ABSTRACT

ELIS LISTIANDINI. A Mathematical Model of the Dynamics of Glucose, Insulin, \( \beta \)-cells Mass, and Insulin Receptors in Diabetes Mellitus Disease Type 2. Supervised by PAIAN SIANTURI and ALI KUSNANTO.

The diabetes mellitus is a disease in glucose-insulin regulatory system, which is referred to as hyperglikemia. Most cases are categorized as type 2 of the diabetes mellitus (T2DM), which are characterized by high blood glucose levels. The T2DM is associated with a deficit in the mass of \( \beta \)-cells. If the blood glucose concentration level is high, then the \( \beta \)-cells release insulin into the pancreas. The aim of this research is to study the glucose-insulin dynamics. A \( \beta \)IG model was proposed to describe the glucose-insulin dynamics. This model provide a pathway for diabetes development through the introduction of a 3rd dynamical variable, the \( \beta \)-cell mass. The addition of insulin receptor is an important factor in this quantitative improvement in order to make the model more realistic. Incorporation of the insulin receptor into the existing mathematical model gives a four dimensional system of nonlinear ordinary differential equations, which is introduced as the modified model. Both of the models have two stable equilibria representing physiological steady state and pathological steady state. Furthermore the third steady state is found to be a saddle point. Nevertheless the average mass of \( \beta \)-cell in the modified model is quantitatively more reasonable and therefore better then \( \beta \)IG models.

Keywords: Type 2 of diabetes mellitus, hyperglikemia, glucose-insulin dynamics, \( \beta \)-cell mass, \( \beta \)IG model, modified model.