World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:10, No:07, 2016

Stability Analysis of Tumor-Immune Fractional Order Model

Authors : Sadia Arshad, Yifa Tang, Dumitru Baleanu

Abstract : A fractional order mathematical model is proposed that incorporate CD8+ cells, natural killer cells, cytokines and tumor cells. The tumor cells growth in the absence of an immune response is modeled by logistic law as it was the simplest form for which predictions also agreed with the experimental data. Natural Killer Cells are our first line of defense. NK cells directly kill tumor cells through several mechanisms, including the release of cytoplasmic granules containing perforin and granzyme, expression of tumor necrosis factor (TNF) family members. The effect of the NK cells on the tumor cell population is expressed with the product term. Rational form is used to describe interaction between CD8+ cells and tumor cells. A number of cytokines are produced by NKs, including tumor necrosis factor TNF, IFN, and interleukin (IL-10). Source term for cytokines is modeled by Michaelis-Menten form to indicate the saturated effects of the immune response. Stability of the equilibrium points is discussed for biologically significant values of bifurcation parameters. We studied the treatment of fractional order system by investigating analytical conditions of tumor eradication. Numerical simulations are presented to illustrate the analytical results.

Keywords : cancer model, fractional calculus, numerical simulations, stability analysis
Conference Title : ICBA 2016 : International Conference on Biomathematics and Applications
Conference Location : Montreal, Canada
Conference Dates : July 14-15, 2016