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NRP Endocrine Disruptors

Intermediate Summary

Hormonal activity of UV screens in aquatic ecosystems (HAUS)
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English Summary

Hormonal activity of UV filters in vitro and in vivo in aquatic animals

UV filters are used in increasing amounts in sunscreens and in the UV protection of materials and enter aquatic ecosystems. Our in vitro studies demonstrate that all analysed UV filters are able to act like sex hormones or inhibit their action. Multiple activities and their action in fish shed new light on the hormonal properties of UV filters.

Project description:

Research questions

Despite high consumption, the hazards and risks of UV filters for aquatic systems are unknown. We aim at providing data for better characterizing the possible environmental risks of these chemicals. We have systematically studied the estrogenic activity of a large number of UV filters in vitro for humans and fish, analysed whether additional hormonal activities occur, and how they interact when occurring in mixtures. Subsequently we investigated whether UV filters are hormonally active in vivo in aquatic animals such as fish and frog.

Results

All of the 18 UV filters exhibited hormonal activities in recombinant yeast systems carrying either a human estrogen receptor (ER), or human androgen receptor. Whereas 9 compounds showed estrogenic, 14 inhibited estrogenic activity. For the first time 6 androgenic and as many as 16 UV filters inhibiting androgenic activity were found. Surprisingly most of the UV filters had multiple activities. UV filter mixtures possessed significant estrogenic activity, when individual compounds were mixed at concentrations showing very little activity. These data give a novel and unexpected picture of the hormonal activities of UV filters in vitro. We also determined the estrogenic activity of over 20 UV filters in a recombinant yeast carrying a fish ER. Five UV filters showed full estrogenic activity, four displayed moderate and two submaximal activity. The relative estrogenic activity was higher in fish than in human in vitro systems.

In juvenile fish exposed for 14 days to UV filters we determined the induction of vitellogenin, a yolk protein used as marker for estrogenic activity. One UV filter induced vitellogenin at water concentrations of 440 µg/L, two others were active at 4500 and 8800 µg/L. Three UV

filters were only active in vitro with no estrogenicity in vivo. In frogs exposed to two UV filters during their entire metamorphosis, we found that neither the rate of metamorphosis, nor the sex determination were affected.

Perspectives

Our study shows for the first time estrogenic activities of some UV filters both in vitro and in vivo in fish and reveal a novel feature of their hormonal activities, acting either as agonists or antagonists on female and male sex hormone system. Whether estrogenic activity in fish occurs at environmental concentrations, and whether the reproduction is negatively affected will be studied in forthcoming experiments. Moreover, the activity of UV filter mixtures and bioaccumulation in fish will be assessed for better environmental risk assessment.