

## THE BIOLOGY OF *DASYCHONE LUCULANA* (SABELLIDAE : POLYCHAETA)

### I- EFFECT OF TEMPERATURE, ZINC AND COPPER ON RESPIRATION

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#### ABSTRACT

Respiration of *Dasychone luculana* collected from Lake Timsah (On the Suez canal) and from El-Shuaiba area, on the Red Sea, Saudi Arabian coast, under different temperatures and concentrations of Zn and Cu was determined. The former's water is considered polluted and the latter's one is considered clean. The oxygen consumption of *D. luculana* collected from the polluted area was significantly higher than collected from the clean one. Increasing the temperature has elevated the amount of oxygen consumed by *D. luculana* collected from both areas. Increasing the sublethal concentrations of both Zn and Cu has increased the respiration of the worms from both areas of study. Those collected from the Saudi coast were more active compared with those collected from the Suez Canal.

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#### INTRODUCTION

The polychaete worms are widely distributed in most of the marine environments<sup>(1,2)</sup>. In addition, some polychaete live in freshwater<sup>(3)</sup>. They are numerous in all substrates, sandy beaches, mud flats<sup>(4)</sup> and rocky regions<sup>(5,6)</sup>. More than 24 polychaete species were recorded at different parts of the world e.g., on the Mediterranean coast, North East of Spain<sup>(7)</sup>, Northern African coast<sup>(8)</sup>. They also exist in the Egyptian Red Sea coast<sup>(9)</sup> and in the Saudi Arabian coasts<sup>(10)</sup>. However, most of the previous studies on polychaete were mainly taxonomical, very little have been directed to the physiology of these species<sup>(11)</sup>.

Generally, different polychaete are found in waters of different quality, i.e., in clean, semi polluted and polluted

waters. This makes them relatively good bioindicators for detecting the water quality.

*Dasychone luculana* is the most commonly found sabellid worm recorded on the Red Sea coast at both the Egyptian and the Saudi Arabian sides<sup>(9,10 & 12)</sup>. It has been recorded in Lake Timsah (a relatively polluted area) and in the Shauiba area at the Red Sea on the Saudi Side (clean area). Water in Shauiba area, however is warmer all over the year compared with the water temperature of Lake Timsah.

Regarding, the pollution control efforts; the toxicity of heavy metals is most frequently evaluated in short-term toxicity survival tests. However, recently, chronic effects of heavy metals on survival, growth and reproduction of aquatic organisms has received a considerable attention.

The present study aims to design a rapid and sensitive test for detection of

sublethal effects of zinc and copper as well as temperature on the *D. luculana* collected from both relatively polluted site and clean area. It also aims to compare the physiological status of this species as indicated by oxygen consumption.

### EXPERIMENTAL

Specimens of *Dasychone luculana* were obtained from the fouling community at lake Timsah, Suez canal and from El-Shauiba area, Saudi coast of the Red Sea during February 1994. The samples were collected by using a broad blade knife to scrape samples from fenders and rocks. Living worms were removed from the mucous tubes by forceps.

Stock solutions of zinc and copper were prepared<sup>(13)</sup>. Test solutions were prepared from the stock solution by adding the calculated volume to millipore filtered Lake Timsah and Shauiba waters to give the following sublethal concentrations of Cu and Zn : 2 ppm; 4 ppm; 6 ppm and 10 ppm. and at 15, 20, 25 and 30°C. The concentrations were chosen

close to the naturally existing concentrations in polluted water.

Oxygen consumption of the tested species was measured by All Glass Student Different Respirometer. Preparation of the respirometer and adjustment of the experimental conditions were carried out as before<sup>(14)</sup>.

### RESULTS

#### Oxygen consumption at different temperatures :

Fig. (1) shows the oxygen consumption of *D. luculana* collected from Lake Timsah and Shauiba areas at 15,20,25 and 30°C. It can be seen that the amount of oxygen consumed by *D. luculana* collected from Lake Timsah was significantly higher at all experimental temperatures than that of Shauiba area, i.e., 0.081, 0.093, 0.14 and 0.165 UL02/mg wet wt./hr for Lake Timsah worms and 0.065, 0.074, 0.010 and 0.12 UL02/mg wet wt./hr for Shauiba worms at 15,20,25 and 30°C, respectively.

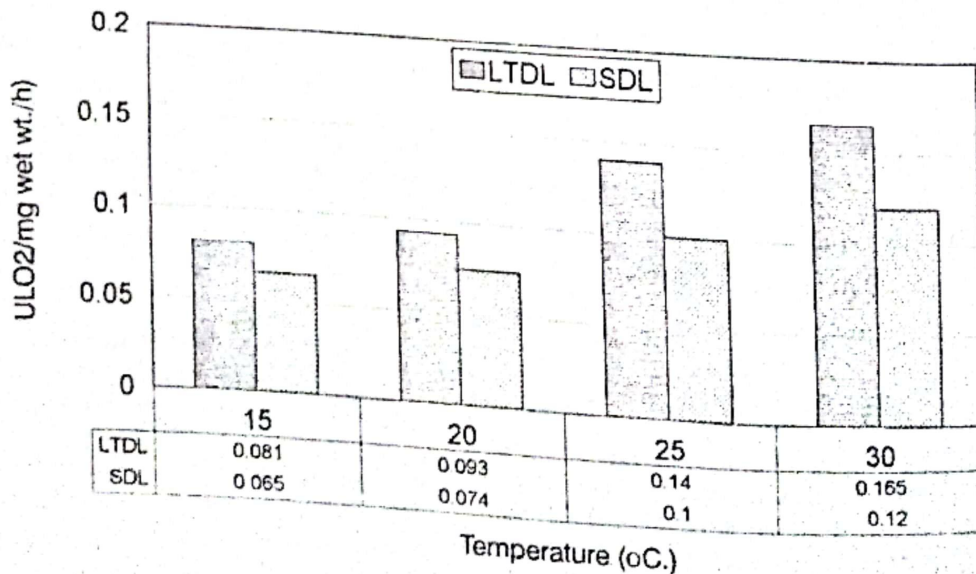


Fig (1) Mean values of the oxygen consumption (ULO2/mg wet wt./h) of *D. luculana* collected from Lake Timsah (LTDL) and from Shauiba (SDL) at different temperatures

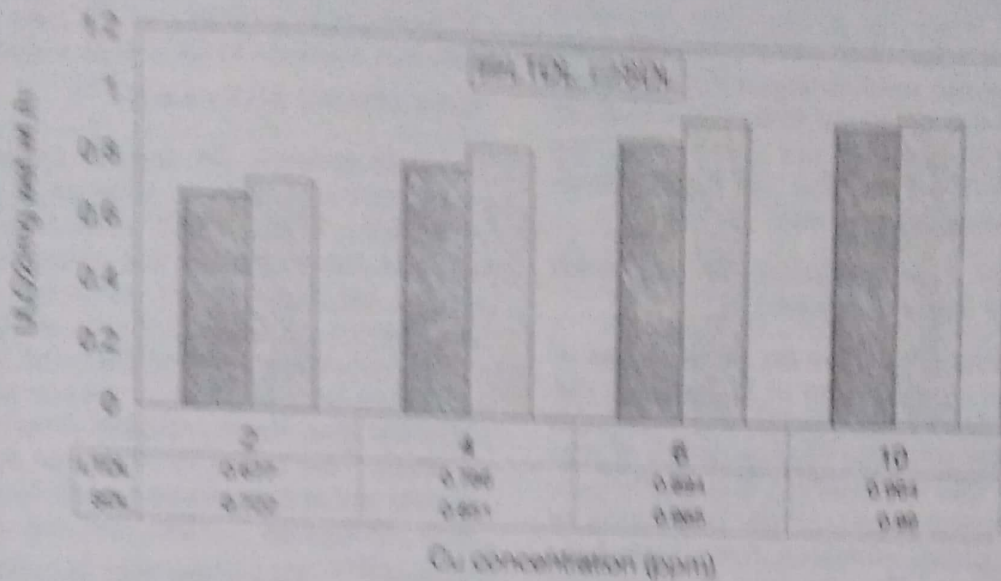


Fig. (2) Mean values of the oxygen consumption (ULO<sub>2</sub>/mg wet wt / h) of *D. huculana* collected from Lake Timsah (CuLTDL) and from Shaubha (CuSDL) at different copper concentrations.

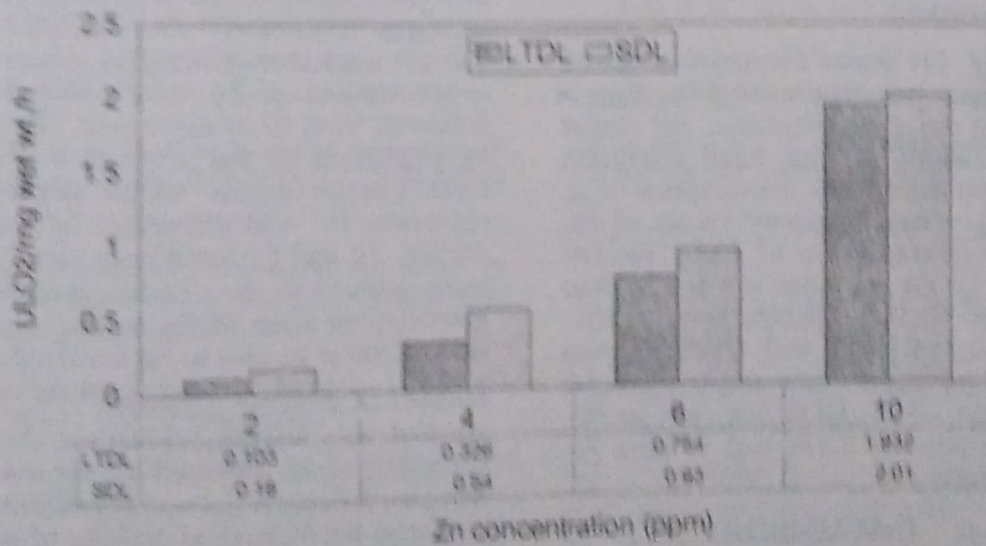


Fig. (3) Mean values of the oxygen consumption (ULO<sub>2</sub>/mg wet wt / h) of *D. huculana* collected from Lake Timsah (ZnLTDL) and from Shaubha (ZnSDL) at different zinc concentrations.

Q10 (the amount of oxygen consumed when the temperature increased by 10°C) for specimens collected from El-Shaouba area is significantly lower than those collected from Lake Timsah, i.e., Q10 is 0.035 and 0.119 UL02/mg wet wt./hr for Shaouba and Lake Timsah specimens, respectively.

#### Oxygen consumption at different copper concentrations :

Fig. (2) shows the mean values of oxygen consumption of *D. luculana* collected from Lake Timsah and Shaouba at different sublethal concentrations of copper. It can be observed that all Cu concentrations increased the respiration of *D. luculana* collected from both Lake Timsah and Shaouba area. However, the oxygen consumption of Lake Timsah specimens is lower than those of Shaouba at all Cu concentrations, i.e., 0.677, 0.786, 0.894 and 0.964 UL02/mg wet wt./hr for the former and 0.727, 0.851, 0.965 and 0.99 UL02/mg wet wt./hr for the latter at 2,4,6 and 10 ppm Cu, respectively.

#### Oxygen consumption at different zinc concentrations :

Fig. (3) shows the mean values of the oxygen consumption of *D. luculana* at different Zn concentrations. All tested concentrations of zinc have activation effects on the oxygen consumption of *D. luculana*. Also, the mean values of the oxygen consumption of Lake Timsah worms in Zn solutions are lower than those of Shaouba species being 0.103, 0.326, 0.754 and 1.932 UL02/mg wet wt./hr for the former and 0.16, 0.54, 0.93 and 2.01 UL02/mg wet wt./hr for the latter at 2,4,6, and 10 ppm Zn, respectively.

### DISCUSSION

The present study has been carried out on specimens of *D. luculana* collected from two sites exhibiting different degrees of water quality. In the Egyptian site at Ismaillia on Lake Timsah which is considered a polluted site<sup>(15)</sup> and the

Saudi Arabian site at El-Shaouba which is considered a clean site<sup>(14)</sup> lake Timsah was reported to have high concentrations of many heavy metals<sup>(16)</sup>.

In general, the oxygen consumption increases with an increase of temperature. As it can be seen from the present study, the oxygen consumption of *D. luculana* either collected from El-Shaouba or Lake Timsah, increased with increasing temperature but those collected from El-Shaouba area were less affected than those collected from Lake Timsah. This could be explained by the higher water temperature at El-Shaouba area compared with that of Lake Timsah<sup>(14)</sup>. This suggestion is supported by the higher amount of oxygen consumed by worms from Lake Timsah (based on the Q10) than that of the Shaouba area. Other findings are in agreement with the results obtained in the present study<sup>(16-19)</sup>.

However, the present study showed that both Zn and Cu have an activity effect on the respiration of *D. luculana*. Specimens collected from Lake Timsah were less affected by increasing concentrations of Zn and Cu than those collected from El-Shaouba area. This can be explained by the adaptation of the Lake Timsah worms to the increasing elevation in concentrations of heavy metals. Zn and Cu have been shown by some authors to have certain biological activities on most of the aquatic organisms. Zinc is known to be involved in a number of enzyme systems<sup>(20-22)</sup>. They showed that marine polychaete require certain concentrations of Zn for normal life i.e., sublethal Zn concentrations are essential for biological activity of polychaete. Copper, on the other hand, is an element of great importance since it is present in some vital enzyme systems (like Zn) as well as in the main respiratory pigment. It has been also reported that basal metabolism by many aquatic organisms was influenced by copper, i.e., it is an essential element in several

enzymes, including tyrosinase and oxidases (23 & 24).

It is obvious that the toxic substances in the acute lethal range of concentrations might cause an inhibition of the respiratory processes of polychaete worms. On the other hand, zinc and copper at the same range of concentrations cause an increase in oxygen consumption during the present experiments. But, the direction and significance of the deviation of the respiratory rate from the normal under the influence of concentrations of metals which are not lethal cannot be clear without data on the effect of the concentrations mentioned on the life span, growth and other biotic characteristics of the worms tested.

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## على بيولوجية دايسيكون لايولانا (عديداً الانشواك : ساييليد)

١- تأثير درجة الحرارة والزنك والنحاس على التنفس

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تم قياس تنفس دايسيكون لايولانا التي تم جمعها من بحيرة التمساح (مياه ملوثة) ومنطقة الشعبيه (على شاطئ المملكة العربية السعودية) تحت ظروف مختلفة من درجات الحرارة وتركيزات عنصرى الزنك والنحاس. أوضحت النتائج أن كمية الأوكسجين المستهلكة بواسطة دايسيكون لايولانا والتي تم جمعها من المياه الملوثة أعلى منه لتلك التي تم جمعها من المياه النظيفة. كما أن زيادة درجة الحرارة قد أدت إلى زيادة كمية الأوكسجين المستهلكة سواء جمعها من المياه الملوثة أو النظيفة. وقد أدت الزيادة فى التركيزات تحت المميته لكل من عنصرى النحاس والزنك إلى زيادة معدل التنفس وكان معدل الزيادة واضحاً لتلك الحيوانات التي تم جمعها من مياه منطقة الشعبيه عن تلك التي جمعت من مياه بحيرة التمساح فى مصر.