11th Conference on Dynamical Systems Applied
to Biology and Natural Sciences DSABNS 2020
Trento, Italy, February 4-7, 2020

IMPACT OF VENEREAL TRANSMISSION ON THE DYNAMICS OF VERTICALLY TRANSMITTED VIRAL DISEASES AMONG MOSQUITOES

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Despite centuries of enormous control efforts, mosquito-borne diseases continue to show upward trend of morbidity. According to WHO reports, malaria caused 438000 deaths in the year 2015 and dengue cases has been increased 30-fold over the last five decades. To control these diseases, it is necessary to understand the transmission dynamics of them among mosquitoes. There are some vertically transmitted mosquito-borne diseases which can also be spread among mosquitoes through sexual contact (e.g., dengue, zika, chikungunya). Recent experimental observations indicate that for virus persistence in mosquito population, the role of venereal transmission can not be ignored. It is therefore important to investigate which transmission route is more responsible for the persistence of the virus when there is no host. To this aim, we propose and analyze a novel compartmental model considering mosquito population only. To the best of authors knowledge, this is the first attempt to take into account both vertical and sexual transmission of the virus in a mathematical model. Expression representing the basic reproduction number is derived using Jacobian approach. Local stability conditions for disease-free equilibrium and complete infection equilibrium are obtained. Global sensitivity analysis of the system is performed with respect to an epidemiologically important response. While investigating the impact of sexual transmission in presence of vertical transmission, we observed that sexual transmission route has the potential to drive the equilibrium from disease free to endemic states. Further numerical experiments reveal that the virus will have higher half life in fertilized infected female mosquitoes for vertical transmission only than for venereal transmission alone. Furthermore, when both transmission pathways are active, a variety of parameters indicate threshold like behavior of the infection.

 ISBN: 978-989-98750-7-4

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 ISBN: 978-989-98750-7-4