Mona, Sudan Academy of Sciences Journal, No. 10, 2015, 57-62
ISSN 1816-8272

Some Aromatic Hydrocarbons in Two Commercial Fish Species *Plectropomus areolatus* and *Chanos chanos* in the Sudan Red Sea Coast

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Abstract

The main objective of this was to establish information about residues of petroleum hydrocarbons, mainly aromatic hydrocarbons as benzene, toluene and exylene in sediments, and in the muscles and livers of two commercial finfish species *Plectropomus areolatus* (najil or silimani) and *Chanos chanos* (milk fish) in Sudan Red Sea Coast. The study was carried out from 2007 to 2009 in two main stations: Mohamed Qoul (control) and Port Sudan (a heavily polluted area). The results showed the highest concentrations of 2.39 ml/g benzene, 0.0012 ml/g toluene and undetectable exylene in the sediments. In the fish samples the highest concentrations were: 0.4901 ml/g of benzene, 0.0765 ml /g of toluene, and 0.1132 ml/g of exylene. The lower concentrations in sediments were: 0.18 ml /g of benzene, 0.0007 ml/g of toluene and below detection limits (BDL) of exylene. In fish meat and liver the concentrations were: 0.0025 ml/g of benzene, 0.0004 ml/g of toluene and 0.0028 ml/g of exylene.

Keywords: Aromatic hydrocarbons, Sediment, Fish, Muscles, Liver, Red Sea coast.

Introduction

The Red Sea is one of the most important repositories of marine biodiversity on a global scale and features a range of important coastal habitats (PERSGA, 1999). It is rabidly developing as one of the world's largest offshore oil production areas. It also comprises a wide range of tropical marine habitats, many of which are internationally recognized for their conservation, scientific, economic and recreational values. Past oil productions, refining and transportation have resulted in chronic pollution of some areas. Environmental programmes to protect new areas of development from pollution damage are assuming increasing importance (Dicks, 1984). The environment and resources of the Red Sea and Gulf of Aden are threatened by a variety of human activities including dredging and filling operations, the disposal of domestic and industrial effluents, and non-sustainable use of freshwater resources. The rate of population and economic growth in the coastal zones of the region has resulted in an increased pressure on the environment. Besides, the global importance of petroleum and the resulting maritime traffic in the Red Sea and Gulf of Aden which pose a serious threat to the fragile coastal and marine environments (PERSGA, 1999). The Red Sea suffers from considerable oil pollution, especially around the oil fields in the Gulf of Suez, in Egyptian waters. Tar balls and slicks are common,

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and fouling of beaches is extensive. Some beaches are through to be beyond recovery. Extensive damage has occurred to coral reefs and sea grass beds in that region (Hinrichsen, 1990). Recently, Sudan became a producer and exporter of oil (crude and refined products), where two additional ports, Bashayer and Alkheir terminals, for exportation of oil and gas were constructed in addition to the existing three ports. The objective of this study is to dekct residues of petroleum hydrocarbons mainly three aromatic compounds, benzene, toluene, and exylene in sediments and in two fish species.

Materials and Methods

Two main stations were chosen for the study: Mohammed Qoul (control) and Port Sudan (relatively heavily polluted as a result of human activities). They were divided into three substations: power station, Deim Mayou, and Dama dama terminal sub-stations.

Oil hydrocarbons extraction and analysis

From sediment: oil hydrocarbons from sediment samples were extracted according to Giger and Blumer (1974) using Soxhlet apparatus. Amount of 100 to 150g of sediments were extracted with 275 ml methanol (CH3 OH) for 24 hours at a temperature at 64-65 ºC, then 75 ml Benzene C6 H6) was added and extraction was continued for another 24 hours at 79-81ºC. Oil constituent separation was carried out by Gas Chromatography (model GC 2010 SHIMADZU) using column DB-I (length 30 m), carrier gas N2/ air, and detector channel IFID.

From fish: The method used for the extraction was that of Farrington and Medeiros (1975) digesting. 150 ml of 6.7% Potassium hydroxide (KOH) in methyl alcohol, were added to 50 g of fresh fish muscles sample and liver (usually liver weight less than 50 gm). Then refluxed in around bottomed flask fitted with condenser, for 1 hour, using water bath model BUCHI Heating Bath B-490, at 64-65ºC. After complete digestion the hydrocarbons were extracted into hexane, washed with ether, dried and concentrated prior to fractionation. The operation was done using separating funnel.

Fish species studied: Two commercial finfish species were chosen according to their trophical level. *Squaretail coral trout P. areolatus*, **one of groupers** (family Serranidae). The other species is milk fish *C. chanos* (family Chanidae).

Statistical analysis:- statistical analysis was done using Excel, graphpad (http://www.graphpad.com/quickcal.),and easy calculation (http:// www. easycalculation.com) software computer programmes.

Results

Sediments samples

Table (1) indicates that, benzene was found in all stations. Toluene was below detection limits in Electric power station and Mohammed Qoul (control). The same results were applied to exylene from all the stations.

ISSN 1816-8272

Table 1. Aromatic hydrocarbons concentrations ml/g in sediments collected from Port Sudan substations and Mohammed Qoul from April to July 2009

Station	Benzene conc. ml/g	Toluene conc. ml/g	Exylene conc. ml/g
Deim Mayou (Desalination plant)	0.18 – 2.39	0.0007 – 0.0012	BDL
Electric power station	0.45 – 1.10	BDL	BDL
Dama dama (Alkheir oil terminal)	1.79 – 2.04	0.51 – 0.73	BDL
Mohamed Qoul (control)	0.97 – 1.07	BDL	BDL

BDL = below detection limits

Fish samples

Fish samples of muscles and livers contained benzene (Table 2). Concentration of benzene in the fish samples ranged between 0.00 ml /g and 0.4901 ml/g. Approximately 50% of the fish samples from Port Sudan contained exylene ranging between 0.0028 and 0.1132 ml /g. More than 50% of the samples contained toluene in concentrations that ranging between 0.0004 and 0.0765 ml//g. Exylene and toluene are below detection limits in all fish samples from the control site in Mohammed Qoul (Table 3).

Table 2. Concentrations of benzene, toluene and exylene in muscles and livers of the fish samples at Port Sudan Station

Species	Aromatic compound	Concentrations ml /g		Average conc. ± sd	
		Muscle	Liver	Muscle	Liver
P. areolatus	Exylene	BDL	0.0 - 0.1132	BDL	0.0566
C. chanos	Exylene	0.0 - 0.0028	0.0 - 0.0964	0.0014	0.0482
P. areolatus	Benzene	BDL	0.0 - 0.1562	BDL	0.0781
C. chanos	Benzene	0.0 – 0.02	0.0025- 0.4901	0.0144± 0.0100	0.1737 ± 0.2744
P. areolatus	Toluene	BDL	0.0 - 0.0765	-	0.03825
C. chanos	Toluene	0.0032 - 0.04	0.0004- 0.0046	0.0041± 0.0010	0.0025± 0.0029

ISSN 1816-8272

Table 3. Concentrations of benzene, toluene and exylene in muscles and livers of the fish samples at Mohamed Qoul Station

Species	Aromatic compound	Concentrations ml /g		Average concentrations ± sd	
		Muscle	Liver	Muscle	Liver
P. areolatus	Exylene	BDL	BDL	BDL	BDL
C. chanos	Exylene	BDL	BDL	BDL	BDL
P. areolatus	Benzene	0.04 – 0.06	0.1418-0.4109	0.05± 0.0621	0.2763± 0.0662
C. chanos	Benzene	BDL	BDL	BDL	BDL
P. areolatus	Toluene	BDL	BDL	BDL	BDL
C. chanos	Toluene	BDL	BDL	BDL	BDL

Discussion

The area around Port Sudan is polluted by cargos for oil and gas products exports and imports, in addition to impacts of the existing industries, and industrial areas in Port Sudan. This agreed with (UNEP1997), who stated that "Development along the Red Sea coast is largely limited to a 70 km strip extending from Port Sudan to Suakin. This zone includes the two cities, major ports, oil terminals, salt works, a shrimp farm and the Red Sea Economic Free Zone. The damage to coastal habitats due to construction within this strip is extensive and in some cases both unnecessary and probably uneconomic in the long term. In some areas such as the main commercial port of Port Sudan, habitat destruction is unavoidable through regrettable and local environmental damage is out weighed by the scale of the economic benefit". Also agreed with (PERSGA, 2003) "Environmental problems are largely restricted to the vinicities of cities of Port Sudan and Suakin".

The three substations represented different types of pollution, the magnitude of which depends on location of the substation and the connection with open sea. Deim Mayou represents a shelter for commercial finfish species such as milk fish *C. chanos* and Mullets Mugil sp., in addition to some sea birds nursed in this part of the sea. Two cases of fish mass mortalities occureed in Deim Mayou, of the Red Sea: one was in September, 2006 and the second was in September 2007, both in summer season, that probably due to over production of freshwater (desalination process), and hence more sodium chloride discharged in this substation. The quantity of dead finfish was about 3 tons, which was consisted mainly of mullets Mugil sp. in addition to milk fish *C. chanos*. The chlorine concentration was 0.86 ppm while, the permitted concentration in water is about 0.5 ppm. Washing of Lories, which were loaded with pesticides in Deim Mayou might have had also contributed to mortalities. The atmosphere near the power plant station is polluted with exhaustion resulting from gasoline combustion by power generators, and black fumes were seen at the time of generators operation. These fumes were carried by winds towards wind directions. In addition to that, the traffic also participates in atmosphere pollution, which ends at the marine environment. An oil film was also seen covering part of the surface water in this

ISSN 1816-8272

substation, which is a nursery ground. Fingerlings were seen in the tidal areas, in spite of oil film existence.

In Alkheir terminal for imports and exports of refined products oil, the area is exposed to oil pollution through; handling, spill from tankers, ballast water, etc.

The Red Sea is considered a closed sea exposed to pollution. This agrees with McGinley (2008) who stated that "Due to its relatively small size, limited oceanographic circulation and high endemism, the Red Sea is particularly vulnerable to pollution, loss of species, and reduction in ecosystem productivity".

In this study no serious effects of pollutants were detected, at least at the present time, in the edible parts of the fish muscles. The fish samples in this study looked healthy, in spite of the hydrocarbon contents. The finding agrees with Frid and Dobson (2002). The effect of oil released into the marine environment depends on the type of oil, the nature of the ecosystem, and on a variety of physical, chemical and biological processes operative at the time of its release. Effects oil spill on pelagic communities are rarely drastic and usually recovers in weeks or months.

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ISSN 1816-8272

Mona, Sudan Academy of Sciences Journal, No. 10, 2015, 57-62

بعض المركبات العطرية فى نوعين من الأسماك التجارية فى ساحل البحر الأحمر السوداني

منى إبراهيم الماحي[1]

مستخلص البحث

تهدف الدراسة لتوفير معلومات عن المخلفات البترولية خاصة المركبات العطرية مثل البنزين، التلوين والزايلين، فى الرسوبيات وفى كبد وعضلات نوعين من الأسماك التجارية: السليمانى (الناجل) والسلمانى (سمك اللبن) بساحل البحر الاحمر السودانى وذلك لضمان سلامة مستهلكى لحوم تلك الأسماك. خاصة وأن السودان قد أصبح من الدول المنتجة والمصدرة للبترول. أُجريت الدراسة في الفترة من 2007م الى 2009م بموقعين: محمد قول (شاهد) وبورتسودان (منطقة تلوث). أوضحت نتائج تحليل الرسوبيات أن أعلى تركيز للبنزين2.39 مل/جم والتلين 0.0012 مل/جم. وفى عينات الأسماك أعلى تركيز للبنزين0.4901 مل/جم والتلين 0.0765 مل/جم والزايلين 0.1132 مل/جم. أما أدنى تركيز في الرسوبيات 0.18 مل/جم للبنزين 0.0007 مل/جم للتلوين، و(BDL) للبنزين. وفى عضلات وكبد الاسماك أدنى تركيز 0.0025 مل/جم للبنزين، 0.0004 مل/جم للتلوين، و0.0028 مل/جم للزايلين.

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ISSN 1816-8272