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Stability analysis of a double delayed HIV– I dynamics model with nonlinear functional response and absorption effect

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Several models for the HIV–I have been constructed with the assumptions that the processes within the body compartments are instantaneous, the incidence rates of the activities between viruses and target cells are bilinear and when pathogens are absorbed into susceptible cells, the number of pathogens is not reduced in the blood volume. Biologically, instantaneous processes, nonlinear incidence rates, and the absorption effect inside the body have been proven.

Thus, in the proposed mathematical model, stability properties of HIV- I dynamics model including a Beddington – DeAngelis type functional response, an intracellular time delay, a maturation time delay, and an absorption effect are investigated. The intracellular time delay can be identified as the period of time between entry of the virus into a susceptible target cell and the production of new virus and the maturation time delay can be recognized as the time period which is taken by a virus to grow after the infected cells create the virus. By analyzing the characteristic equations of the model, the local stability behaviors of the infection free equilibrium (E_0) and the chronic infection equilibrium (E^*) are established. The mathematical analysis shows that the stability properties are entirely determined by the basic reproduction number (R_0) of the model. By means of Ruth Hurwitz stability criterion, it is proven that the infection free equilibrium is locally asymptotically stable when $R_0 \leq 1$, and the chronic infection equilibrium is locally asymptotically when $R_0 > 1$. Moreover, the numerical simulations are also demonstrated in order to validate the theoretical results. These results will lead to give more important recommendations to the drug producers to upgrade the existing drugs.

Keywords: Absorption Effect, HIV- I infection model, Intracellular Delay, Local Stability, Maturation Delay

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