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Disposition of (9-^{14}C) Phenanthrene in a Subtropical Marine Teleost (*Haemulon sciurus*)*

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The increased oil pollution in the Bermuda region results in a growing need for environmental and pollution research in this part of the North Atlantic Ocean. The Bermuda environment represents the northern most distribution of many tropical marine species and thus the organisms are subject to temperature stress for much of the year (MORRIS et al. 1977).

The chronic presence of tar on the beaches has only become obvious within the past fifteen years; its presence mainly attributed to tanker operational discharge in the North Atlantic gyre (BUTLER et al. 1973). A recent study of tar on the beaches of Bermuda indicates that the levels have not significantly decreased in the past eight years (KNAP et al. 1980). SLEETER et al. (1979, 1980) have reported elevated concentrations of petroleum hydrocarbons in the near-shore sediments attributed to this source with a marked decrease off-shore.

A recent study on the occurrence of petroleum hydrocarbons in the liver of fish from the near-shore areas of Bermuda indicate that those species that graze on the sediment/water interface co-ingest tar during the process of feeding, resulting in a petrogenic source signal in their livers (KNAP & BINKLEY 1981). It was therefore interesting to determine the extent and rate of uptake and depuration of petroleum hydrocarbons in Bermuda fish. It was also of interest to determine the uptake and removal rates of petroleum hydrocarbons from fish in a sub-tropical environment in the light of recent work on this subject with temperate species (PALMORK & SOLBAKKEN 1980, 1981; SOLBAKKEN & PALMORK 1980; SOLBAKKEN et al. 1979). These studies have successfully used [9-^{14}C]phenanthrene, a well-studied polycyclic aromatic hydrocarbon, PAH. Therefore this technique was adopted for the present study on the disposition of PAH in sub-tropical fish. Blue-striped grunts (Haemulon sciurus) were used in this study as they are a commercial, sediment/water interface feeder well represented in the near-shore areas of Bermuda as well as the Caribbean.

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EXPERIMENTAL

The bluestriped grunts (Haemulon sciurus) were collected from the coastal area near Bermuda (mean weight ± SD; 286 ± 158g) and transported to an experimental tank containing 1550 L of running seawater (flowrate, 33 L/min; temp., 24°C; salinity, 35,5 o/oo). Fishes of both sexes were used, and they were not fed four days prior to and four days after dosing. In experiments of longer duration the grunts were fed thawed frozen market squids (Loligo opalasen). Dosing was performed as described by SOLBAKKEN et al. (1979), but in the present study the capsules were not cut prior to dosing. Each fish received a dose of 9.25 µg (1.0 µCi) of [9-^{14}C]phenanthrene (spes. act. 19.3 mCi/mmol).

At appropriate times after dosing, samples of fish were frozen and maintained at -20°C until analyzed. After thawing, different tissues and bile were removed and weighed. The liver, muscle, bile and gonads were analysed for radioactivity (two samples of each tissue), according to a method previously described (SOLBAKKEN et al. 1979).

RESULTS AND DISCUSSION

The results of the present study are given in Fig. 1. The values are expressed as % of given dose for the liver and the muscle (Fig. 1a, b) and concentration of radioactivity (dpm/g) in the gonads and bile (Fig. 1c, d).

The main accumulation of phenanthrene occurred during the first two days in the liver and gonad tissue (Fig. 1a, c). Other than a small peak 3 days after dosing, the content of radioactivity in the muscle tissue remains essentially constant throughout the experiment. A peak of increased radioactivity occurred in the bile 3 days after dosing (Fig. 1d); two days after the peak in the liver. This delay is related to the metabolism of phenanthrene by the liver and then subsequent excretion to the gall bladder (SOLBAKKEN & PALMORK 1981a; SOLBAKKEN et al. 1979, 1980).

The capsule containing the radioactivity was administered to the stomach of the fish in toto, therefore a time delay of 12-14 hours occurs before the radioactivity is found in the digestive fluid (SOLBAKKEN, unpublished data). The accumulation rate of phenanthrene in the liver and gonads of the grunts appears to be faster than the rate exhibited by livers from fish inhabiting temperate environments (SOLBAKKEN & PALMORK 1980, 1981b; SOLBAKKEN et al. 1979). The amount of radioactivity as expressed as % of given dose, was approximately four times as high in the grunts compared with results of similar experiments with rainbow trout (Salmo gairdneri) and flounder (Platichthys flesus), (SOLBAKKEN & PALMORK 1980, 1981b), which also have a small liver/body weight ratio as do the grunts.

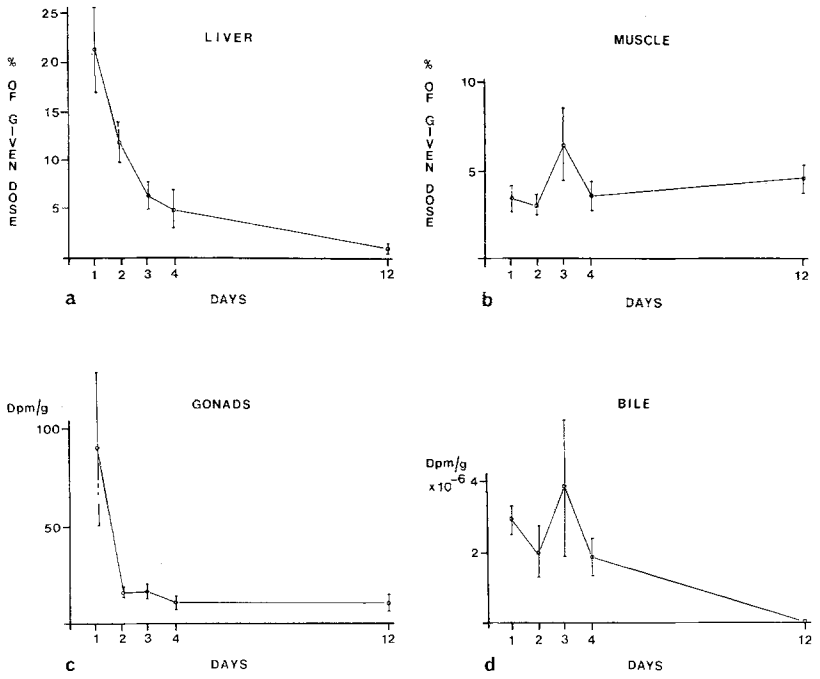

Fig. 1. The radioactivity in different tissues and bile at various times after dosing. The results shown (mean ± SE) are given as; % of given dose in liver (a) and muscle (b), and concentration of radioactivity (dpm/g) in gonads (c) and bile (d).

The amount of radioactivity after dosing was 1 and 5% of given dose, respectively. This may be due to a higher content of lipids in the liver of grunts (more than 20%, KNAP & BINKELY 1981) then in livers of rainbow trout and flounder (less than 10%, SOLBAKKEN, unpublished data). The elimination of radioactivity in the liver of the grunt during the first 4 days of the experiment is similar to that found for the rainbow trout and the coalfish, Pollachius virens (SOLBAKKEN & PALMORK 1980; SOLBAKKEN et al. 1979). Although the amount of radioactivity had decreased significantly after 12 days there was still radioactivity present (1% of given dose) well above background. In the muscle tissue there was no significant decrease in radioactivity during the experiment and 4.6% of the given dose was still present after 12 days. This observation has not been reported for teleosts before,

however, experiments with the spiny dogfish (Squalus acanthias) indicate that 8% of the given dose was present in the muscle tissue 28 days after dosing (SOLBAKKEN & PALMORK 1980).

The concentration of radioactivity in the gonads decreased rapidly after dosing and after 2 days remained essentially constant throughout the experiment at very low concentrations. The excretion of radioactivity into the gall bladder showed great variation during the experiment. There was a decrease in radioactivity between 1 & 2 days after dosing, followed by an increase at day 3. The concentration after day 3 decreased markedly; however, a small amount of radioactivity was still present after 12 days.

The present study shows that the rate of uptake of [9-^{14}C]phenanthrene in the sub-tropical teleost Haemulon sciurus is greater than that found for fish inhabiting temperate areas. Despite a low liver to body weight ratio the liver had a significantly greater amount of radioactivity one day after dosing compared to rainbow trout and flounder (SOLBAKKEN & PALMORK 1980, 1981b). The rate of elimination is similar to those of temperate areas but the extent of elimination, especially in the muscle, was not as complete as in the previous studies. This indicates that further species need to be analysed before a definite extrapolation can be made between the disposition of phenanthrene in temperate and sub-tropical teleosts.

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