

ABSTRACT

Biofouling is defined as organisms attached to man-made surfaces submerged in the aquatic environment. It is a huge problem globally and many different antifouling products are available. There are two major groups of antifouling products, those that contain some kind of biocide and those that inhibit settlement by means of physical forces. None has proven to be completely effective and at the same time environmentally friendly, although many have claimed that their product has both these properties.

The aim of this thesis is to evaluate the risk of medetomidine, which is under development as an antifoulant. Medetomidine is a commonly used sedative and analgesic in veterinary medicine and has also been shown to effectively prevent the settlement of barnacles. A variety of species, mainly non-target organisms, were chosen for sublethal effect and bioaccumulation studies. All species selected are, in at least one part of their life cycle, inhabiting areas with high boating activity thus being exposed to antifouling compounds.

The most obvious effect caused by medetomidine is the paling in fish. Medetomidine causes pigment aggregation in melanophores which makes the fish appear pale. This was investigated in two different fish species, lumpfish (*Cyclopterus lumpus*) and turbot (*Psetta maxima*). It was most pronounced in turbot where an effect was observed within ten minutes with a LOEC (Lowest Observed Effect Concentration) of 8.4 nM and after one hour with a LOEC of 2.1 nM.

As a sedative, medetomidine affects the metabolism in mammals. Oxygen consumption was therefore investigated in fish since it can be used as a surrogate for metabolic rate. We observed decreased oxygen consumption with increasing concentrations of medetomidine in fish larvae, most obvious in lumpfish with a LOEC of 5 nM. In addition, respiration frequency was affected in turbot, with a LOEC of 2.1 nM. Since respiration is intimately linked to metabolism in fish basic metabolism is affected by medetomidine. Activity is also linked to metabolism and this too is affected by medetomidine, both in a fish and a bivalve. Spontaneous swimming activity in three-spined stickleback (*Gasterosteus aculeatus*) decreased with increasing concentrations of medetomidine with an EC50 (concentration that provokes half maximal effect) of 121 nM. In addition, an increased response time to food and decreased feeding was observed. A decreased burrowing behaviour in *Abra nitida* was also affected in a dose dependent way with a LOEC of 40 nM and a decreased sediment reworking activity was obvious with a LOEC of 10 nM and an EC50 of 4.4 nM.

Medetomidine was shown to have a maximal bioconcentration factor (BCF) of 1195 l/kg FW (fresh weight) in periphyton communities at steady state, indicating that medetomidine should not be classified as bioaccumulating according to the European Chemicals Bureau. The BCF in blue mussel (*Mytilus edulis*) was 133 l/kg FW and 2.8 l/kg FW in brown shrimp (*Crangon crangon*) demonstrating that bioaccumulation is species dependent. A rapid and almost complete elimination of medetomidine was also observed.

In conclusion, all observed effects caused by medetomidine may decrease the organisms' ability to survive in nature. A decreased respiration or activity hence metabolism may lead to slower reactions and decreased ability to catch prey and hide from predators. In combination with an inability to adapt the skin colour to the background this may be very serious. However, all observed effects were reversible, at least to some extent. In addition, the effects occurred at concentrations well above the predicted environmental concentration which in a worse case scenario is 0.001 nM.