CSCanada
Studies in Sociology of Science
Vol. 6, No. 1, 2015, pp. 1-6
DOI: 10.3968/6399

ISSN 1923-0176 [Print]
ISSN 1923-0184 [Online]
www.cscanada.net
www.cscanada.org

Crude Oil Spills and Its Consequences on Seafoods Safety in Coastal Area of Ibeno: Akwa Ibom State

Ekpenyong, Nkereuwem Stephen[a],*; Udeme Sunday Udofia[b]

[a]PhD, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria.
[b]Department of Food Science and Technology, Michael Okpara, University of Agriculture, Umudike,Nigeria.
*Corresponding author.

Received 20 November 2014; accepted 10 January 2015
Published online 26 January 2015

Abstract

Crude oil spill constitutes the most significant source of hydrocarbon in the Nigerian environment. Hence, a study on the impact of oil spill on sea foods of safety was conducted. The mean concentration of total petroleum hydrocarbons (TPH) in the tissues of various fish species sampled ranged from 5.73 mg/l in Chrysichthys nigrodigitatus to 21.27 mg/l in Ethmalosa finbriata. These values are well below the GESAMP recommended upper limit of 25mg/kg allowed for detection in seafood. The concentration of heavy metal, varied remarkably. Total Iron (Fe) ranged between 49.4 mg/kg in Selene dorsalis and 435 mg/kg in Alectis alexandrinus in the incident zone, and between 45.2 mg/kg in Pseudotholitus elongates and 344 mg/kg in Alectis alexandrinus in the control zone. Lead (Pb) ranged between 0.2 mg/kg in most species to 8.54 mg/kg in Mugil cephalus in both incident and control zones. The concentration of Fe and Zn was considerably higher than reference values of 11.20-12.6 mg/kg reported for fin-fishes in Egypt and 5.4 mg/kg reported for fin-fishes in Ghana. The mean concentration of mercury (0.002 mg/kg) in species from incident and control zones was the lowest of all the trace metals. Elevated levels of heavy metals such as mercury, lead etc and hydrocarbons (benzene, toluene, ethylene and xylene), have been implicated in carcinogenic and mutagenic conditions.

Key words: Sea food; Crude oil; Oil spill; Coastal area; Environment; Hydrocarbon

Stephen, E. N., & Udofia, U. S. (2015). Crude Oil Spills and Its Consequences on Seafoods Safety in Coastal Area of Ibeno: Akwa Ibom State . *Studies in Sociology of Science, 6*(1), 1-6. Available from: URL: http://www.cscanada.net/index.php/sss/article/view/6399
DOI: http://dx.doi.org/10.3968/6399

INTRODUCTION

Oil spill constitutes the most significant source of hydrocarbons in the Niger Delta Region.

Oil exploration and exploitation have over the last four decades impacted disastrously on the socio-physical environment of the oil-bearing communities, massively threatening the subsistent peasant agricultural economy and the environment and hence the entire livelihood and basic survival of the people (Oyekunle, undated).

Every spill incident raises concern about seafood safety. Oil endangers fish hatcheries in coastal water and as well contaminates the flesh of commercially valuable fish (Nwilo & Badejo, 2005). Oil kills plants and animals in the estuarine zone. Oil settles on beaches and kills organisms that live there. It settles on the ocean floor and kills benthic (bottom-dwelling) organisms such as crabs. Oil poisons algae, disprupts major food chains and decrease the yield of edible crustaceans.

Both actual and potential contamination of seafood can substantially affect commercial and recreational fishing and subsistence seafood use. Loss of confidence in seafood safety and quality can impact seafood market long after any actual risk to seafood from oil spill has subsided, resulting in serious economic consequences (Yender et al., 2002).

Several reports have been published on the biological effects of oil on marine life (Wardley-Smith, 1976; Connel Miller, 1981; NOAA, 1998; Charles Darwin Foundation, 2002). The variables which influence the biological effects include type of oil, volume of oil, time of year, type of receiving environment, degree of dispersion or spread, weather conditions, types of clean-up, rate of weathering etc. Moreover, the impact of oil spill on human health varies depending on the intensity, duration of exposure and the ambient health status of the individual or population at risk. Location and activity of the individual also affects the degree of exposure of the individual (Lyons et al., 1995; Burger, 1997; Spitzer, 2001).

Consumers protection from unsafe and unpalatable seafood is a primary objective of federal and state public health agencies after a spill incidence.

This study sought to investigate the post impact of the frequent oil spill incidents on seafoods in Ibeno oil bearing communities of Akwa Ibom State.

1. OBJECTIVE OF THE STUDY

1.1 The Goal of the Study Is

To determine whether oil spill has affected the quality and safety of seafood resources within the study area. A key feature of this study is a design that compares observations made in the incident (oil spill) zone with observation from control (non oil spilled) zones:

1.2 Specifically, the Objective of This Study Includes

To investigate the concentration of hydrocarbon in fish tissues

To investigate trace (heavy) metal concentration in fish tissues

To define “safe” and “unsafe” level of hydrocarbon/trace metal concentrations in seafoods.

To suggest recommendations on management and processing of seafood based on risk rates that are commonly considered acceptable.

2. MATERIALS AND METHODOLOGY

The study area was divided into two zones – the incident zone and the control zone.

The incident zone was the area exposed to frequent oil spill, while the control zone was the area not exposed to oil spill incident.

The incident zone was Upenekang in Ibeno Local government area. The control zone was Oron in Oron Local govt. area. The choice of these zones was based on the economic activity (fishing) of the zones, and the bulk of seafoods in Akwa Ibom markets come from there.

The study involved field and laboratory work. The field work involved sampling within the coastal environment.

3. FIELD SAMPLING

Fish samples were randomly collected from the sampling sites using fishing nets. Fish collected were tagged properly according to spices and site of collection. They were put in separate aquarium containing source water from the fish source. They were kept alive until analysis.

4. ANALYSIS FOR HYDROCARBONS

This analysis was conducted using Gas chromatography and mass spectrophotometry (GC/MS). The procedures of analyses used are as described by either of these methods

APHA—American Public Health Association (20th edition, 1999)

ASTM—American Society for Testing and Materials (1999 edition)

USEPA—United State Environmental Protection Agency

Heavy metal concentrations were analyzed on Perkin Elmer Absorption spectrophotometer model UNICAMP 191 for Copper (Cu), Lead (Pb), Mercury (Hg) etc..

Statistical Analysis: analyses of data was carried out using SPSS 17.0 software.

5. RESULT AND DISCUSSION

The result of the present study are as shown in tables below:

Table 1
Total Petroleum Hydrocarbon (TPH) Concentration in Fish Harvested From the Coastal Areas of Upenekang (Incident Zone) and Oron (Control Zone)

Parameter	Species											
	Chrysichthys nigrodigitatus		Ethmalosa finbriata		Illisha africana		Mugil cephalus		P. elongatus		P.typus	
	Incident	Control	Incident	Control	Incident	Control	Incident	Control	Incident	Control	Incident	Control
C_8	<0.01	0.05	<0.01	<0.01	0.05	0.97	<0.01	<0.01	0.08	0.39	<0.01	0.43
C_9	0.01	0.02	< 0.01	<0.01	0.18	0.19	0.02	<0.01	0.25	0.18	<0.11	0.10
C_{10}	<0.01	< 0.01	<0.01	<0.01	0.10	0.17	<0.01	<0.01	0.13	0.15	<0.01	0.08
C_{11}	0.02	< 0.01	<0.01	<0.01	0.10	0.04	<0.01	<0.01	0.30	0.04	<0.01	0.02
C_{12}	0.04	0.04	<0.01	<0.01	0.07	0.47	<0.01	<0.01	0.08	0.57	0.06	0.22
C_{13}	0.09	0.05	<0.01	0.10	0.17	0.14	<0.01	<0.01	0.08	0.15	0.05	0.05

To be continued

Continued

Parameter	Species											
	Chrysichthys nigrodigitatus		**Ethmalosa finbriata**		**Illisha africana**		**Mugil cephalus**		**P. elongatus**		**P.typus**	
	Incident	**Control**	**Incident**	**Control**	**Incident**	**Control**	**Incident**	**Control**	**Incident**	**Control**	**Incident**	**Control**
C_{14}	0.11	<0.01	0.03	0.09	0.15	0.24	0.04	<0.01	0.17	0.16	0.12	0.21
C_{15}	0.27	0.07	0.10	0.09	0.38	0.10	0.08	<0.01	0.10	0.28	0.17	0.05
C_{16}	0.09	0.14	0.17	0.26	0.20	0.48	0.21	<0.01	0.29	0.20	0.29	0.06
C_{17}	0.11	0.21	0.05	0.88	0.33	1.04	0.05	0.17	0.02	0.17	0.04	<0.01
C_{17+}	0.30	0.92	0.04	1.68	0.42	0.17	0.13	0.19	0.13	0.13	0.17	<0.02
C_{18}	0.07	0.10	0.56	0.98	0.38	0.50	0.23	0.14	0.18	0.36	0.24	0.05
C_{18+}	0.03	0.37	0.32	1.39	0.78	0.18	0.29	0.17	0.21	0.24	0.37	0.11
C_{19}	0.11	0.07	0.88	1.19	0.50	0.43	0.80	0.56	0.26	0.05	0.65	0.17
C_{20}	0.56	0.14	0.72	7.85	0.46	0.53	0.16	0.54	0.70	0.49	0.22	1.98
C_{21}	0.29	0.12	1.10	0.94	0.86	0.83	0.21	0.82	0.56	0.09	0.34	0.10
C_{22}	0.27	0.14	0.76	0.69	0.35	0.50	0.19	0.72	0.08	0.37	0.34	0.09
C_{23}	0.14	0.37	2.20	0.48	0.28	2.29	0.05	0.95	0.31	0.28	0.71	0.10
C_{24}	0.32	0.34	1.18	0.34	0.74	0.76	0.70	1.61	0.37	0.10	0.55	0.10
C_{25}	0.52	0.33	4.51	0.37	0.74	4.38	0.55	1.53	0.73	1.03	0.22	0.83
C_{26}	0.53	0.61	2.00	0.63	0.68	0.54	0.39	1.48	0.38	0.78	0.47	0.07
$C2_{7}$	0.57	0.55	1.12	0.11	0.14	0.89	0.37	1.42	0.65	0.34	0.40	0.11
C_{28}	0.10	3.43	0.31	0.14	0.26	0.07	0.64	1.49	0.41	0.17	0.29	0.06
C_{29}	0.11	0.89	0.18	1.78	0.06	0.21	0.65	0.98	0.43	0.21	0.26	0.06
C_{30}	0.11	0.23	0.26	1.05	0.04	1.13	0.36	1.18	0.21	0.39	0.74	0.31
C_{31}	0.39	0.31	0.08	0.20	0.11	0.20	0.46	1.07	0.50	1.27	0.17	1.01
C_{32}	<0.01	0.12	0.42	0.36	0.44	0.56	0.30	0.22	<0.01	0.29	0.48	0.28
C_{33}	<0.01	<0.01	0.11	<0.01	<0.01	<0.01	0.74	<0.01	<0.01	<0.01	<0.01	<0.01
C_{34}	<0.01	<0.01	1.52	<0.01	<0.01	<0.01	0.60	<0.01	2.54	<0.01	<0.01	<0.01
C_{35}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.81	<0.01	<0.01	<0.01	<0.01	<0.01
C_{36}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
C_{37}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
C_{38}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
C_{39}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
C_{40}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total	**5.27**	**9.73**	**18.78**	**21.73**	**9.05**	**18.09**	**9.13**	**15.41**	**10.23**	**8.96**	**7.47**	**6.76**

From the table, it is shown that the mean concentration of total petroleum hydrocarbons (TPH) in the flesh of the various species of fish sampled from the study area ranged from 5.27 mg/kg in chrisichthys nigrodigitatus to 21.73 mg/kg in Ethmalosa finbriata. These values were all below the GESAMP recommended upper limit (25 mg/kg) allowed for detection in seafood.

Therefore with regard to bioaccumulation of hydrocarbon in near-shore fish flesh, oil pollution has no effect. However, this may be attributed to rapid oil spill clean up responds by agencies concerned, self- cleansing effect due to wave action of the water, as well as the time lapse after the spill, and mode of feeding of the species involved.

Table 2
Heavy Metal Bioaccumulation in Fish Tissues From Incident and Control Zones

Species	Zone	Parameters										
		Total iron	Lead	Copper	Cadmium	Total Chromium	Cobalt	Nickel	Mercury	Zinc	Vanadium	MEAN
Pseudotolithus typus	Control zone	65.2	0.20	2.95	0.02	0.10	0.10	0.10	0.002	32.0	0.20	10.09
	Incident zone	96.5	0.20	1.59	0.02	0.10	0.10	0.10	0.002	29.1	0.20	12.79
P. elongatus	Control zone	45.2	0.20	1.79	0.02	0.10	0.10	0.10	0.002	42.5	0.20	7.02
	Incident zone	62.1	0.20	1.70	0.02	0.10	0.10	0.10	0.002	45.9	0.20	11.04
Ethmalosa finbriata	Control zone	80.4	0.20	2.51	0.99	12.5	0.10	13.3	0.002	35.1	0.20	14.53
	Incident zone	75.7	0.20	1.79	0.02	0.10	0.10	0.10	0.002	25.6	0.20	10.35
Illisha africana	Control zone	280	0.20	3.59	0.98	11.1	0.10	13.0	0.002	50.3	0.20	35.95
	Incident zone	74.2	0.20	2.87	0.02	0.10	0.10	0.10	0.002	107	0.20	18.50
Chrysichthys nigrodigitates	Control zone	127	0.20	3.67	1.18	12.7	0.10	8.87	0.002	48.8	0.20	22.06
	Incident zone	436	0.20	1.72	0.02	0.10	0.10	0.10	0.002	66.7	0.20	50.51
Macrobrachi um spp	Control zone	83.9	0.20	2.76	0.02	0.10	0.10	0.10	0.002	37.1	0.20	12.45
	Incident zone	72.8	0.20	2.17	0.02	0.10	0.10	0.10	0.002	93.3	0.20	16.90
Selene dorsalis	Control zone	354	0.20	1.91	0.02	0.10	0.10	0.10	0.002	30.8	0.20	38.74
	Incident zone	49.4	0.20	0.05	0.02	0.10	0.10	0.10	0.002	37.7	0.20	8.79
Alectis alexandrinus	Control zone	344	0.20	1.96	0.02	0.10	0.10	0.10	0.002	30.0	0.20	37.67
	Incident zone	435	0.20	3.19	0.02	0.10	0.10	0.10	0.002	41.6	0.20	48.05
Mugil cephalus (grey mullet)	Control zone	113	8.54	3.27	1.18	13.6	0.10	11.8	0.002	95.4	0.20	24.71
	Incident zone	111	8.04	2.18	0.64	12.2	0.10	2.28	0.002	42.2	0.20	17.88

The concentration of heavy metal in fish tissues harvested from coastal waters of incident and control zones varied remarkably. For instance:

Total Iron (Fe): In the incident zone, the total iron, Fe, ranged between 49.4 mg/kg in Selene dorsalis and 435 mg/kg in Alectis alexandrinus. These high levels may be attributed to its abundance in the earth crust. The levels in the control zone ranged from 45.2 mg/kg in Pentanemus quinquarius to 344 mg/kg in Alectis alexandrinus. These values are considerably higher than reference values of 11.20-12.6 mg/kg reported for fin-fishes in Egypt (Saad, 1987) and 5.4 mg/kg reported for fin-fishes in Ghana.

Lead (Pd): From table 1.1, it is shown that concentrations of Pb were relatively low in many fish species ranging from 0.2 mg/kg in Pseudotolithus typus and others in both incident and control zones to 8.54 mg/kg in Mugil cephalus. Higher levels are observed in some species when compared to permissible Pb concentration standards of between 1.6 and 3.0 in fishes (WHO 1993, Table 1.2).

Copper (Cu): Copper ranged from 0.0 5 mg/kg in Selene dorsalis (control zone) to 3.59 mg/kg in Illisha africana (control zone). The concentration of Cu in some fishes from both incident and control zones were higher than the reference value of 2.0 mg/kg WHO standard.

Cadmium (Cd): Levels of Cd ranged from 0.02 mg/kg is most species to 1.18 mg/kg in Mugil cephalus and Caranx hippos both from control zones. However, the WHO reference standard is 2. 0 mg/kg.

Chromium (Cr): Total chromium levels in fish tissues were generally low (0.10 mg/kg) in the incident and control zones exception of Mugil cephalus (13.6 mg/kg) in control zone. Reference standard for Cr are not available.

Cabalt (Co): Cobalt concentration was low (0.10 mg/kg in all the species sampled. Though no reference standard are available, the present concentration did not indicate any Co-contamination.

Nickel (Ni): Generally, the concentration of Ni in the fish tissues were low (0.10 mg/kg) except for Caranx hippos (8.87 mg/kg) in control zone and Mugil cephalus (11.8 mg/kg) and 2.68 mg/kg) in control and incident zone respectively). No reference standard for Ni concentration in fish tissues is available.

Mercury (Hg): Of all the trace metals, Hg has the lowest concentration of 0.002 mg/kg recorded in all the fish samples from the incident and control zones. These levels were lower than the reference standard value of 0.5mg/kg for fin-fish (WHO limits).

Zinc (Zn): Zn concentrations in coastal waters of both incident and control zones vary from 29.1 mg/kg in Pseudotolithus typus to 107 mg/kg in Illisha Africana. The concentration of Zn in most species was considerably lower than WHO reference standards of 150 mg/kg (WHO, 1989).

Vanadium (V): The concentrations of vanadium in the fish samples were low (0.20 mg/kg) and did not indicate any contamination. No reference standards are available for comparison.

The high concentration of Fe and Zn in particular in fish tissues from both incident and control zones of Upenekang and Oron respectively, may be due to input from domestic and industrial effluents and subsequent bioaccumulation in fish tissues. Also, the high content of Fe could be due to ingestion through food sediment because of its abundance in the earth crust.

The concentrations of Pb could be attributed to petroleum related activities within the coastline which also results in the discharge of spent oils, diesel, petrol from workshops and motorized craft.

CONCLUSION

Levels of hydrocarbons and heavy metals in the fishes from the study areas did not result in any obvious physiological impairment. Studies carried out by Miesner (2002) have shown that elevated levels of total petroleum hydrocarbon (TPH) up to 48,700 mg/kg do not cause any physiological impairment and that all fish species examined were in good health condition.

Despite the low levels of hydrocarbons and trace metals under study, there is need to control indiscriminate discharges of industrial and domestic waste into coastal waters.

Spill responders, public health officials and seafood managers should be proactive in their response to spill incidents. Good management practices should be adopted in the processing and management of seafoods resources.

REFERENCES

Akpabio, I. A. (2003). *Social Impact assessment of exxon-mobil.* EAP/AOR in Akwa Ibom State" Submitted to PEL P/Harcourt, River State.

Alo, B. I. (2008). *Short term environmental evaluation of the Feb 29, 2008 Idoho-QIT Pipeline Oil Spill*. Technical Report submitted to Mobil Producing Nigeria.

Bubb, J. M., & Lester, J. N. (1991). The impact of heavy metals on lowland rivers and applications from man and environmental. *The Science of Total Environment, 100,* 207-233.

DeZuane, J. (1985). *Difco manual of dehydrated culture media and reagents for microbiology laboratory* (p.1155). Difco Laboratory, Michigani, U.S.A.

Edet, A. E., & Offiong, O. E. (2002). *Evaluation of water quality pollution indices for heavy metal contamination monitoring*. A Study Case from Akpabiouyo Odukpani Area, Lower Cross River Basin (Southeastern Nigeria).

EGASPIN. (2002). *Environment guidelines and standards for the petroleum industry in Nigeria* (p.279).

Federal Ministry of Environment (FMENV). (1991). *National guidelines for water quality in Nigeria*.

FEPA. (1991). *Guidelines and standards for environmental pollution control in Nigeria* (p.238).

Froehner, S., M., Maceno, E., Cardso, Da. L., Souza, D. B., & Machado, K. S. (2010). Distribution of polycyclic aromatic hydrocarbons in marine sediments and their potential toxic effects. *Environmental Monitoring and Assessment,* 168(1-4), 205-213.

Hem, J. D. (1998). S*tudy and interpretation of the chemical characteristic of natural water* (pp.2254-263). USGS Water Supply Paper.

Jones, J. G., & Edington, M. A. (1968). *Journal of General Microbiology, 57,* 381-284.

Mallins, D. C. (1977). Oil pollution and the environmental. *Bulletin of Science of Association of Nigeria, 3.*

Marcus, O., & Ikusemiju, K. (1984). Some aspects of the reproductive biology of the clupeid, IIisha Africana (Bloch) off the Lagos coast Nigeria. *J. Fish Biol., 25,* 679-689.

Miesner, J. (2002). *Contaminant residue analysis of fish tissues from marias des cygens.* National Wildlife Refuge-Kansas. United States Fish and Wildlife Service. Region 6. Contaminant Report Number R6/801M/1998.

Mobil Producing Nigeria Unlimited (MPNU). (2010). *February 28, 2008 Idoho – QIT Pipeline Oil Spill PIA* (p.235). Final Report.

Nouri, J., Mahvi, A. H., Babaei, A. A., Jahed, G. R., & Ahmadpour, E. (2006). Investigation of heavy metals in groundwater. *Pakistan Journal of Biological Science,* (3), 377-384.

Ntekim, E. E. U., Ekwere, S. J., & Ukpong, E. E. (1993). Heavy metal distribution in sediments from Calabar River, Southeastern Nigeria. *Environmental Geology, 21,* 237-241

Offiong, O. E., & Edet, A. E. (1998). Water quality assessment in Akpabuyo, Cross Rivers basin, southeastern Nigeria. *Environmental Geology, 34*(2/3), 167-174.

Ogbeibu, A. E. (2005). *Biostatistics – Apractical approach to reach and data handling* (p.264). Mindex Publishing Company Ltd. Benin City, Nigeria.

Osuji, L. C., & Onojake, C. M. (2004). Trace heavy metals associated with crude oil: A case study of Ebocha-8 oil-spill-polluted site in Niger Delta, Nigeria. *Chem Biodivers, 1*(11), 1708-15.

Pais, I., & Jones, Jr. J. B. (1977). *The handbook of trace elements* (p.223). St. Lucie Press Boca Ration, Florida.

Spitzer, E. (2001). *Oil spills: Big problems from small leaks*. State of New York Office of the Attorney General Reports.

Valdes, J., Roman, D., Rivera, L., Avila, J., & Cortes, P. (2011). Metal contents in coastal waters of san Jorge Bay, Antofagasta, northern Chile: A baseline for establishing seawater quality guidelines. *Environmental Monitoring Assessment, 183,* 231-242.

World Health Organization. (1993). *Guidelines for drinking water quality* (2nd ed.). Health Criteria and Other Supporting Information. Geneva.

XXXX (XXXX). Akwa, Ibom State Ministry of Finance and Economic Viability of Early et Season Trawler Fishery in Southeastern Nigeria. *Journal of Sustainable Agriculture and the Environment, 2*(2), 226-232.