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# Fractional modeling and uncertainty quantification of hepatitis B dynamics using a homotopy approach

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The dynamics of viral infections can be better understood with the use of mathematical models. We address the uncertainty inherent in biological systems by presenting a fuzzy fractional-order model for the hepatitis B virus (HBV) in this paper. To examine the dynamics of infection and viral clearance, the model uses a double parametric-based homotopy method. The suggested model's existence and uniqueness are also explored. Incorporating a fractional-order derivative with fuzzy logic reduces peak viral load and decreases cellular damage, especially when therapy is started early, according to our data. Nevertheless, it can take more time to completely eradicate the pathogen. The results provide light on the many phases of HBV infection and their development, which improves our ability to forecast diseases and develop effective therapeutic intervention plans.

*Keywords: HBV-infection model, double parametric approach, fuzzy-fractional differential equation, Caputo fractional derivative*
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