possible implementations and applications of enzymatic biosensors in space. For this experiment it was necessary to develop and implement a specific device, MEK, to allow that the mixture of liquids and multiple enzymatic bioreactions might be realized correctly in space, and be later easily recovered for biochemical analysis on earth. Invertase and lipase enzymes were used in the experiment, mainly due to the importance and large use they have in food, pharmaceutical and fine chemicals industry processes. Each of them was tested with different reagent concentrations, for proper kinetic data collection, in a total of fifteen samples. The implementation of MEK device presented some severe challenges, in order to satisfy the necessary requirements to fly on the Brazilian Centenary Mission aboard the International Space Station. MEK device consists of a mechanical part, which contains 15 reaction chambers, especially designed for this purpose, for the mixture of enzyme and substrate liquids, with temperature sensors, and electronic circuits, to ensure monitoring, data acquisition, correct control activation, timing, and heating of liquids up to the correct temperature, which is necessary to interrupt each biochemical reaction. Enzymes and correspondent substrates were placed in two compartments of each reaction chamber, and were mixed by the action of a piston. MEK device was implemented with protection system requirements, for unexpected temperature elevation and threefold sealing, among others, to ensure safety for the ship and the crew. The experiment was carried out in three series, as a whole, in which it was tested the kinetics of invertase, free lipase and immobilized lipase enzymes, at five different concentrations for each respective substrate. The results were satisfactory, both regarding the equipment functioning and the biochemical reactions. The experiment however needs to be repeated several times in order to confront data, which are to be collected in different situations, and also to ensure statistical repeatability of results.