

Population genetic diversity in *Spirocerca lupi*

by

Janishtha Ramesh Mitha

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Supervisor: Dr. Pamela J de Waal

Co-supervisors: Prof. Jaco M Greeff and Ms. Kerry Reid

To my dearest grandmother

A woman of great character, overflowing with wisdom and virtue,
the one who taught me life's greatest lessons.

Ganga Jamnadas Rama
16.12.1924 – 18.12.2013
Forever in my heart

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Abundant blessings to all those that have shared this journey with me and reminded me always... to keep smiling.

Inspiration...

“If you can win over your mind, you can win over the whole world.”

- *Sri Sri Ravi Shankar,*

Founder of the Art of Living Foundation, Spiritual leader and Global humanitarian

“There are many realities. There are many versions of what may appear obvious. Whatever appears as the unshakeable truth, its exact opposite may also be true in another context. After all, one's reality is but perception, viewed through various prisms of context.”

- *Amish Tripathi,*

Author: The Immortals of Meluha

“Creation and destruction are the two ends of the same moment. And everything between the creation and the next destruction is the journey of life.”

- *Amish Tripathi,*

Author: The Oath of the Vayuputras

“Great minds discuss ideas. Average minds discuss events. Small minds discuss people.”

- *Eleanor Roosevelt,*

Former First Lady of the United States

“Sometimes it falls upon a generation to be great. You can be that great generation. Let your greatness blossom.”

- *Nelson Mandela,*

Former President of South Africa, Tata – Father of the Nation

“There is nothing like returning to a place that remains unchanged to find the ways in which you yourself have altered.”

- *Nelson Mandela,*

Former President of South Africa, Tata – Father of the Nation

“First they ignore you, then they ridicule you, then they fight you, and then you win.”

- *Mahatma Gandhi,*

Freedom Fighter and Leader

EXECUTIVE SUMMARY

Spirocerca lupi is a nematode that parasitises canid species across the world. Infested hosts show symptoms associated with the disease called spirocercosis. The parasite is known to cause significant damage to its final host and often leads to death. Treatment of the disease has been a challenge for veterinarians for many years since symptoms of the disease only become apparent at advanced stages of the disease, by which time, the available treatment is considered ineffective. Many studies to date have given insight into the characterisation and description of spirocercosis, however very few studies have been conducted on the molecular biology, biochemistry, genetics, epidemiology, ecology and host-parasite interactions. This study utilises molecular tools to perform genetic analyses to better understand the parasite's population structure which will contribute to improved strategies for the treatment, prevention and control of spirocercosis.

By integrating a population genetic approach with molecular marker data, it is possible to decipher the transmission dynamics of a parasite. For this purpose, microsatellite markers were developed using the FIASCO (fast isolation by AFLPs of sequences containing repeats) protocol and 454 pyrosequencing. Nine polymorphic microsatellite loci were developed to conduct population genetic analyses on *S. lupi* nematodes sampled across three geographical locations in South Africa, namely KwaZulu-Natal (Durban), Eastern Cape (Grahamstown) and Gauteng (Tshwane Metropole). Some of these loci proved to be effective in cross-species amplification testing. The loci were also used to provide molecular evidence that *S. lupi* is in fact found in jackal.

Microsatellites proved to be effective markers in detecting subtle levels of population structuring between the three geographical locations, however allelic frequencies indicated that high amounts of gene flow was occurring. High levels of heterozygosity were found in individual hosts as well as between different hosts, suggesting that little or no inbreeding occurs between *S. lupi* nematodes within the final host. This could be due to the life cycle of the parasite. *Spirocerca lupi* uses a dung beetle intermediate host as well as several paratenic hosts, which allows for significant mixing of parasite genotypes before reaching the final host. In this way, the final host acquires a highly diverse genetic mixture of parasites, which influences mating patterns and results in outbreeding.

This is the first study on *S. lupi* that uses co-dominant markers to study genetic variation and epidemiology across a wide geographical range. The implications of this study are that since *S. lupi* populations have high levels of genetic diversity, they have the genetic potential to adapt to changing environmental conditions as well as the ability to withstand possible treatments that are administered to final hosts. This is critical to consider when control mechanisms are implemented aimed to reduce the risk of infestation in canids. Additional research is required on the impact that different life cycle stages of the nematode have in the different hosts and its implication for effective prevention and control of spirocercosis.

DECLARATION

I, Janishtha Ramesh Mitha declare that the dissertation, which I hereby submit for the degree Magister Scientiae at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

Signature

Date

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