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Parasites and their symbionts: a useful relationship?

In the last decades the relationships between bacterial symbionts of parasites have been studied, mainly to understand how to control parasites. An example of this are bacteria of the genus Wolbachia, that have been used as tool to enhance treatment against both parasitic arthropods and filarial nematodes both in human and veterinary medicine. One example is Wolbachia that is a symbiont of the canine heartworm (Dirofilaria immitis). This relationship has been studied with the aim of finding how it could improve adulticide therapy. In one study dogs were experimentally infected by D. immitis and then treated with a combination of antiparasitic ivermectin (IVM) and antibacterial drug doxycycline, (DOXY). The results showed that this combination affected the survival of D. immitis, which was demonstrated by around a 80% decrease in the fitness of adult heartworms in the treated group as compared to control groups, exposed to each of the single drugs or was left untreated. A severe damage to D. immitis was observed in the recovered nematodes from the dogs treated with the combination. A field trial was then performed on naturally infected dogs. Also in this study the drug combination (IVM+DOXY), led to a 70% decrease in parasitic burden of dogs that also turned out to be antigen-negative at termination of the experiment.

Similar symbionts are present also in ticks; some of them are classified as endosymbionts, because they are vertically transmitted, i.e. they are multiplying in the uterus of the female ticks and reach the progeny via the eggs. In the case of Midichloria mithocondrii, which is the most common endosymbiont in Ixodes ricinus, these bacteria are usually located within the mitochondria of tick cells. It is still unclear how M. mithocondrii affect tick's fitness, but is most likely that they provide the ticks with essential metabolic pathways that may have been lost during the evolution into the parasitic lifestyle.

The study of the composition of bacterial symbionts associated with ticks started almost a decade ago, with the introduction of next generation sequencing techniques (NGS). Since the advent of NGS, several microbiomes in different ticks has been described. Through the project TICKBIOCON, the microbial communities of Swedish ticks as well as other aspects of the interaction between ticks and associated bacteria, will be studied. The plan is to study the dynamic interactions between ticks, their endosymbionts as well as other microorganism. After the characterization of the microbiomes, an in vitro model of some of the most common associations found in Swedish ticks will be established to study fitness effect on tick cells cultured in vitro. Then, the most promising alterations of ticks' microbiome/symbionts composition will be recreated in vivo in ticks in order to study potential outcomes at the organismal level. Parameters used to study fitness effects will be for example viability, engorgement rate and fecundity of manipulated ticks. Through the identification of combinations of microbiome/symbionts reducing the fitness of ticks we

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hope to provide the basis for a new approach that can be utilized in the control of ticks and tick-borne pathogens.