Organochlorines and organophosphours pesticides,petroluem hydrocarbons,polychlorinated biphenyls and trace metal monitoring of nile river in egypt

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Egypt is a typical third world country as well as being mainly an agriculturaleconomy. It has relied heavily on pesticides to fight pests harmful, mainly, to cotton,maize, corn, sugarcane and rice as well as many different varieties of vegetable and fruitcrops.It is well recognized that the industrial activities over a long period of time haveenhanced the levels of pollutants in the environment. As a result of the modernagricultural practices, River Nile receives municipal, industrial and agricultural wastesalong its course.In Egypt, the continuing discharge of many industrial wastes as well asagrochemical in water streams might increase the level of pesticides, PCBs, petroleumhydrocarbon and heavy metals in River Nile and subsequently in surface and groundwater. In Egypt there are no regular monitoring programmes concerning theidentification and determination of different pollutants in the environment, althoughEgypt is the largest pesticide market in Arabian countries and the fourth largest importerof pesticides among developing countries.Scope and Objective of Study:The objectives of this study are to evaluate the levels of various chemicalpollutants such as highly toxic heavy metals, organochlorine and organophosphoruspesticides, polychlorinated biphenyls, polycyclic aromatic hydrocarbons and aliphatichydrocarbons in aquatic environment (sediment, water and fish) at El Menofiyagovernorate, Egypt. Samples were taken from El-Sarsawia, El-Bagoria, Bahr Shebincanals, in addition to three drainage canal sites El-Embaby, El-Menofi and Miet-Rabihadrain.The obtained results could summarize in the following points:1. Pesticide residuesA. Organochlorine pesticidesA.1. Organochlorine pesticide residues in water· The highest mean amounts of ß-HCH, heptachlor epoxide and endrin were1.668, 2.098 and 4.66 ng l-1, respectively in water samples from El-SarsawiacanalThe highest average amounts of aldrin and endosulfan were 2.149 and 5.746 ng l-1, respectively, which were found in El-Embaby drain.· The highest average amount of γ-HCH (1.815 ng l-1), heptachlor (1.232 ng l-1),dieldrin (1.199 ng l-1) and γ-chlordane (1.569 ng l-1) were found in water sampletaken from El-Menofi drain, El-Embaby drain, Bahr Shebin canal and MietRabiha drain, respectively.· The highest average amount of DDT and its metabolites p,p’-DDE (15.106 ng l-1), p,p’-DDD (8.150 ng l-1) were found in El-Menofi drain and p,p’-DDT (0.894ng l-1) was found in Miet Rabiha drain,

respectively, in water sample.· The data showed that the concentration of pesticides residue in the analysedsamples followed the following descending order p,p’-DDE > p,p’-DDD >endosulfan > endrin > heptachlor epoxide > aldrin > γ-HCH > ß-HCH > γ-chlordane > heptachlor > p,p’-DDT.A.2. Organochlorine pesticide residues in sediment· The highest average concentration of α-HCH (21.234 ng g-1) was found insediment sample of El-Bagoria canal. The highest average residue level of ß-HCH -(7.815 ng g-1) was found in El-Embaby drain. In addition, the highestamount of γ HCH (57.471 ng g-1 in El Menofi drain), δ-HCH (27.08 ng g-1 inMiet-Rabiha drain), heptachlor (16.56 ng g-1 in El-Menofi drain), heptachlorepoxide (66.010 ng g-1 in Miet-Rabiha drain) and endosulfan (32.942 ng g-1 inEl-Menofi drain) were detected in sediment samples.· DDT and its metabolites p,p’-DDD, p,p’-DDE, p,p’-DDT (mean concentrations29.79, 32.506 and 11.067 ng g-1, respectively, in El-Menofi drain) were detect athigh levels in sediment sample. Metabolic transformation of DDT underoxidative conditions leads to p,p’-DDE, whereas under anaerobic conditions p,p’-DDD is formed.· The data showed that sediment samples had higher concentrations of pesticideresidues than water and fish samples.A.3. Organochlorine pesticide residues in fish· The p,p’-DDE residues were the most abundant residues in fish, and weredetected in most samples at relatively higher concentration compared to otherresiduesThe highest average concentration of p,p’-DDE was found in fish samples fromEl-Bagoria canal (5.957 ng g-1).· α-HCH residues were only found in fish samples from El-Sarsawia canal and El-Embaby drain at the average concentration of 0.837 and 2.404 ng g-1,respectively.· The highest average concentration of heptachlor (2.88 ng g-1) and heptachlorepoxide (4.541 ng g-1) were found in fish samples collected from Miet Rabihadrain. While the highest average concentration of aldrin (1.122 ng g-1), dieldrin(2.123 ng g-1) and γ-chlordane (1.650 ng g-1) were found in fish samplescollected from El-Bagoria canal. In addition, the highest mean concentration ofendrin (1.75 ng g-1) and endosulfan (3.836 ng g-1) were found in fish samplescollected from El-Embaby drain.· The data showed that the mean values of DDT, dieldrin and γ-HCH found in thisstudy were therefore below the Philippines maximum permissible limits set forsurface water and below the limit set by EU for drinking water.· The residue levels of organochlorine pesticides in all analyzed fish in thisinvestigation are considerably lower than the tolerance levels set by the NationalAcademy of Sciences and National Academy of Engineering (NAS-NAE, 1972)and WHO maximum acceptable limits (WHO, 1996).B. Organophosphorus pesticidesB.1. Organophosphorus pesticide residues in water· In all water sample analyzed only chlorpyrifos-methyl and prothiphos weredetected in only one water samples collected from El-Embaby drain.B.2. Organophosphorus pesticide residues in sediment· Compound identified included profenophos, prothiphos, chlorpyrifos anddiazinon.· Profenophos were detected at the level of 63.37 ng g-1 (dry weight basis) in onesediment sample collected from El-Menofi drain and at the level of 13.43 ng g-1(dry weight basis) in one sediment sample collected from Miet-Rabiha drain.· Chlorpyrifos, prothiphos and diazinon were found only in one sediment samplescollected from Bahr Shebin canal at the levels of 33.79, 36.84 and 7.80 ng g-1(dry weight basis), respectivel.3. Organophosphorus pesticide residues in fish· Chloropyrifos, cadusafos, diazinon, prothiphos and malathion were detected infish

tissues samples.· Chlorpyrifos was detected in samples collected from El-Sarsawia canal, and El-Embaby, El-Menofi and Miet-Rabiha drain.· The highest amount of chlorpyrifos (9.38 ng g-1 fresh weight basis) was detectedin El-Embaby drain.· Prothiphos were found in tissues collected from El-Sarsawia canal and Miet-Rabiha drain at mean concentration of 4.91 and 6.55 ng g-1, respectively.· Diazinon was only found in one fish sample that collected from El-Menofi drainat the level of 9.23 ng g-1.· Malathion was detected in samples from El-Embaby and El-Menofi drain ataverage concentration of 8.31 and 1.47 ng g-1, respectively.3. Polychlorinated Biphenyls residuesA. Polychlorinated Biphenyls residues in water· The data showed that most of PCB congeners were detected in water samples,except for PCB congeners no 192 and 194.· The highest concentration of total PCBs in water samples was 67.89 ng L-1,which was found in Bahr Shebin canal.· Among the congeners, PCB no 44 and 152 represented the most abundantcongeners in water samples.· The congener patterns are dominated by tetra-, penta- and hexachlorobiphenyl,including the highly persistent and hyDROPhobic 152.· The levels of PCBs in water samples are considered to be high and exceed thepermissible levels for drinking water recommended by EPA.B. Polychlorinated Biphenyls residues in sediment· The data showed that, most of PCB congeners were detected in sedimentsamples.· The highest concentration of total PCBs in sediment samples was 108.118 ng g-1dry weight basis, which was found in El-Embaby drain.· Among the congeners, PCB no 44 and 152 represented the most abundantcongeners in sediment samples.– – ––SUMMARY145· The data showed that the residue levels of PCBs in sediment followed in theorder, El-Embaby drain > Meit-Rabiha drain > El-Sarsawia canal > Bahr Shebincanal > El-Bagoria canal > El-Menofi drain.C. Polychlorinated Biphenyls residues in fish· The data showed that the concentration levels of total PCB congeners in fishsamples ranged from 11.036 to 69.367 ng g-1 fresh weight at Bahr Shebin canaland El-Bagoria canal, respectively.· Also, the result illustrated that the most abundant PCBs congeners in fishsamples was PCB congener no 70 which represented 62.5, 87.5, 37.5, 50, 50 and25% in sample collected from El-Sarsawia canal, El-Bagoria canal, Bahr Shebincanal, El-Embaby drain, El-Menofi drain and Miet Rabiha drain, respectively.· The residue levels of PCBs in all analyzed fish in this investigation areconsiderably lower than the tolerance levels set by National Academy ofSciences and National Academy of Engineering (NAS-NAE, 1972), FDA, andEgyptian standard.4. Petroleum Hydrocarbon4.1. Polycyclic aromatic hydrocarbonA. Polycyclic aromatic hydrocarbon in water· The total concentrations of 13 PAH in -water samples ranged from 226.9 ng L-1 atEl-Sarsawia canal to 1492.2 ng L-1 at El Menofi drain.· The highest concentration of total PAHs was observed at El-Menofi drain whichobviously related to combustion of fossil material followed by atmosphericfallout, sewage outfalls and industrial and agricultural waste water discharge,which were observed during the sampling.· Naphthalene was found only in water samples collected from El-Sarsawia canaland El-Embaby drain with an average concentration of 17.2 and 22.7 ng/L,respectively.· The highest mean levels of acenaphthene (96.6 ng/L), acenaphthylene (117.4ng/L), fluorene (100.15 ng/L), anthracene (69.66 ng/L) and pyrene (71.3 ng/L)were recorded in El-Menofi drain.

While the highest average concentrations ofphenanthrene (100 ng/L), fluoranthene (50.86 ng/L), chrysene (27.5 ng/L),– – ––SUMMARY146dibenzo[a,h]anthracene (15.6 ng/L) and benzo[g,h,i]perylene (11.04 ng/L) wererecorded in water samples collected from El-Embaby drain.· Benzo[a]pyrene was detected in most samples from all location sites and itsmean concentration ranged from 2.88 to 16.96 ng L-1. The highest concentrationwas found in El-Embaby drain. Meanwhile, the detected concentration wasbelow the permissible limits (700 ng L-1) according to Egyptian guidelines.· The highest mean concentration of benzo[b]fluoranthene (29.63 ng/L) was foundin water samples collected from Bahr Shebin canal.· In terms of individual PAH composition in surface water, the sample weredominated by three-ring PAHs.· In general the residue levels of PAHs in water samples collected from 6 sitestend to be in the order: El-Menofi drain > El-Embaby drain > Miet-Rabiha drain> Bahr Shebin canal > El-Bagoria canal > El-Sarsawia canal.B. Polycyclic aromatic hydrocarbon in sediment· The total concentration of 13 PAH in sediment ranged from 1197.79 ng g-1 dryweight at Bahr Shebin canal to 2701.55 ng g-1 dry weight at El-Embaby drain.· The highest mean concentrations of acenaphthene (35.18 ng g-1), acenaphthylene(32.18 ng g-1), phenanthrene (139.5 ng g-1), anthracene (127.5 ng g-1), pyrene (89ng g-1), chrysene (87.60 ng g-1) and benzo[b]fluoranthene (78.76 ng g-1) werepresent in sediment samples collected from El-Embaby drain.· The highest average concentrations of naphthalene (16 ng g-1), fluorene (66 ng g-1) and dibenzo[a,b]anthracene (229 ng g-1) were found in sediment samplescollected from El-Menofi drain.· The highest mean concentrations of fluoranthene (131.6 ng g-1) andbenzo[a]pyrene (95.80 ng g-1) were recorded in sediment samples collected fromEl-Sarsawia canal.· Benzo[g,h,i]perylene was -recorded the highest average level (119.6 ng g-1) insediment samples of Miet Rabiha drain.C. Polycyclic aromatic hydrocarbon in fish· The total concentrations of PAH in fish samples in the same location weredetermined at 371.68 ng g-1wet weight in El-Sarsawia canal to 2019.25 ng g-1 wetweight in Bahr Shebin canal with differences between location site.– – ––SUMMARY147· The concentration of PAHs detected in fish samples were higher than thosedetected in water samples from the same sampling location site.· The highest concentration of total PAHs was observed at Bahr Shebin canalwhich is surrounded by densely populated and urban area with an intenseindustrial and agricultural activity.· The highest mean concentrations of acenaphthene (10.07 ng g-1), anthracene(23.51 ng g-1), fluoranthene (173.2 ng g-1), pyrene (114.18 ng g-1), chrysene(19.57 ng g-1) and benzo[a]pyrene (16.60 ng g-1) were present in fish samplescollected from Bahr Shebin canal. While the highest average concentrations ofnaphthalene (7.35 ng g-1), acenaphthylene (31.58 ng g-1) and phenanthrene (49.50ng g-1) were found in fish samples collected from El-Menofi drain.· The highest mean concentrations of benzo[b]fluoranthene (32.88 ng g-1) anddibenzo[a,b]anthracene (72.27 ng g-1) were recorded in fish samples collectedfrom Miet-Rabiha drain.· The highest mean concentration of fluorene (8.13 ng g-1) was recorded in El-Sarsawia canal.· Benzo[g,h,i]perylene was only found in one fish sample collected from BahrShebin canal at concentration of 9.10 ng g-1 wet weight.· The data showed that the residue

levels of PAHs in fish samples collected from 6sites tend to be in the order: Bahr Shebin canal > El-Menofi drain > El-Embabydrain > Miet-Rabiha drain > El-Bagoria canal > El-Sarsawia canal.· Similar to sediments PAH in the fish were mostly dominated by the highmolecular weight PAHs (4-6-rings).· The data showed that in water, sediment and fish samples the simultaneousoccurrence of isomer ratios 1, in all studied location except in fish sample collected phenanthrene / anthracene from El-Bagoriacanal and in water sample collected from El-Menofi drain, which indicates thatthe polycyclic aromatic hydrocarbon are of pyrolytic (combustion) origin at moststations.– – ––SUMMARY1484.2. Aliphatic hydrocarbonA. Aliphatic hydrocarbon in water· The total concentration of the fourteen aliphatic hydrocarbons in water samplesranged from 804.9 ng/L at El-Bagoria canal to 1741.81 ng/L at Meit-Rabihadrain.· The highest levels of aliphatic hydrocarbons were found at Miet-Rabiha draindue to direct spillage of industrial, agricultural and domestic wastes into thedrain.B. Aliphatic hydrocarbon in sediment· The total concentration of 14 aliphatic hydrocarbons in sediment samples rangedfrom 1227.9 ng g-1 dry weight at El-Sarsawia canal to 2860.70 ng g-1 dry weightat El-Embaby drain.· The residue levels of aliphatic hydrocarbon also varied between differentlocation sites with highest concentration values in samples collected from thedrainage canals, while the drainage canals have been exposed to much industrialand sewage pollution.C. Aliphatic hydrocarbon in fish· The total concentrations of aliphatic hydrocarbons in fish samples in the samelocation were ranged from 1051.20 ng g-1wet weight in El-Bagoria canal to1975.72 ng g-1 wet weight in Miet-Rabiha drain with differences betweenlocation sites.· The highest concentration of total aliphatic hydrocarbon was observed at Miet-Rabiha drain which obviously related to sewage outfalls and industrial andagricultural waste water discharge, which were observed during the sampling.5. Heavy metalA. Heavy metal in water.· According to the data, iron has the highest concentration, followed by lead, zinc,cadmium and copper.· The mean concentration of iron ranged from 52.132µg/L in water samplescollected from Bahr Shebin canal to 152.26 µg/L in water samples collected fromEl-Bagoria canal.· The mean lead concentration ranged -from 8.678 to 21.948 µg/L, in watersamples collected from El-Sarsawia canal and El Embaby drain, respectively.– – ––SUMMARY149· The copper and cadmium mean concentrations ranged from 0.67 and 0.500 to4.908 and 5.650 µg/L, respectively, in water samples collected from Bahr-Shebincanal and El-Embaby drain, respectively.· The highest mean concentration of zinc (7.086 µg/L) was found in water samplescollected from El-Embaby drain, while the lowest mean concentration (2.678µg/L) was found in water samples collected from El-Bagoria canal.· The water samples from all location sites are polluted by lead according to EPA.Iron and copper values are within the allowable limits according to WHO,(1993), US-EPA, (2001) and Egyptian chemical standard, (1994).· Water samples collected from El-Embaby drain is considered as polluted waterby cadmium according to WHO and EU.B. Heavy metal in sediment.· Iron was the dominant metal measured in the sediment samples from the entiresampling location site and cadmium presented the lowest levels.· The mean concentration of iron ranged from 4551 to 4955 µg/g,

in sedimentsamples collected from El-Embaby and El-Menofi drain, respectively.· The average concentration of lead ranged from 17.12 to 46.42 μg/g in sedimentcollected from El-Bagoria canal and Miet Rabiha drain, respectively.· Copper mean concentration varied from 14.48 to 36.04 μg/g in sediment samplescollected from El-Bagoria canal to El-Menofi drain, respectively, while the meanconcentration of cadmium ranged from 0.830 to 1.630 μg/g in sediment samplescollected from El-Bagoria canal and El-Sarsawia canal, respectively.· In addition, the average concentration of zinc in sediment samples collected fromall -the sampling location varied from 2.092 to 19.31 μg/g at Bahr Shebin canaland El Embaby drain, respectively.· In the present investigation, the high concentrations of metals were found insediment samples collected from the drainage canal, and is -referred to somewaste effluents discharge from human activities, agricultural run off and from theatmospheric input.· The mean concentrations of Cd, Cu, Pb and Zn in sediment samples in this studyare less than the probable effect concentrations recorded by MacDonald et al.,2000– – ––SUMMARY150C. Heavy metal in fish.· Iron concentration was highest in fish samples analyzed in this study. Meanmetal content in the fish samples in all location sites followed the profile: iron >zinc > lead > copper > cadmium.· The highest mean concentration of lead (1.864 μg/g), copper (1.495 μg/g) andcadmium (1.840 μg/g) were found in fish samples collected from El-Embabydrain. While the highest mean concentration of iron -(108.26 μg/g) and zinc(24.35 μg/g) were present in fish samples collected from Miet Rabiha drain.· Also, the highest concentrations of the metals were found in fish samples thatcollected from the drainage canal.· Lead and cadmium were found in higher concentration than those recommendedfor fish; other heavy metals were almost found at the concentration to thoserecommended by FAO.