

INVITATION

PUBLIC DEFENCE

Investigations into potential alternatives for sustainable control of psoroptic mange in Belgian Blue cattle

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PROMOTORS

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Curriculum Vitae

Zhenzhen Chen was born in Henan Province, China, on March 13th, 1989. In September 2009, he was admitted to Sichuan Agricultural University in China, and majored in Pharmacology in the department of Veterinary Medicine. In June 2013, he obtained his Bachelor of Science degree. In the same year, he was attained a qualification of exemptions and enrolled as a master student in Sichuan Agricultural University, where he was focused on the mode of action of Octadecanoic acid-3, 4-tetrahydrofuran diester against *Sarcoptes scabiei* in rabbits by a combination of transcriptomics and proteomics. At the same time, he was responsible for clinical studies on a new antiparasitic drug. Furthermore, he obtained one invention patent with his MSc supervisor. After graduation in 2016, he received a PhD scholarship from the Chinese Scholarship Council, to start his PhD research at the Laboratory of Parasitology, Faculty of Veterinary Medicine, Ghent University. His PhD research focused on potential alternatives for sustainable control of psoroptic mange in Belgian Blue cattle. During his PhD, he successfully completed the Doctoral Training Programme, organized by the Ghent University Doctoral Schools. He is author/co-author of ten scientific publications in national and international journals. He has given four oral/poster presentations in national and international scientific conferences/symposia.

How to attend?

The defense takes place on **Thursday 25 February 2021 at 16h30**. The defence will be in English.

Due to current Covid-19 measures, the defence will only be accessible online. If you wish to attend, please register by sending an email to Zhenzhen.Chen@UGent.be before 24 February 2021 to receive a personal invitation.

Members of the Examination Committee

Prof. dr. Luc Duchateau
Chairman of the Examination Board, UGent

Prof. dr. Geert Opsomer
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Prof. dr. Stewart Burgess
Moredun Research Institute, Pentlands Science Park, UK

Prof. dr. Bert Devriendt
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Faculty of Veterinary Medicine, University of Liège

Summary

Psoroptes ovis, the causative agent of psoroptic mange, causes severe allergic dermatitis and intense pruritus in sheep and cattle. The disease is highly contagious and causes impaired animal welfare and economic losses in livestock all over the world. In cattle, psoroptic mange is a severe problem, especially in Belgian Blue (BB) beef farms. The BB cattle breed is highly susceptible to *P. ovis* infestation, whilst other breeds such as Holstein Friesian (HF) seem to be more resistant. The reason for this difference has not been clarified yet, but could be caused by host factors, such as genetic and immunologic variations. Although currently available treatments still work to some degree, psoroptic mange is increasingly difficult to treat, due to the development of acaricide resistance. Therefore, alternative control measures should be investigated.

In **Chapter 1**, a literature review focuses on the taxonomy, life cycle, epidemiology, pathogenesis, clinical signs, diagnosis and treatment of *P. ovis*, with emphasis on host immune reactions during *P. ovis* infestation and potential alternative control methods, such as the use of essential oil (components).

In **Chapter 2**, the aims of the thesis were formulated.

In **Chapter 3**, the acaricidal activity of plant-derived essential oil components against *P. ovis* was studied *in vitro* and *in vivo*. Three components showed a concentration-dependent acaricidal activity in a contact assay, with LC₅₀ of 0.56, 0.38, and 0.26% at 24h for geraniol, eugenol, and carvacrol, respectively. However, 1,8-cineol showed no activity at any of the tested concentrations. In a fumigation bioassay, carvacrol killed all mites within 50 min after treatment, whereas geraniol, eugenol, and 1,8-cineol needed 90 to 150 min. In a residual bioassay, carvacrol killed all mites after 4h of exposure to LC₉₀, while geraniol and eugenol killed all mites only after 8 h exposure. Based on these results, carvacrol was further assessed *in vivo*. Mite counts in the treatment group were reduced by 98.5 ± 2.4% at 6 weeks post-treatment, while in the control group, the mite population increased. Topical application of carvacrol only caused mild and transient erythema 20 min after treatment. Considering the strong acaricidal activity of carvacrol *in vitro* and *in vivo* and the mild and transient side effects, carvacrol shows potential as an acaricidal agent in the treatment of *P. ovis* in cattle.

In **Chapter 4**, the dermal immune responses against *P. ovis* were investigated in experimentally infested BB and HF cattle, to determine the factors responsible for the different susceptibility between these breeds. Mite numbers and lesion area of BB cattle were greater than in HF cattle during the whole period. Significant influxes of eosinophils in the epidermis and dermis were detected in both breeds, with significantly higher eosinophils in BB at 6 weeks post infestation (wpi). Mast cell numbers were significantly elevated relative to pre-infestation in BB cattle only, at 2 and 6 wpi. The more pronounced cutaneous eosinophilia and higher IL-4 levels at 6 wpi in BB cattle suggest that a Th2-type immune response is underlying the high susceptibility of the BB breed. In naturally infested BB cattle, development of mange lesions, numbers of eosinophils and CD3+ T-cell areas were severely depressed after treatment with dexamethasone, suggesting that anti-inflammatory treatment could potentially be an alternative to control the pathology caused by *P. ovis*.

In **Chapter 5**, the early stage of dermal immune responses against *P. ovis* was studied in artificially infested BB and HF cattle. Significant influxes of eosinophils, T-cells, and B-cells in the epidermis and dermis were detected in comparison with the pre-infestation samples only in BB cattle. Mast cell counts remained stable during the infestation in both breeds, but were significantly higher in BB than in HF cattle in the deep dermis. Despite the marked influx of eosinophils, transcription of the eotaxins CCL-24 and CCL-26 was significantly down-regulated in both breeds, and the transcription of CCL-5 and CCL-11 remained unchanged. Although Th2-type cytokines were not significantly upregulated, the higher influx of eosinophils may underly the higher susceptibility of the BB breed to *P. ovis*.

In **Chapter 6**, a general discussion on the research data generated in this thesis was formulated. The main conclusions drawn in this thesis are: (1) the acaricidal activity of plant-derived essential oil compounds *in vitro* and *in vivo* and the mild side effects suggest that carvacrol is a potential acaricidal agent for the treatment of *P. ovis*; (2) a cutaneous inflammatory response is related to the development of psoroptic mange lesions in cattle and immunotherapy could be an alternative method for controlling *P. ovis* infestation; (3) Breed differences in susceptibility to *P. ovis* infestation between BB and HF were confirmed. Although the experimental infestation studies did not fully unveil the difference between the cattle breeds, an increased influx of eosinophils is related with the higher susceptibility of BB.