



Possible Side Effects of Antiparasitic Treatment of Argulosis in Common Carp (*Cyprinus carpio*) with Therapeutics Currently approved for Salmon Aquaculture

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1. INTRODUCTION

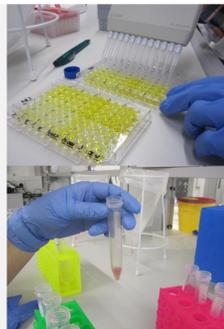
Parasitic diseases in European aquaculture continue to be an economic and ecologic threat to farmed and wild fish populations.

The primary infection with ectoparasites can open the door to secondary or super-infection with bacterial and viral pathogens. Specifically, the infection with *Argulus foliaceus* (fish louse) of common carp (*Cyprinus carpio*) can increase production losses in affected carp farms. However, current veterinary drug use regulations in Germany limit the range of medications approved as treatment against ectoparasites in freshwater fish. In order to prioritize some drugs compared to others, the focus of this study is to investigate possible side effects of Diflubenzuron, Ivermectin and Doramectin treatments on the innate immune system of a cyprinid fish. These results could serve as a base for recommendations to veterinarians as well as fish farmers. The choice of tested drugs was founded by the usage of treatments against a comparable parasite *Lepeophtheirus salmonis* (salmon louse) with Diflubenzuron, Ivermectin and Doramectin (pesticides) in various countries.

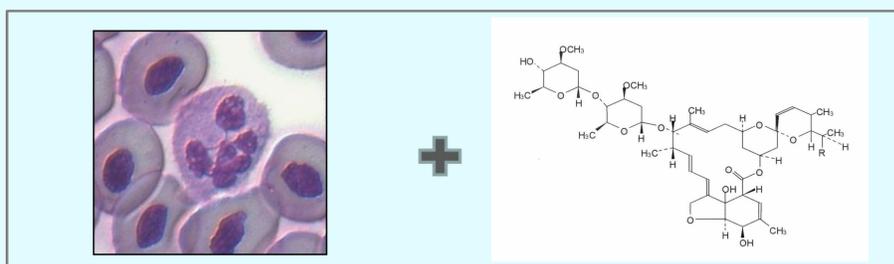


2. AIM OF THE STUDY

The overall research objective is to determine which antiparasitic drug and in what concentration/dose would present an effective treatment of the *A. foliaceus* without causing measurable side effects on fish neutrophil function. The first specific aim (presented here) is to determine in vitro effects of commercial formulations of Diflubenzuron (e.g. Aradol, JBL), Ivermectin and Doramectin on fathead minnow (*Pimephales promelas*) neutrophil function.



3. MATERIALS AND METHODS



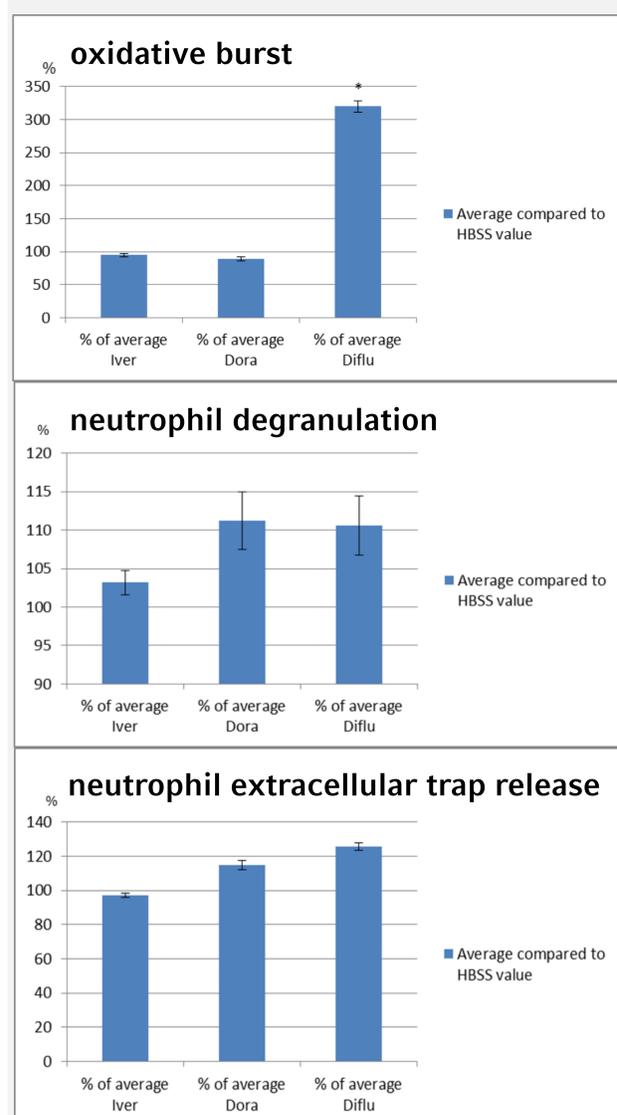
1. primary granule exocytosis (MPO)

2. neutrophil extracellular trap release (NET)

3. oxidative burst

Detect neutrophil stress in different biological pathways

4. RESULTS



Treatment effects in vitro on oxidative burst, degranulation, and neutrophil extracellular trap (NETs) release were studied.

Application of Diflubenzuron, Ivermectin and Doramectin (in an estimated plasma concentrations of 200, 308, and 125 ng mL⁻¹, respectively) caused a significant stimulation of oxidative burst (marked in the graphs with *), and a noticeable stimulation of degranulation of primary granules and NETs release.

Diflubenzuron treated neutrophils showed up to three times higher activity than non-treated control. Observed effect indicates the potential of the above antiparasitic compounds to interfere with disease resistance in fish populations by modulating immune responses during treatment.

5. DISCUSSION

Other studies showed as well that the innate immune system is very fragile and reacts sensible to different impacts like different kinds of stress (handling, crowding, change in pH or temperature) and toxic substances. So when actually treating fish, it is important to take into account that some active ingredients will stress the immune system more than others so one can choose more educated the more results we gain about those interactions. The study is limited to in-vitro findings, it would be interesting to confirm them in-vivo. Therefore, further studies are required to find optimal therapeutic doses for an effective and safe treatment against ectoparasites in cyprinid fishes.

6. CONCLUSION

Our major results show that the used active compounds do in fact influence the neutrophil behavior. Since the neutrophil granulocytes are an important part of the innate immune response, changes in their behavior allow us to draw the conclusion that this in-vitro findings will be reflected in an in-vivo model as well. So it is an acceptable statement to reason that the compounds Ivermectin, Doramectin and Diflubenzuron in particular manipulate the immune response of fish while being treated and so attenuate the ability of fish immune system to react appropriate when challenged with pathogens like bacteria, viruses and fungi.

7. REFERENCES

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