

## Summary

Rodents exhibit diverse biology, mating systems and diverse sperm morphology. Different levels of sperm competition have therefore been found in this group. Generally, it is accepted that sperm competition in animals causes the prolongation of sperm tails. However, what other sperm morphological adaptations in rodents are affected by sperm competition? Species-specific sexual selection likely optimizes sperm morphology. Sperm physiology, morphology and competition may be influenced, ultimately, by environmental factors.

This Ph.D. thesis focuses on sperm competition in murine rodents. The thesis contains three research articles (including one as a submitted manuscript). In addition, another published article, partially related to the topic of this thesis, is represented in the Appendix.

The sperm morphology in rodents plays an important role in sperm competition. Longer tails and apical hooks are usually found in the species with relatively larger testes and with higher percentage of multiple paternity (i.e. rate of promiscuity), that is in species with the higher risk of sperm competition. The goal of the first study was to investigate the relationships between relative testis weight and sperm traits (apical hook and tail lengths and variance in this traits). The apical hook length was positively associated with relative testis mass thus indicating directional post-copulatory selection on sperm phenotypes. Moreover, our study shows that increased levels of sperm competition lead to the reduction of variance in the hook length, indicating stabilizing selection.

The second study focused on the changes in the curvature of sperm apical hooks during the final stages of spermiogenesis and stages before fertilization. Apical hook curvatures of field mice (*Apodemus agrarius* and *A. sylvaticus*) varied significantly between dormant and active sperm. In contrast, there was no significant difference among the stages in the eastern house mouse (*Mus musculus*). Since there are high ranges of angle values in all stages, the mean angles of apical hook curvature are not appropriate for evaluating the risk of sperm competition, though the ranges of angle values point to the level of flexibility of the apical hooks.

The objective of third study was to investigate the *in vivo* effect of fluoride and aluminium ions in mice on spermatogenesis and on capacitation *in vitro*. We found that the exposure of mice to an increased concentration of ions resulted in a decreased level of spermatogenesis, qualitatively affected the morphological structure of the testicular tissue and modified the ability of mouse sperm to successfully undergo capacitation.

The paper in the Appendix is related to proteins that are involved in chemical communication in rodents and may have some impact on biological processes, including sperm competition.