Review of: "Analysis of the Spread of Covid-19 via Atangana-Baleanu Fractional Derivatives"

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Potential competing interests: No potential competing interests to declare.

 # Reviewer Report

Analysis of the Spread of Covid-19 via Atangana-Baleanu Fractional Derivatives

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The manuscript entitled "Analysis of the spread of Covid-19 via Atangana-Baleanu fractional derivatives" presented a mathematical analysis and formulation of a fractional model for the spread of Covid-19. The authors carried out rigorous mathematical analysis on the model dynamics; their results show that the existence of a disease-free equilibrium and proved its stability properties. Numerically, they provided a numerical scheme for the fractional model for the outbreaks of Covid-19 and presented various simulation results.

The manuscript has scholarly importance and seems to be interesting. Therefore, the manuscript can be considered further for publication in Qeios if the authors are ready to address the following specific comments:

Point 1: My comments on the Abstract:

1. From the Abstract, one finds the authors obtain that the Covid-19 model can reach the disease-free equilibrium. However, in the main Section 5.1, the reviewer cannot even find the disease-free equilibrium of the Covid-19 model with respect to the fractional order, and quarantine rate,. Please explain.

Point 2: My comments on Keywords:

1. Add the phrase "**fractional derivative**" to this study.

Point 3: My comments on section 1:

1. Please strengthen the motivation for writing this article in the Introduction section. The introduction should also be enriched by recent results.
2. Please provide more related research status about the fractional derivative model and explain the innovation of this paper compared to current research in the introduction section.

Point 4: My comments on section 3:

1. Replace the Jacobian matrix for the **disease-free equilibrium** with the Jacobian matrix for the **endemic equilibrium** of the model (2). In the main Section 5.1, the reviewer cannot even find the disease-free equilibrium of the Covid-19 model with respect to the fractional order, and quarantine rate, .

Point 5: My comments on section 4:

1. The authors can find the exact analytical solution using Maple software. The reviewer suggests including the analytical expression for the endemic equilibrium, of the model. The analyzed methods are numerical simulations, and the authors must find the endemic equilibrium that needs to be shown in the numerical simulation section.

Point 6: My comments on section 5.1:

1. From the Figures, in the legend, there is the quarantine rate labeled. However, in the main Section 2, the reviewer cannot even find the parameter of the quarantine rate in the models (1) and (2). Please explain.

2. The analyzed methods are numerical simulations. Numerical results are obtained in section 5.1 by Adams' methods and are discussed in the context of Atangana-Baleanu's derivative (ABD) of a fractional model for the dynamics of the spread of Covid-19. The results obtained are not clear to describe the effect of the number of individuals and time.

The reviewer suggests the authors change the figures by combining them with the number of individuals and time in a figure for each type of fractional order and quarantine rate.

The reviewer suggests a few references that could help in rethinking the figures:

M.F. Elettreby, Ali S. Alqahtani & Tamer Nabil (2020). Complex dynamical behavior of a discretized fractional-order multi-drug antimicrobial resistance model. *Alexandria Engineering Journal*, 59, 3119-3131.

Mahmoud Moustafa, Farah Aini Abdullah, Sharidan Shafie & Zuhaila Ismail (2022). Dynamical behavior of a fractional-order Hantavirus infection model incorporating harvesting. *Alexandria Engineering Journal*, 61, 11301-11312.

3. Display the value of endemic equilibrium points of the figures in the Table.

4. Please provide some practical examples to illustrate the practical significance of the model proposed in this article.

5. Is there any real data used in this article to verify the model? It should be explained carefully.