ACUTE TOXICITY TEST OF THREE OILS WATER – SOLUBLE FRACTIONS (WSF) TO SEVERAL ORGANISMS HABITED IN SHATT AL – ARAB RIVER [+]

اختبار السمية الحادة للاجزاء الذائبة بالماء من ثلاثة نفوط اتجاه عدة انواع من الكائنات المتواجدة في نهر شط العرب

Wisam A. Farid [*] **Wasen A. Farid** * **Luma H. Ali** [**]

Abstract:

The water – soluble fractions (WSF) of gas oil (refined product) , Gar (heavy) and Nahran – Umar (light) crude oils were tested for their acute toxicity . Four animals species (*Lymnaea auricularia* , *Thiodoxus jordani* , *Corbicula fluminalis* and *Corbicula fluminea*) from Shatt Al – Arab river were exposed to series concentrations of oils water - soluble fractions . The tests were carried out for 96 hours , into renewal toxicity system , under the laboratory conditions . In the terms of median lethal concentration (LC_{50}) , the order of test sensitivity was *L. auricularia* , *T. jordani* , *C . fluminalis* and *C . fluminea* . The water - soluble fractions of gas oil were the most toxic to test animals than water - soluble fractions of crude oils . The water - soluble fractions of light crude oil were more toxic than those of the heave one .

المستخلص:

تم اختبار السمية الحادة للأجزاء الذائبة بالماء من نفط الغاز (ناتج تكرير) ونفط خام جار (نوع الثقيل) ونفط خام نهران عمر (نوع الخفيف) . إذ عرضت أربعة كائنات من نهر شط العرب وهي *Lymnaea auricularia* و *Theodoxus jordani* و *Corbicula fluminalis* و *Corbicula fluminea* إلى تراكيز مختلفة من للأجزاء الذائبة بالماء من النفوط لمدة 69 ساعة في نظام متجدد للاختبار تحت الظروف المختبرية . بمصطلحات متوسط التركيز المميت كان ترتيب كائنات الاختبار تبعا لحساسيتها اتجاه للأجزاء الذائبة بالماء من النفوط كما يلي : *T. jordani* < *L. auricularia* < *C. fluminea* < *C. fluminalis* . كانت للأجزاء الذائبة بالماء من نفط الغاز اكثر سمية اتجاه جميع كائنات الاختبار من للأجزاء الذائبة بالماء من النفوط الخام . كانت للأجزاء الذائبة بالماء من النفط الخام الخفيف اكثر سمية اتجاه كائنات الاختبار من للأجزاء الذائبة بالماء من النفط الخام الثقيل .

Introduction:

Crude oils and their refined products are complex hydrocarbons mixture which interact with various organisms in different ways to produce toxicity to them .

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[*] **Assistant Lecture/ Technical College - Basrah**
[**] **Assistant researcher /Technical College - Basrah**

Aromatic hydrocarbons are potentially toxic components of oils because they are carcinogenic [1] . Many laboratory studies have been conducted with aquatic organisms , both vertebrates and invertebrates , to assess the toxic effects of water – soluble fractions (WSF) rather than specific hydrocarbons [2 , 3] .

In spite of , a fair amounts of hydrocarbons released into Shatt Al – Arab stream , there was a liming information available about the toxicity of these hydrocarbons to aquatic organisms habited the river .

The aim of the present study is to test and compare the acute toxicity of water – soluble fractions of the refined product , gas oil and the crude oils , Gar (heavy) and Nahran – Umar (light) to four animals species found in Shatt Al – Arab river , i.e. *L . auricularia* , *T . jordani* , *C . fluminalis* and *C . fluminea* .

Materials and Methods:

Specimens of the mollusca species *L . auricularia* , *T . jordani* (gastropods) , *C . fluminalis* and *C . fluminea* (bivalves) were collected by hand during the low tide from Shatt Al – Arab river . All samples were taken from Abu – Al – Khassib region Figure (1) . The specimens were kept in aquarium for an acclimation period of one week prior to start of tests , under laboratory temperature of 20 ± 2°C with light / dark cycle (2 : 2) under aeration condition .

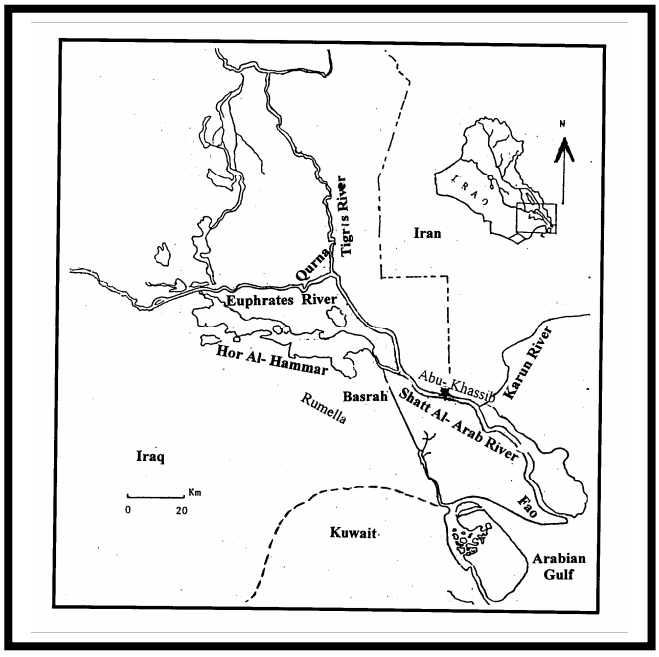

Figure (1) : Map of sampling location .

Crude oil (Gar and Nahran - Umar crude oils) and refined product (gas oil) were supplied by Iraqi South Oil Company which were transferred to laboratory by dark glass bottle closed tightly and kept in a cold and dark place prior to use .

Test solutions were prepared freshly by adding a graded volume of the oil to volumetric flask containing a bout 150 ml of freshwater collected from Shatt Al - Arab river , which was filtered and boiled before use. The resulting mixture was then mixed for about three hours an magnetic stirrer at temperature of 20 ± 2 °C. After stirring , the

volume was brought to 1l . With filtered and boiled river water . The solution was poured into one liter separating funnel and allowed to separate for two hours at temperature of 20 ± 2 °C. Following separation , the lower 950 ml of solution was removed to one liter flask and mixed for 30 minutes , while the unsoluble fraction was discarded [4] . The pH , salinity and dissolved oxygen (DO) of test solutions were about (7.1 - 7.8) , 1.6 ppt and (5.0 - 5.1) mg / l respectively .

Renewal toxicity tests were conducted by exposing the mollusca to different concentrations for definite exposure time , after which the animals were transferred to clean river water , 10 individuals were placed in glass jar , (10 x 7 x 20 cm^3) in size , containing of the test solution . The jar was covered by glass lid to reduce evaporation of hydrocarbons . Mortality was recorded after 2 hours recovery in clean river water . Mortalities in gastropods species were taken as the number of animals still immobile and remaining in the water , in the case of bivalves , mortalities were taken as the number of individuals showing no signs of life and with permanently gaping shells . In all cases , the test solution was changed daily . The test was set up in three replicates together with three control (untreated) . 30 individuals were used for each replicated and for an exposure time of 48 and 96 hours . The test was carried out using concentrations of 2 , 5 , 10 , 20 , 25 , 30 , 40 , and 45 mg of crude oil / l of river water .

To compute the LC_{50} values and their upper and lower 95 % confidence limits , a method which described by UNEP [4] was used .

Results and Discussion:

The percentage mortality and the LC_{50} values and their upper and lower 95 % confidence limits of the species *L . auricularia* , *T . jordani* , *C . fluminalis* and *C . fluminea* exposed to different concentrations of WSF of three oils are presented in Table (1) . It is apparent from toxicity data that the survival of the four species are generally degrease with increasing the WSF concentration of the three oils . It has been shown that the 96 h. values of the four species are varied . The species *L . auricularia* records the lowest 96 h. LC_{50} values of WSF of three oils . These values are 10.0 ml / l , 18.7 ml / l and 11.4 ml / l for gas oil , Gar and Nahran - Umar crude oils respectively . The species *L . auricularia* followed by the species *T . jordani* (14.4 ml / l , 21.6 ml / l and 14.7 ml / l) , *C . fluminalis* (17.4 ml / l , 25.0 ml / l and 19.2 ml / l) and *C . fluminea* (22.2 ml / l , 28.9 ml / l and 24.0 ml / l) respectively comparing with the same oil . This indicates that the species *L . auricularia* is the most sensitive to the WSF of three oils than the species *T . jordani* and *C . fluminalis* . The lowest sensitivity is for the species *C . fluminea* shown in the following arrangement : *L . auricularia* > *T . jordani* > *C . fluminalis* > *C . fluminea*

It is possible that the difference in sensitivity to the WSF of three oils among the test species may due to the difference in the membrane structure of their bodies , their ability on the metabolism , excretion and storage of the toxicants and / or the difference in the transportation of the toxicants into the site of action .

Table (1) : Percentage mortality of the mollusca *L . auricularia* , *T. jordani* , *C . fluminalis* and *C . fluminea* exposed to different concentrations of three oils and LC_{50} values and their upper and lower 95 % confidence limits at 96 hours .

Concentration ml / l	Gas oil				Gar crude oil				Nahran - Umar crude oil			
	A	B	C	D	A	B	C	D	A	B	C	D
2	13.3	10.0	3.3	0	0	0	0	0	3.3	0	0	0
5	30.0	26.6	16.6	10.0	10.0	3.3	0	0	20.0	16.6	6.6	3.3
10	50.0	40.0	36.6	30.0	30.0	23.3	6.6	3.3	46.6	40.0	23.3	6.6
20	73.3	63.3	56.6	40.0	35.3	46.6	20.0	16.6	73.3	66.6	35.3	26.6
25	39.3	76.6	73.3	66.6	70.0	60.0	50.0	36.6	90.0	83.3	76.6	60.6
30	100	96.6	90.0	83.3	80.0	76.6	63.3	56.6	96.6	93.3	90.0	83.3
40	100	100	100	96.6	96.6	40.0	76.6	70.0	100	100	100	93.3
45	1000	100	100	100	100	100	100	100	100	100	100	100
Control	0	0	0	0	0	0	0	0	0	0	0	0
LC_{50}	10.0	14.4	17.4	22.2	18.7	21.6	25.0	28.9	11.4	14.7	19.2	24.0
Upper 95% confidence limit of LC_{50}	25.7	37.0	39.8	45.9	38.8	41.5	37.3	40.0	24.6	30.2	33.9	35.4
Lower 95% confidence limit of LC_{50}	3.8	5.5	7.6	10.7	8.9	11.2	16.7	20.8	5.2	7.1	10.8	17.7

A = *L . auricularia* ; B = *T. jordani* ; C = *C . fluminalis* and D = *C . fluminea*

Several studies conducted on the toxicity of oils on the organisms from Shatt Al – Arab river showed that the organisms were varied in their sensitivity to different oils . Farid [5] studied the short – term toxicity of Basrah regular crud oil to three species of snails (*T . jordani* , *M . nodosa* and *M . tuberculata*) and one species of bivalves (*C . fluminalis*) . He found the following order of sensitivity of the animals : *M . nodosa* > *T . jordani* > *M . tuberculata* > *C . fluminalis* . Al - Aabbawy [6] tested the acute toxicity of three oil products (kerosene , gas oil and lubricating oil) to the snails *T . jordani* and *M . nodosa* , and found that the snail *M . nodosa* was more sensitive to the three oil products than the snail *T . jordani* .

In the present study , the total acute effects of refined oils on the animals are: restrict their normal activities , prevent their adhering ability to test vessels walls , bring narcosis and anesthesia , loss their ability to react to the external cue , rapture their tissues , lead them to leave their shells and finally lead them to die . All the above is due to the chemical toxic effect of the water soluble hydrocarbons on animals , which associate with their lipids and other tissues in a sufficient amount to produce the abnormal activities and die . A similar observation on these toxic acute effects of WSF of oils on many other varieties of aquatic organisms were also reported by [7 , 8 , 5] .

It is clear that the 96 h. LC_{50} values of the test species exposed to the WSF of gas oil are lower than of the 96 h. LC_{50} values of the same species exposed to the WSF of crude oils . On the other hand , the 96 h. LC_{50} values of the species exposed to the WSF of light crude oil are lower than of the 96 h. LC_{50} values of the same species subjected to the WSF of the heavy crude oil . This indicates that the WSF of refined product , gas oil is more toxic to four test species than the WSF of crude oils . The WSF of the light crude oil (Nahran – Umar) is more toxic than the WSF of heavy one (Gar) . Altte [9] reported that the kerosene was more toxic to river crab *Sesarma boulengeri Calman* than crude oil . Othe studies have also shown that the refined oil products were more toxic to aquatic organisms than crude oils [10 , 6] . Linden [11] reported that the light oils are more toxic to *Gammarus oceanicus* than the

heavy oils . Laws [10] has shown that the toxicity of heavy oils to be of physical or mechanical nature and chemical toxicity due to light oils . The light oils are rich in low boiling aromatic hydrocarbons . These are known to be readily soluble and toxic .

We may conclude , that the test animals of present study show variable sensitivity to the WSF of oils . The WSF of gas oil (refined product) was the most toxic to test species than the WSF of crude oils . The WSF of light crude oil (Nahran – Umar) was more toxic to animals than the WSF of the heavy one (Gar) .

Finally , we recommend further studies to test the acute and chronic toxicity of oils , oils products , oil fractions and oil components in the environment of Shatt Al - Arab river . This would help to predict the effects of oil pollution on living organisms and ecology of the river , to determine permissible effluent discharge rates into the aquatic environment of the river and in monitoring levels of oil pollution in stream with respect to water quality standards .

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