



Effects of Potassium Dichromate on Skin Ulcers of Musky Octopus (*Eledone moschata* Lamarck, 1799) (Mollusca: Cephalopoda)

T. TANSEL TANRIKUL¹, HALIL SEN¹ and NEJDET GÜLTEPE^{2,*}

¹Aquaculture Department, Fisheries Faculty, Ege University, 35440 Urla, Izmir, Turkey

²Department of Basic Sciences, Inebolu Fisheries Faculty, Kastamonu University, 37100 Kastamonu, Turkey

*Corresponding author: E-mail: nejdetgultepe@yahoo.com

(Received: 3 October 2011;

Accepted: 15 June 2012)

AJC-11593

Effects of potassium dichromate ($K_2Cr_2O_7$) on skin ulcers upon the mantle tip of musky octopus (*Eledone moschata*) in controlled conditions were investigated. Therefore, the trials on five octopuses were performed at 0.1, 0.15 and 0.2 gL^{-1} concentrations of potassium dichromate by bath method. The bath applications were carried out at 20.3 ± 0.1 °C for 1 h day^{-1} for two days consecutively. The following 10 days, the musky octopuses were observed for cicatrization or any mortality. In the control group, one individual died and it was observed of the skin lesion enlargement in the one individual and cicatrized of skin ulcers in the remainders, but did not like in the disinfected groups. At 0.1, 0.15 and 0.2 gL^{-1} concentrations of potassium dichromate, cicatrization of skin ulcers upon mantle tip of the musky octopuses in controlled conditions was observed without any mortality.

Key Words: *Eledone moschata*, Cicatrization, Potassium dichromate, Skin ulcers, Treatment.

INTRODUCTION

Infections have caused more or less dramatic results for cephalopods, since beginning of the research on the capture, maintenance and culture of cephalopod species with potential or demonstrated value in biomedical research. Cephalopod skin consists of a thin epidermis and a thicker dermis that covers the muscle layers beneath. The underlying dermis is thicker and contains connective tissue, blood vessels, nerves, amoebocytes and chromatophore organs and iridescent cells used for colour change¹. All species of cephalopods have been to be susceptible to bacterial infections of the skin. Skin ulcers first affected the epidermis of the mantle and then penetrated downward through the dermis and underlying muscle tissue². Skin lesions sustained when octopuses contact tank walls often result in internal infections as well as the usual external secondary bacterial infections found in the lesion³. The infections may be acute (death within 8-10 days) but are more commonly chronic (lasting weeks or months before an animal dies)³.

Potassium dichromate ($K_2Cr_2O_7$) is known to be mutagenic in bacterial cells⁴⁻⁷. In addition, it has been used in preservation of cows' milk and chicken's eggs⁸⁻¹² and even preservation of human milk and blood^{13,14}. Furthermore, allergic dermatitis in humans treated by using potassium dichromate¹⁵.

In fish, to treatment of infected skin lesions, potassium dichromate is applied with iodine and merthiolet¹⁶. Additionally,

as an antiseptic bath of potassium dichromate at 1/20000 ratio for 0.5 h in a day is used for fish¹⁷.

However, there is no study in the literature on using of potassium dichromate application to treatment of skin ulcers in cephalopods. Hence, the aim of the current investigation was to observe the effects of potassium dichromate on skin ulcers upon the mantle tip of musky octopus *Eledone moschata* in controlled conditions.

EXPERIMENTAL

The study was performed between April 14 and May 27. Initial of the experiment, specimens of musky octopus (*Eledone moschata*) were caught by bottom trawling in Izmir Bay. The octopuses were transported in two 50 L tanks with the sea water being renewed every 20 min during 4 h shipping from the fishing area to indoor facilities at Ege University Fisheries Faculty in Urla, Izmir. All individuals (N = 100; 90-600 grams of body weight) were placed in a square polyester tank, which has 2000 L of sea water volume with an open flow-through filtered seawater system and aeration. The musky octopuses adapted to the controlled conditions in a week without any shelters. In this period, mean water temperature, salinity and oxygen saturation were measured as 17.1 ± 0.8 °C, 37 ± 0.2 ppt and 7 ± 0.3 $mg L^{-1}$, respectively. Photoperiodicity in the tank was adjusted naturally. The octopuses were fed with *ad libitum* mainly with live or freshly death crabs (*Goneplax*

rhomboides L., 1758) and mantis shrimps (*Squilla mantis* L., 1758) by hand. The following day, uneaten parts of the prey were removed from the tank by siphoning.

Total 20 injured octopuses from the 100 octopuses with body weights ranging 103-593 g (341 ± 138 g) were selected randomly from the adaptation tank. They were placed in to 4 cylindrical plastic tanks (450 L) including adequate PVC tubes as shelters for minimizing of stress factors with an open flow-through filtered seawater system and aeration. They were acclimatized within 10 days at the same maintenance protocol that as mentioned above. During the period, mean water temperature, salinity and oxygen saturation in the experimental tanks were measured as 17.9 ± 0.9 °C, 37 ppt and 9.4 ± 0.3 mg L⁻¹ respectively.

Twenty musky octopuses were divided into 4 groups including 5 animals in each according as potassium dichromate concentrations: Control group as C1; $0.1 \text{ g L}^{-1} \text{ K}_2\text{Cr}_2\text{O}_7$ as C2; $0.15 \text{ g L}^{-1} \text{ K}_2\text{Cr}_2\text{O}_7$ as C3; and $0.2 \text{ g L}^{-1} \text{ K}_2\text{Cr}_2\text{O}_7$ as C4. The disinfection was performed in the experimental tanks for avoiding manipulative stress at 20.3 ± 0.1 °C for 1 h day⁻¹ for two days consecutively with bath applications because of attained adequate elimination of bacteria in open flow-through filtered seawater system. Furthermore, aeration was supplied during the period. In the following 10 days, the octopuses were observed for cicatrization or any mortality. The specimens were put on fast 24 h before initial of the experiment and during the disinfection periods also. Subsequent to the procedure, the octopuses were fed *ad libitum* mainly with live or freshly death crabs (*Goneplax rhomboides* L., 1758) and mantis shrimps (*Squilla mantis* L., 1758) by hand. Along the observation, mean water temperature, salinity and oxygen level in the tanks were measured as 21.4 ± 1.8 °C, 37 ppt and 8.9 ± 0.8 mg L⁻¹, respectively.

Data were given as mean \pm SD values in the text. To determine significant differences in survival rates among the groups were tested by chi-square test and significance level was set at 0.05.

RESULTS AND DISCUSSION

Skin ulcers on the mantle tip of the octopuses occurred within 10 days in adaptation conditions. Any toxic affect of potassium dichromate was observed even if in the high level (0.2 g L^{-1}) during the study. Furthermore, during the bath applications, did not observe any stress signs such as escaping from the tanks, hit to tank walls, jetting or inking behaviour. Additionally, after the applications, all octopuses fed tuck into.

In the C1 trial, one individual died on 6th days of the experiment and one individual uncured and skin ulcers of the other three animals being to cicatrization, but did not like in the other groups. In the C2, C3 and C4 trials, cicatrization of the skin ulcers in all specimens were observed without any mortality. One sample photos of the skin ulcers that belonging to the trials' octopuses were given in Figs. 1-4.

There were significant differences in survival rates between the groups ($p < 0.05$), but no significant differences were found among the groups of C2, C3 and C4 depending on the doses ($p > 0.05$).

The skin ulcers are fatal and are likely a result of crowding due to increasing to contact among octopuses and on the tank walls, but they are curable and preventable¹⁻³.

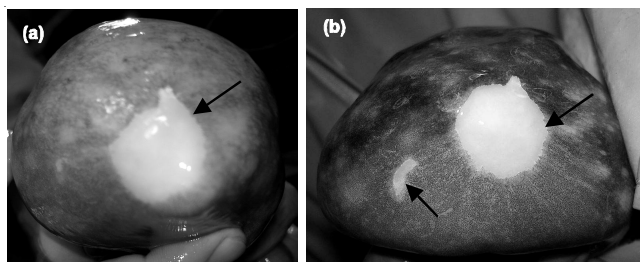


Fig. 1. A view of the skin ulcer on the mantle tip of *Eledeone moschata* in C1 (a, initial; b, final)

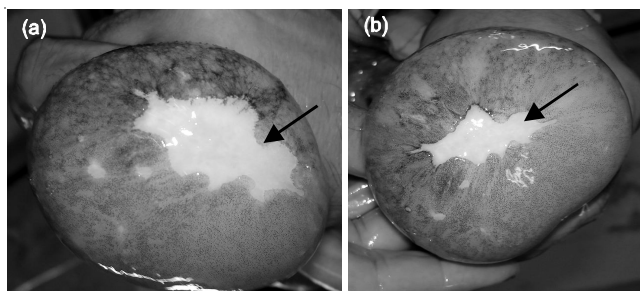


Fig. 2. A view of the skin ulcer on the mantle tip of *Eledeone moschata* in C2 (a, initial; b, final)

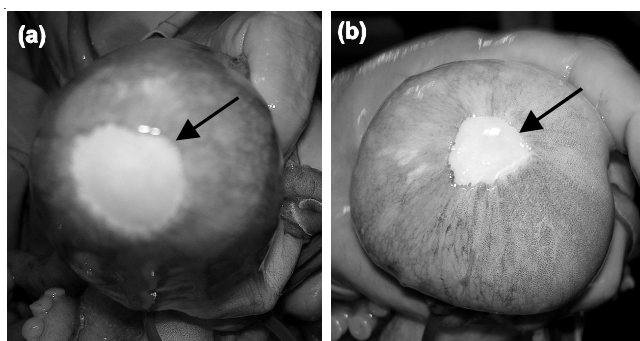


Fig. 3. A view of the skin ulcer on the mantle tip of *Eledeone moschata* in C3 (a, initial; b, final)

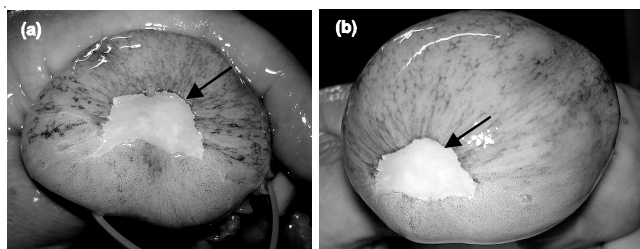


Fig. 4. A view of the skin ulcer on the mantle tip of *Eledeone moschata* in C4 (a, initial; b, final)

Forsythe *et al.*³ noticed that the ineffectiveness of most antibiotics when dissolved in sea water severely limits their usefulness for mariculture. A strong need exists for palatable artificial ration that can serve as a vehicle for oral administration of therapeutic compounds to large numbers of animals. Intramuscular injections of sick individuals and their food items are effective, but logistically impractical on a large scale. Moreover, though several effective treatments have been established for octopuses and cuttlefish, none yet exist for loliginid squids.

In early studies, some disinfectants which are acidic acid, acriflavin, calcium hypochlorite, formaldehyde (37 %),

malachite green/chloride, malachite green/oxylate, metronidazole and quinacrine were used for treatment of ectoparasites in cephalopods by bath application³. Although potassium dichromate with bath application using for disinfection in fish¹⁷, it hasn't been used for cephalopods until the current study. Potassium dichromate used locally to treatment of skin infections in fish besides to treatment of dermatitis in humans as the same way. After penetration to skin of 6 chromium of potassium dichromate, reducing to chromium 3 it is thought to be it begins immunogenic activity¹⁵.

Any toxic affect of potassium dichromate on *E. moschata* was observed even if in the high level (0.2 g L^{-1}) during the current study. Furthermore, during the bath applications, did not observe any stress signs such as escaping from the tanks, hit to tank walls, jetting or inking behaviour in the musky octopuses. Additionally, after the applications, all octopuses fed tuck into. Finally, in the all treatment groups, the skin lesions of *E. moschata* cicatrized effectively by potassium dichromate.

Conclusion

In conclusion, this is the first study about cicatrizing effects of potassium dichromate for musky octopus *E. moschata* in the controlled conditions. Nevertheless, there is no study in the literature on using of potassium dichromate application to treatment of skin ulcers in cephalopods. So the present findings couldn't be discussed sufficiently. According to the actual results that potassium dichromate can cure to skin ulcers in octopuses by cicatrization, especially on *E. moschata*, with minimum dose (0.1 g L^{-1}) and effortless. However, more detailed studies on treatment of skin ulcer in octopuses and

other cephalopods with potassium dichromate should be performed.

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