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ACUTE TOXICITY OF SOME OIL DISPERSANTS TO MULLET FRY (*LIZA MACROLEPIS*) OF THE ARABIAN GULF

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ABSTRACT

The acute toxicity of Shell LTX, Shell Concentrate, Servo CD 2000 and Exxon OSD 9217 were used to calculate 72 – hr. LC_{50} and toxicity curves to the Mullet Fry (*Liza macrolepis*) under the Arabian Gulf conditions (Temp. $\simeq 20^{\circ}C$ and Salinity $\simeq$ 40 ‰). These dispersants are specified by the manufacturers to be non – ionic and to have less than 3 % of aromatic content. The 72 – hr. LC_{50} were 244, 55, 44 and 27 ppm respectively. These values are different from the manufactureres' information sheets probably because of using different animal species under different environmental conditions to those of the Gulf.

INTRODUCTION

The Arabian Gulf is a semi – enclosed body of water ($24^{\circ} - 30^{\circ}.30$ N and $48^{\circ} - 56^{\circ}$ E), covering an area of 226000 Km^2 with a mean depth of 35 meters, salinity range of 37 – 50 ‰ and temperature range of $15 - 40^{\circ}C$ (Purser, 1973). Being a major oil – production area, it is subject to accidental spills either through oil – fields' activities and / or tanker accidents.

In the absence of agreed – upon guidelines for the use of dispersants among the Gulf states, Qatar General Petroleum Corporation (QGPC) presently stocks several brands for application to slicks in the Qatari waters whether they originated locally or are moved in from offshore by winds and currents. In 1979 – 84, 17800 litres of different dispersants were used in the Qatari waters alone (Anon , 1985).

Observations during various spill accidents – where dipersants have been used – have shown a considerable mortality among marine animals in the intertidal zone (Sivasubramaniam & Ibrahim, 1984). Toxic effects of dispersants depend upon their characteristics, the physicochemical conditions and sensitivity of the animals. This paper is concerened with a specific approach to evaluate acute effects of 4

different types of dispersants to Mullet Fry (*Liza macrolepis*), an important economic fish species in the Gulf, under the mean prevailing environmental conditions of the region.

MATERIALS AND METHODS

L. macrolepis fry were dipnetted from the inshore water of Qatar, sorted for size –from 2 to 3.5 cm in length and their wet weight was found to range from 0.11 to 0.5 g / fry – and were kept in a holding tank in the in – door facilities of Qatar National Museum along with seawater collected from the same area of capture (salinity 40 ‰) as stock. The holding tank, the experimental tanks as well as the stock water were kept well aerated in temperature ranging from 19 – 21 °C using 60 watt automatic heaters. The fish were fed twice daily with fresh mixed food used in the aquarium of Qatar National Museum. 48 hours prior to testing, about 100 healthy fish were transfered to a stock tank with good aeration and no feeding at controlled temperature of 19 – 21 °C.

Five experimental tanks 30 x 30 x 60 cm (including one as control) were filled with 40 liters of the stock water, covered with cyllophane paper and supplied with a vertical stirrer with shielded blades. Four different dispersants, namely Shell LTX, Shell Concentrate, Servo CD 2000 and Exxon OSD 9217 – as stocked by QGPC offshore – were used to conduct 72 – hr. LC_{50} tests. The technical information sheets of these dispersants indicate that their active ingredient is a non – ionic surface active compound with aromatic content of less than 3 %.

Except for the control tank, a one litre water sample was taken from each of the experimental tanks. Designated different volumes of the dispersants – to obtain the required concentrations in the experimental tanks – were added to the water samples, mixed by hand shaking and then returned to its tank. Concentrations from 20 – 360 ppm were chosen to cover the whole rangs of the expected 72 hr – LC_{50} for that species (Ibrahim, Personal Communication). Thirty minutes after adding the dispersant mixture, ten randomly – picked fish from the stock tank were introduced to each of the five experimental tanks, and experimental timing started.

At least six times daily, the test tanks were checked for removal of dead fish, defined by no overt movement and / or no response to gentle prodding. The number and weight of dead fish were then recorded. The test was terminated after

72 hours. The tanks were cleaned and the experiments were repeated in the same way with a fresh batch of fish to duplicate the results. The whole procedure was carried out several times using different concentrations of the dispersants. Any mortality in the control tank $\geqslant$ one fish caused the assigned experiment run to be rejected.

RESULTS AND DISCUSSION

Standard statistical methods described by Bishop (1978), Southwood (1978) and Harris (1977) were applied to the data obtained. The statistics for the four dispersants used are presented in table (1) and figure (1). The regression equations for 72 – hr. LC_{50} for the dispersants Shell LTX, Shell Concentrate, Servo CD 2000 and Exxon OSD 9217 are given by equations 1 to 4 respectively, where θ is the Arcsin transformation of the % killed in drgrees given from the relation:

$\text{Sin } \theta = \sqrt{\frac{\% \text{ killed}}{100}}$ and (x) is log concentration in ppm.

$$\theta = 103\ (x) - 201 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ 1$$

$$\theta = 62\ (x) - 62 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ 2$$

$$\theta = 52\ (x) - 41 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ 3$$

$$\theta = 38\ (x) - 9 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ 4$$

Among the four dispersants used and regardless of the manufacturers' recommendations for use, Exxon OSD 9217 brand seems to be the most toxic with mean 72 – hr. LC_{50} of 27 ppm, while Shell LTX is the least toxic with 72 – hr. LC_{50} of 244 ppm. For Shell Concentrate and Servo CD 2000 brands the 72 – hr. LC_{50} were 55 and 44 ppm respectively.

The Arabian Gulf is characterised by high thermal stratification during summer where the surface water temperature may reach 40 °C. As the first consideration in oil spill is the removal of the slick either physically and / or by dispersion, hence, ill practice in applying the dispersant directly to the slick may result in a surplus amount of free dispersant that may be carried away by winds and currents exerting a threat to slick – free areas and causing mortality among the marine animals. In winter, on the other hand, and because of the well mixed condition of the water in the Gulf, the effect of the free dispersant on marine animals may be minimised through dilution.

CONCLUSION

The 72 – hr. LC_{50} of the dispersants; Shall LTX, Shell Concentrate, Servo CD 2000 and Exxon OSD 9217 to Mullet Fry (*Liza macrolepis*) under the Arabian Gulf conditions are 244, 55, 44 and 27 ppm respectively. These values are very different from manufacturers' technical information sheets which show values of 48 – hr. $LC_{50} \geqslant 1000$ ppm, propably bacause of the use of different species of animals under conditions different from those of the Gulf.

Assuming that the above results are representative of dispersant impact on the Gulf biota and if dispersion is the only soultion to oil slick problem, accurate calculations of the size of the slick, and careful control of the amount of the dispersant to be used is vital. The weather conditions during application as well as good practice in applying the dispersant directly to the slick should be stricktly monitored to minimise the adverse effects of dispersants to marine animals.

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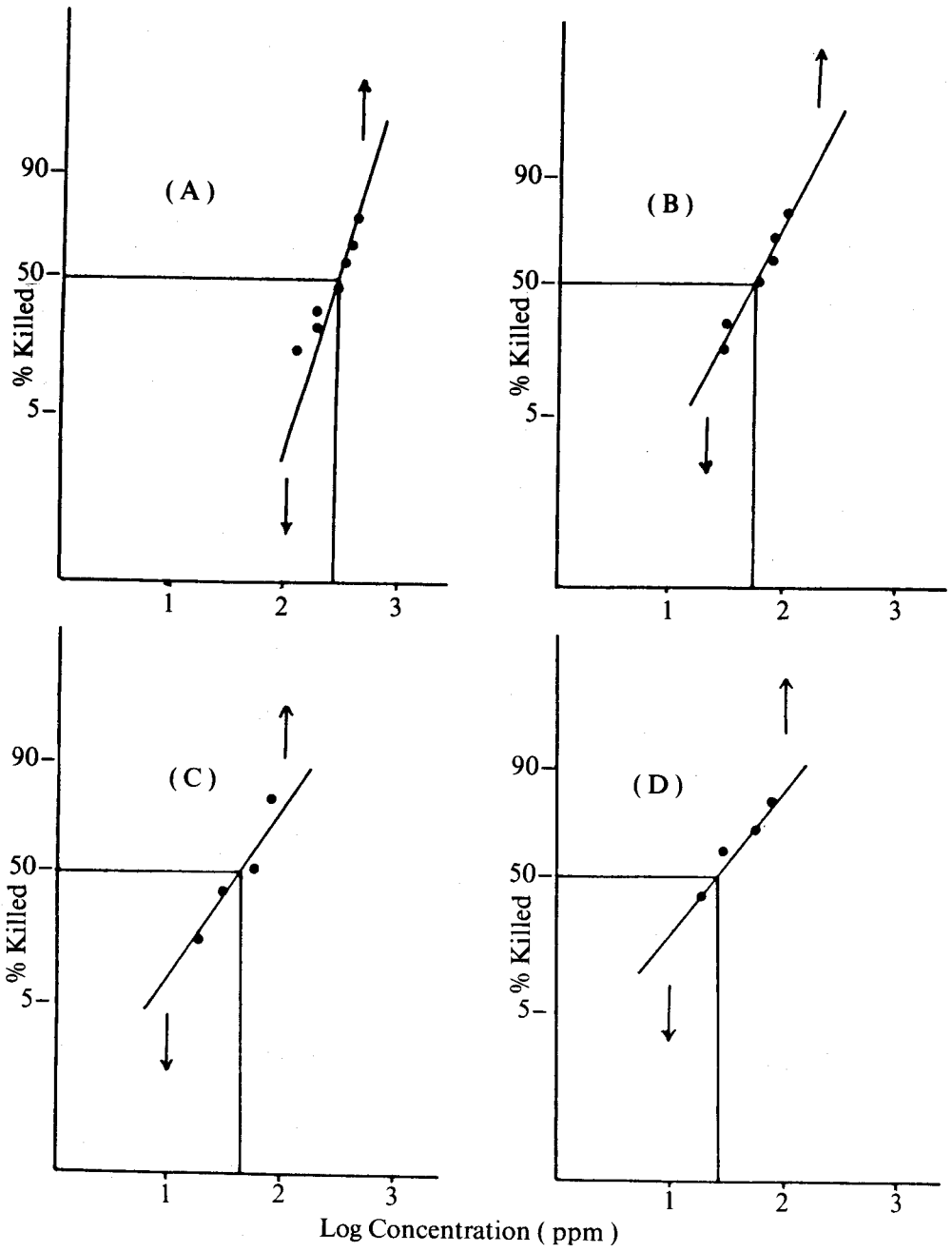

Fig. 1: The 72-hours LC_{50} of four oil dispersants to Mullet Fry (Liza macrolepis) of the Arabian Gulf. The dispersants are: A – Shell LTX, B – Shell Concentrate, C – Servo CD 2000 and D – Exxon OSD 9217.

Table 1

Statistics of 72 – hr. LC_{50} of four dispersant brands to Mullet Fry (Liza macrolepis) of the Arabian Gulf

Dispersant	Shell LTX	Shell Concent	Servo CD 2000	Exxon OSD 9217
No. valid test runs	8	7	4	6
Correlation Coefficient (r)	0.932	0.974	0.940	0.984
Slope (b)	102.945	61.853	52.352	38.079
Confidence limit for 72–hr. LC_{50} (95% prob. level)				
Upper limit	277	62	45	28
Lower limit	215	48	42	26
Standard Deviation	83	30	28	29
Mean 72–hr. LC_{50} (ppm)	244	55	44	27

التأثير السام لبعض مشتقات البترول على زريعة أسماك البياح (البوري) في الخليج العربي

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أختيرت أربعة مشتقات بترول من الأنواع المستعملة على مدى واسع في مياه الخليج العربي عموماً وفي المياه القطرية على وجه الخصوص لدراسة التأثير السام للتركيزات المختلفة من كلٍ منها على زريعة أسماك البياح تحت ظروف المياه القطرية وقت إجراء التجربة عند درجة حرارة ٢٠° م وملوحة ٤٠ جزء في الألف .

والمشتقات المختارة من الأجيال الحديثة التي تتكون من مركبات كيميائية غير أيونية ، القاعدة العطرية فيها كمذيب لا تتعدى ٣ ٪ .

وقد أثبتت مقارنات النتائج للمشتقات التي أجريت عليها الدراسة أن المشتت المسمى إكسون هو أكثرها سمية ، إذ أن التركيز القاتل منه لنصف عدد أسماك التجربة خلال مدة ٧٢ ساعة يبلغ حوالي ٢٧ جزء في المليون ، يليه المشتت سرفو بتركيز ٤٤ جزء ، ثم المشتت المسمى مركز شل بتركيز ٥٥ جزء ، وأقلها سمية هو المشتت شل لتكس بتركيز ٢٤٤ جزء في المليون / ٧٢ ساعة .

هذا على الرغم من أن النشرات الإعلانية لتلك المشتقات توضح أن التركيز القاتل منها يتعدى ألف جزء في المليون ؛ ربما لأن تجارب الشركات المنتجه تمت على أنواع مختلفة من الكائنات وظروف بيئية أخرى عن تلك السائدة في الخليج العربي .

كذلك تطرق البحث إلى بعض التوصيات عند اللجوء إلى إستخدام مشتقات البترول لمكافحة بقع الزيت .