Polyaromatic Hydrocarbons in Oysters from Coastal Lagoons Along the Eastern Coast of the Gulf of Mexico, Mexico

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INTRODUCTION

Polynuclear aromatic hydrocarbons (PAHs) appear to be widely distributed in the sea, as well as in river water and soil. The presence of these compounds in aquatic organisms has been mainly attributed to oil spills, but biosynthesis, aerial transport, and terrestrial contributions are also important sources (ZOBELL, 1971). There is a vast literature on the PAHs levels in marine organisms, and special attention has been focused on those considered potentially carcinogenic (U. S. NATIONAL ACADEMY OF SCIENCE, 1975).

The assessment of PAHs levels in marine bivalve mollusks has attracted great interest, since they are useful in determining the status of coastal areas with regard to petroleum contamination (FARRINGTON and QUINN, 1973).

The presence of PAHs in oysters from a contaminated harbor was reported by CAHNMANN and KARATSUNE (1957); amounting to 1 ppm wet weight. BLUMER et al., (1970a) determined that after a minor spill of fuel oil in Buzzards Bay, Mass., USA, oysters had incorporated in their lipid pool petroleum hydrocarbons of various structures over a wide molecular weight range. ERHARDT (1972) reported high concentrations of polyaromatic hydrocarbons in oysters from Galveston Bay near the entrance of the Houston Ship Channel, Tex., USA, approximately 132 ppm wet weight, 56% of the total load.

STEGEMAN and TEAL (1973) through bioassay tests provided valuable information on the accumulation, release, and retention of petroleum hydrocarbons by Crassostrea virginica. The PAHs fraction extracted from the oyster tissues after a 50-day exposure constituted a great percentage of the total

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hydrocarbon load, compared to their concentration in the hydrocarbons introduced into the system.

This paper is concerned with the analytical determination and identification of PAHs in oysters from lagoons and estuaries along the eastern coast of the Gulf of Mexico. Data of this kind are urgently needed in view of the increasing utilization of these areas as sites for industrial and urban development.

METHODS AND MATERIALS

Specimens of Crassostrea virginica were collected from ten different locations along the eastern coast of the Gulf of Mexico (Fig. 1); these oysters were found in dense clusters on soft muddy bottoms. The anterior-posterior dimension of the animals varied from 50 mm to 100 mm. After collection of one hundred individuals from each site, the oysters were immediately frozen and sent to the Centro de Ciencias del Mar y Limnologia in Mexico City.

The following procedures were performed on the samples The oyster tissues were homogenized, after being shucked, in a waring blender. The homogenate was freeze-dried, and the dried materials stored in wide mouth glass bottles throughly cleaned. The extraction procedure was conducted on 5 g of the dried material using 200 ml of cyclohexane in a Soxhlet extractor for about 12 hours. The oyster extracts were reduced to 1 and 2 ml in a rotary evaporator, followed by clean-up and fractionation (ROSE and MIDDLETON, 1955).

The extracts were placed on silica gel columns (5.0 x 30 cm) and eluted with 2500 ml of iso-octane followed by 1500 ml of benzene. The silica gel column was calibrated with two standards, biphenyl and 9-phenylanthracene. The benzene fractions were analyzed for PAHs by means of capillary column gas chromatography (ONUSKA et al., 1976). The glass capillary column was 12 m x 0.26 mm coated with SE-52 (0.28 μ thickness) by the static method of NOVOTNY and BARTLE (1973).

The investigation was carried out with a Carlo Erba Model 2301 gas chromatograph equipped with a splitless injector. A linear temperature programming was carried out at 4 ^{o}C/min from 60^{o} to 240 ^{o}C. Helium was used as the carrier gas. Samples solutions of 3.0 μl were in-

troduced onto the capillary column through a precolumn, a 2 mm layer of specially treated chromosorb Q with Apiezon L according to AUE et al. (1973).

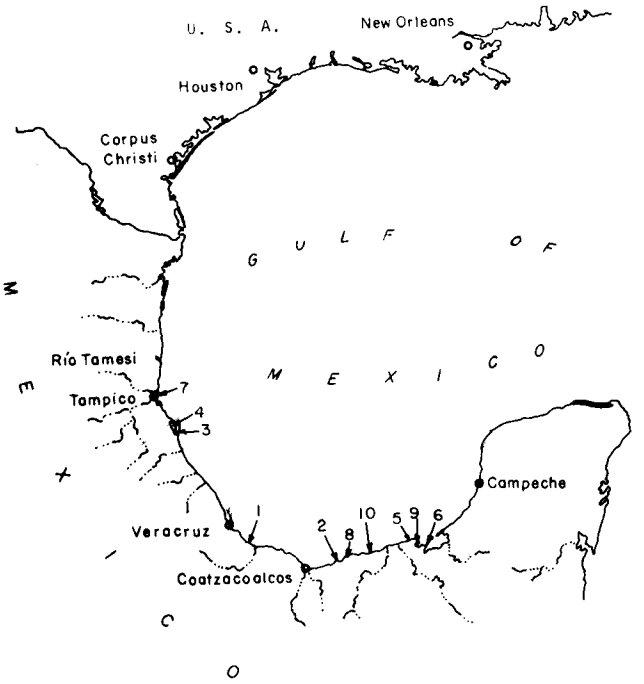


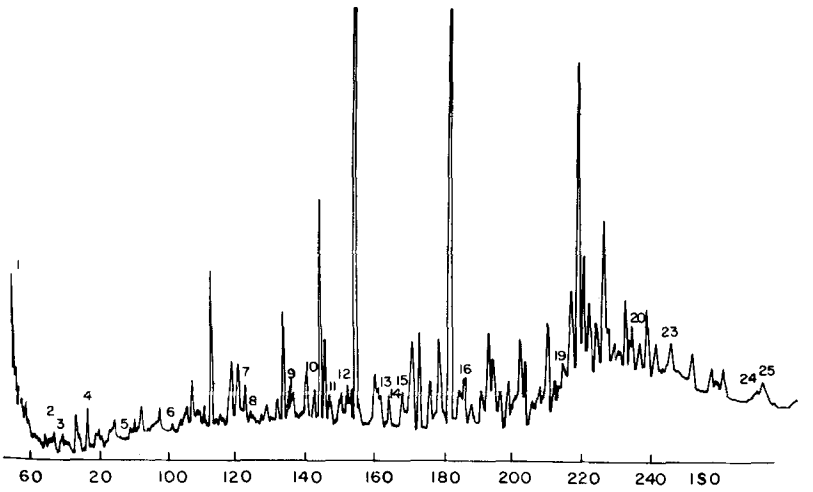
Fig. 1: Sampling sites: 1. Laguna de Alvarado, 2. Laguna Machona, 3. Canal de Tampamachoco, 4. Laguna de Tamiahua, 5. Laguna Puerto Rico, 6. Laguna de Terminos (Palizada Vieja, 7. Laguna de Pueblo Viejo, 8. Laguna del Carmen, 9. Laguna de Terminos (Boca de Atasta), 10. Estero de Tamulte.

RESULTS AND DISCUSSION

The use of glass capillary columns provides an excellent approach to the rapid analysis of PAHs. The major advantage of such columns is their superior separation capability.

A typical chromatogram for the benzene fraction of a

shellfish sample from site number 6 is given in Fig. 2. A substantial background of various compounds other than PAHs were still noticeable. They belonged to a number of chemical classes such as, glycerol lipids, fatty acids, waxes, etc.



Temperature ^{o}C

Fig. 2: Gas chromatogram of oyster sample from site 6. 1. naphthalene, 2. 2-me naphthalene, 3. 1-me naphthalene, 4. biphenyl, 5. acenaphthene, 6. fluorene, 7. phenanthrene, 8. anthracene, 9. 2-me phenanthrene, 10. 9-me anthracene, 11. fluoranthrene, 12. pyrene, 13. benz (a) fluorene, 14. benz (b) fluorenene, 15. 1-me pyrene, 16. chrysene, 17. benz (e) pyrene, 18. benz (a) pyrene, 19. perylene, 20. 9, 10 diphenyl anthracene, 21. dibenzanthracene, 22. benzperylene, 23. dibenzcarbazole, 24. coronene, 25. dibenzpyrene.

Residue levels of the PAHs in oysters from the ten different sites along the eastern coast of the Gulf of Mexico are presented in Table 1.

TABLE 1

Total concentration of PAHs in oysters from the different sites.

Site	PAHs ppm (w/w) (1)
1	3.58
2	6.28
3	2.12
4	4.57
5	2.99
6	2.08
7	3.91
8	9.16
9	3.27
10	6.11

(1) These values correspond to one sample for each site, and each sample consists of the homogenized tissues of one hundred oysters. They are mean values of replicate analysis.

The higest concentrations encountered were for oysters from sampling sites 2 and 8, Machona and Carmen lagoons. These lagoons are located in an undeveloped area with very low population density; however, since it is an oil-producing area some of the wastes reach these lagoons.

The lowest levels of PAHs residues were determined in oysters from sites 3, 5 and 6 in the general area of Terminos Lagoon which is a sparsely populated area.

No statistical significance can be derived for differences in the total concentration of PAHs in oysters from sites 1, 3, 5, 6, 7 and 9 which showed concentrations lower than 4 ppm. Oysters from sites 2, 4, 8 and 10 had slightly higher values for the total concentration of PAHs found, but were not significantly different from values ranging from 4 to 10 ppm.

The total concentrations of the PAHs in the analyzed samples are surprisingly high for oyster tissues. Clearly, no single causative factor will adequately explain environmental data of this kind because the possibility of accidental spillages and intermittent activites that may contribute to the distortion of these results and provide a basis for further investigation.

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