Application of the humpback whale fibroblast cell lines in chemical risk assessment

Migrating southern hemisphere humpback whales observed during a sampling campaign.

Antarctica is the coldest, the driest, the windiest and the remotest continent. Almost no people inhabitant these pristine area. We would also expect it is the cleanest. However, our studies revealed the presence of organochlorine pesticides like DDT, industrial chemicals like PCBs or dioxins, which were already banned decades ago.

These chemicals are long-lived and semi-volatile, over decades they evaporate out in the atmosphere and condensate at colder temperatures. That's how these chemicals are transported from warm to colder climate. Once deposited at the poles its a one-way trip and Persistent Organic Pollutants (POPs) end up concentrating. They aren’t broken down, instead they accumulate in the body fat of animals and magnify in the food web.

Marine mammals accumulate the greatest levels of POPs due to their long life, high proportion of body fat, and top position of the marine food chain. Southern hemisphere humpback whales feed only during the Antarctic summer, mainly on highly lipophilic krill. Further, they undertake the

longest migration known in any mammal and this time period is also associated with voluntary fasting. During their migration they only live of accumulated fat reserves. This adipose tissue acts as temporary buffer for POPs. However, long-term fasting periods lead to rapid weight loss, reactivation and redistribution of POPs. We found in our studies that single POP concentrations in the blubber of humpback whales increased by up to 50 times between early and late migration.

However, measuring the toxicological impact of POPs on wild populations of humpbacks is a challenge in chemical risk assessment. Non-lethal approaches are logistically challenging and very cost intensive. To date, there are no suitable methods established to study toxicological sensitivity. In order to bridge this information gap, better tools for deriving species-specific data are required.

Cell lines are well applied in ecotoxicology and enable rapid and cost- effective assessment of meaningful toxicological data. This study aimed in collaboration with the Environmental Toxicology group at the Swiss Federal Institute of Aquatic Science and Technology (Eawag) to develop and assess an in vitro toxicity approach for humpback whales using newly established fibroblast cell lines.

Primary fibroblasts were isolated from the dermal connective tissue of skin biopsies and cultured under standard mammalian conditions. Of nine initial biopsies, two cell lines were established. Both HuWa1 and HuWa2 were identified as fibroblasts stemming from male individuals with a karyotype of 2n = 44, which has commonly been observed in other baleen whale species e.g., blue whales. The sensitivity of the HuWa cells to a typical POP differs considerably from human fibroblasts, and to a natural POP mixture. This emphasizes the importance of species-specific toxicity evaluation and the role of in vitro methods to evaluate those.

Publication

Establishment of the first humpback whale fibroblast cell lines and their application in chemical risk assessment.
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