



Spectral Analysis and Invariant Measure in Studying the Dynamics of a Metabolic Process in the Glycolysis-Gluconeogenesis System

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Abstract: The paper presents an original general mathematical model of the glycolysis-gluconeogenesis metabolic processes chain. The scenario of the appearance of auto-periodic and chaotic modes for the system is studied with the help of the Fourier series of one of the system variables. The invariant measure of the strange attractor is calculated. The histograms of the invariant measure projections of the system onto the phase space plane are constructed. Conclusions are made about the self-organization and adaptation of the system to changes in the cell and the environment.

Keywords: *self-organization; strange attractor; glycolysis; gluconeogenesis; Fourier series; invariant measure; bifurcation, protobions.*

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1 Introduction

An essential task of natural sciences is a search for the general physical laws of self-organization in Nature. The gradual development of nonlinear thermodynamics led to the emergence of a new scientific direction - synergetics. The mechanism of structure formation in open nonlinear systems became clear thanks to synergetics [1]. The science of self-organization and evolution of living organisms suggests an answer about the flow of physical and chemical processes in a cell [2].

One of the general chains of metabolic reactions running in each cell is glycolysis and its inverse process, gluconeogenesis. Cells receive energy from glucose in the form of ATP

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