Content

List of Figures III

List of Tables IV

Acknowledgements VI

Abstract VII

Resumen IX

Resum XI

1. Introduction **1**
1.1. Toxoplasmosis 1
1.2. Bovine Babesiosis 3
1.3. Epidemiological mathematical models 4

2. Mathematical Model of Toxoplasmosis Disease in Varying Size Population **5**
2.1. Introduction 5
2.2. Mathematical model 7
2.3. Scaling the model 8
2.4. Numerical simulation 11
2.5. Conclusions 14

3. Dynamics of a model of Toxoplasmosis disease in human and cat populations **15**
3.1. Introduction 15
3.2. Mathematical model 18
3.3. Stability analysis of the model 20
3.3.1. Scaling model 20
3.3.2. Equilibrium points of the model 21
3.3.3. Stability analysis 22
3.4. Numerical simulations 25
3.5. Discussion and conclusions 27

4. Modeling dynamics of Babesiosis disease in bovines and ticks populations **30**

4.1. Introduction 30
4.2. Mathematical model 31
4.3. Analysis of the model 34
4.3.1. Model equilibrium points 34
4.3.2. Stability analysis 35
4.4. Numerical simulations 37
4.5. Conclusions 41

Bibliography **43**

List of Figures

2.1. Diagram of the Toxoplasmosis disease on the population. 8
2.2. Dynamics of the different subpopulations β= 0.0206055 and $\gamma = 0.000232$. 11
2.3. Dynamics of the different subpopulations β= 0.010327 and $\gamma = 0.000232$. 12
2.4. Dynamics of the different subpopulations β= 0.0206055 and $\gamma = 0.1$. 13

3.1. Flow diagram of the Toxoplasmosis disease model for human and cat populations as defined in system (3.1). 19
3.2. Dynamics of the different subpopulations when $\beta_c = 0.00066$, $\gamma = 0.000232$ and $\mathcal{R}_0 = 0.909$. ($X_1^* = 1, Y_1^* = 0$ and $A_1^* = 1$) 26
3.3. Dynamics of the different subpopulations when $\beta_c = 0.0008$, $\gamma = 0.000232$ and $\mathcal{R}_0 = 1.2121$. ($X^* = 0.0603, Y^* = 0{,}9386$ and $A^* = 0.825$) 27
3.4. Dynamics of the different subpopulations when $\beta_c = 0.0008$, $\gamma = 0.000232$, $p_c = 0.0001$ and $\mathcal{R}_0 = 121.21$. ($X^* = 0.0112, Y^* = 0.9878$ and $A^* = 0.00825$) 27

4.1. Dynamics of the Babesiosis disease in bovine and tick populations 33
4.2. Ecologic stability, when $\beta_B = 0.00061$, $\beta_T = 0.00048$, $\alpha_B = 0.001$ and $\mathcal{R}_0 = 6.8$. 39
4.3. Dynamics of the different subpopulations when $\beta_B = 0.0003$, $\lambda_B = 0.0265$, $p = 0.1$ and $\mathcal{R}_0 = 0.33$ 39
4.4. Dynamics of the different subpopulations when $\beta_B = 0.006$ and $p = 0.1$, with initial condition $S_B(0) = 0.3816$, $I_B(0) = 0.5184$, $S_T(0) = 0.60$ and $\mathcal{R}_0 = 67.54$. 40
4.5. Dynamics of the different subpopulations when $\beta_B = 0.006$ and $p = 0.1$, with initial condition $S_B(0) = 0.70$, $I_B(0) = 0.10$, $S_T(0) = 0.20$ and $\mathcal{R}_0 = 67.54$. 40
4.6. The dynamics of the subpopulations is sensitive to the parameters β_B and β_T. 41

List of Tables

2.1. Basic parameters of the mathematical model 8
2.2. Parameters of the model 10
2.3. Equilibrium point when $\beta = 0.0206055$ and $\gamma = 0.000232$ of system (2.11) 11
2.4. Eigenvalues of the Jacobian $J(s^*, e^*)$ when β=0.0206055 and γ=0.000232 of system (2.11) 11
2.5. Equilibrium point when $\beta = 0.010327$ and $\gamma = 0.000232$ of system (2.11) 12
2.6. Eigenvalues of the Jacobian $J(s^*, e^*)$ when β=0.010327 and γ=0.000232 of system (2.11) 13
2.7. Equilibrium point when β= 0.0206055 and $\gamma = 0.1$ of system (2.11) 13
2.8. Eigenvalues of the Jacobian $J(s^*, e^*)$ when β= 0.0206055 and $\gamma = 0.1$ of system (2.11) 14

3.1. Parameters of the model 26

4.1. Parameters for simulation. The values β_B, β_T and α_B have been calculated assuming an ecologic stability. 38