RESIDUES OF ORGANOCHLORINE PESTICIDES IN FISH FROM THE ARABIAN GULF

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Abstract. High-resolution electron capture gas chromatography was used to determine residue levels of organochlorine pesticides in 13 commercially important fish species collected from the NW Arabian Gulf. While most of the residues were below the detection limit of 1 μg kg\(^{-1}\) wet weight, relatively low concentrations of ZDDT, endrin and dieldrin were detected in the edible tissue of these fishes. The ZDDT residue levels ranged from 2 to 1 μg kg\(^{-1}\) wet weight, endrin ranged from none detected (nd) to 45 μg kg\(^{-1}\) and dieldrin from nd to 5 μg kg\(^{-1}\). A definite correlation was established between total organochlorine pesticide residues and lipid content (r = 0.6) for the NW Arabian Gulf fishes. Comparison with fish from Hor-al-Hammar Lake (an area that used to be sprayed with pesticides) has shown that the latter contained significantly higher residue levels. The ZDDT residue levels ranged from 5 to 45 μg kg\(^{-1}\) wet weight, endrin from 3 to 83 μg kg\(^{-1}\) and dieldrin from nd to 4 μg kg\(^{-1}\). Based upon the observation that the original DDT (p, p'-DDT) was identified in the NW Arabian Gulf fishes, it has been concluded that there was a recent input of DDT to this region. Since DDT application has been banned in Iraq, consequently it was assumed that DDT must originate from a more remote source.

1. Introduction

The Arabian Gulf is a semi-enclosed sea situated both downstream and down-wind of the Shatt al-Arab Delta and the Tigris-Euphrates River Basin. This latter area is a well established agricultural region in which various pesticides such as DDT, aldrin-dieldrin, ... etc. have been used. These compounds are characterized by their relative chemical and biological stability, and hence persistence in the environment. Organochlorine pesticides could enter the Arabian Gulf either as a run-off or through atmospheric deposition. Damage to marine environment by these chemicals is well documented. However, up to this time of writing, only sparse data concerning the distribution of organochlorine pesticides in the Arabian Gulf have been available (Burns et al., 1982). A preliminary survey of marine samples revealed the presence of DDT derivatives in the oysters (Pinctada margaratifera) collected from Kuwaiti waters (Anderlini et al., 1981). These findings indicate that inputs from the Tigris-Euphrates Basin may indeed be taking place. It has also been observed that at a certain times, dust fall-out is associated with shirmp-larval kills in culture ponds (Farmer, 1984). Although speculative, it may be possible that at these times, airborne dust from Tigris-Euphrates carries pesticides and/or their chlorinated extenders. The work described in this paper was conducted in order to establish the background residue levels of organochlorine pesticides in 13 commercially significant fish species from the NW Arabian Gulf.
2. Materials and Methods

2.1. MATERIALS

Pesticides grade acetone, \( n \)-hexane, acetonitrile, and diethyl ether were obtained commercially from Burdick and Jackson and were used as received. High purity (99 + %) analytical standards of pesticides and their related compounds as well as the remaining chromatographic supplies were provided by Supelco S.A. FlorisilPR, 60 to 100 mesh (lot No. 307) and anhydrous, granular sodium sulphate (Fisher Scientific Company) were extracted with \( n \)-hexane for a minimum of 36 hr in a soxhlet apparatus. Following clean-up, florisil was activated and stored according to the procedure described by the (U.S. EPA, 1980). The amount of florisil used was determined by lauric acid titration (Mills, 1968). All non-volumetric glassware used were acetone rinsed then oven-baked at 300 °C for about 24 hr prior to use. Volumetric glassware was sequentially rinsed with acetone and \( n \)-hexane, followed by air drying.

2.2. COLLECTION OF FISH

Composite samples of 13 fish species were collected from the NW Arabian Gulf during July 1985 to establish the 'background' residue levels of organochlorine pesticides. Samples of 5 fish species were collected from Hor al-Hammar Lake (Figure 1) to determine the influence of pesticide inputs. Generally, each composite consisted of at least 10 uniform size of adult fish of the same species.

2.3. PREPARATION OF SAMPLES

Fish samples (edible tissues only) were pooled and macerated in a food chopper from which at least 5 replicates of 60 g were freeze-dried, ground and sieved through 1 mm metal sieve. The extraction procedure employed in the present study was based upon that of the Draught Method of the Standing Committee of Analysis for the determination of organochlorine insecticides and PCB in fish and is outlined below.

Exactly 10 g of the dried fish muscles were placed in a pre-extracted cellulose thimble and soxhlet extracted with \( n \)-hexane for about 24 hr. At the end of this period, the extract was transferred to a storage flask and the sample was further extracted with fresh solvent. The combined extracts were reduced in volume to \( ca. \) 10 mL in a rotary evaporator. The extraction procedure removed volatile constituents of the samples. Further clean-up was achieved by transferring to a separating funnel and apportioning between acetonitrile/\( n \)-hexane (Mills, 1961). Then, the acetonitrile was diluted with water and the residues were extracted with \( n \)-hexane which was dried over a column of sodium sulphate. However, in order to remove the unsaponified lipids, extracts were further cleaned and fractioned on active florisil. The extract was charged to the florisil column, and eluted with 6 and 15% diethyl ether in \( n \)-hexane. The combined elutants were evaporated to about 10 mL in a rotary evaporator, then to exactly 1 mL by a stream of purified \( N_2 \).