

CEPHALOPODS AS BIO-INDICATORS OF METALLIC ENRICHMENT OF MARINE ENVIRONMENT IN THE GULF OF GABES, SOUTH-EASTERN TUNISIA

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Abstract

In this study, we collected two cephalopod species, *Octopus vulgaris* and *Sepia officinalis*, from different sites in the Gulf of Gabes, south-eastern Tunisia, and analyzed the concentrations of mercury (Hg), zinc (Zn), cadmium (Cd) and copper (Cu) in their edible tissues (mantle and arms). The comparison of the results found showed significant differences only between the sampling sites, and not between the two species. The distribution of trace metals analyzed in the Gulf of Gabes was found to be similar for both tissues analyzed in the two species, with the highest concentrations found in the central area of Gabes Gulf, and the lowest in the northern and/or southern areas.

Keywords: *Metals, Cephalopods, Pollution, Gulf of Gabes*

In the Mediterranean Sea, many marine species accumulate various pollutants including trace metals. Most of these metals bio-accumulators are preys for many predators including the cephalopod molluscs which are known to host in their tissues higher contents of metals. It is for example the case of the two cephalopods *Octopus vulgaris* and *Sepia officinalis* which have been widely studied in this regard. Although these two latter species are widely consumed in Tunisia, only few studies have been carried out on their metals bioaccumulation. The aim of the present study is to assess the concentrations of trace metals in the edible tissues (mantle and arms) of *O. vulgaris* and *S. officinalis* collected from different sites in the Gulf of Gabes and discussing the metallic enrichment of the marine environment in this area. To do so, 39 octopuses and cuttlefishes were collected from four sites representing the entire surface area of Gabes Gulf (GG): Elbibane Lagoon (southern GG), Gabes (central GG), Kerkennah Island and Chebba (northern GG). Mantle and arms samples were taken from each collected cephalopod, preserved and analyzed for Hg (using a direct mercury analyzer), Zn, Cd and Cu (using an IC-PMS) and the concentrations found were reported as $\mu\text{g g}^{-1}$ WW. Similar patterns of spatial trace metals distribution were found with the two examined tissues of both cephalopod species (Table 1).

Tab. 1. Average (\pm Standard Deviation) concentrations of trace metals analyzed in mantle and arms tissues of *Octopus vulgaris* and *Sepia officinalis*, sampled from the Gulf of Gabes.

Cephalopod Species	Samples/Sites	Trace metals			
		Hg	Zn	Cd	Cu
<i>Octopus vulgaris</i>	Mantle				
	Elbibane lagoon	0.038±0.006	8.39±1.252	0.034±0.004	6.164±0.961
	Gabes	0.048±0.013	21.41±2.015	0.136±0.032	3.113±0.775
	Kerkennah Island	0.036±0.007	17.38±3.327	0.098±0.018	5.005±0.622
	Chebba	0.031±0.003	12.32±1.877	0.029±0.010	4.559±0.698
	Total	0.038±0.010	14.94±5.491	0.077±0.046	4.832±1.327
	Arms				
	Elbibane lagoon	0.035±0.005	9.237±1.780	0.024±0.009	5.041±1.104
	Gabes	0.045±0.010	21.943±2.402	0.127±0.037	2.451±0.722
	Kerkennah Island	0.034±0.007	17.131±2.808	0.088±0.016	3.768±0.907
Chebba	0.029±0.003	12.299±1.406	0.024±0.009	3.643±0.568	
Total	0.036±0.008	15.203±5.283	0.068±0.047	3.808±1.263	
<i>Sepia officinalis</i>	Mantle				
	Elbibane lagoon	0.036±0.005	8.427±1.396	0.032±0.004	5.328±1.514
	Gabes	0.048±0.010	20.864±2.135	0.127±0.023	3.278±0.848
	Kerkennah Island	0.033±0.007	16.170±2.247	0.108±0.014	4.678±1.031
	Chebba	0.030±0.005	11.941±2.087	0.026±0.008	4.222±1.108
	Total	0.037±0.009	13.901±5.238	0.071±0.046	4.474±1.405
	Arms				
	Elbibane lagoon	0.031±0.004	7.141±1.550	0.031±0.004	4.824±1.524
	Gabes	0.046±0.008	19.363±1.670	0.118±0.016	3.031±0.868
	Kerkennah Island	0.031±0.007	15.421±2.456	0.106±0.014	4.545±0.798
Chebba	0.027±0.004	11.469±1.373	0.024±0.007	3.946±1.015	
Total	0.034±0.009	12.847±5.135	0.068±0.043	4.163±1.322	

In fact, for both mantle and arms tissues of *O. vulgaris*, the highest concentrations of Hg, Zn and Cd were noted in Gabes; whereas the lowest were found in Chebba and/or Kerkennah Island (for Hg) and Elbibane Lagoon and/or Chebba (for both Zn and Cd). Regarding Cu, the analysis of both tissues of the common octopus showed that the highest contents were recorded in Elbibane

Lagoon; whereas the lowest in Gabes. In the case of *S. officinalis*, trace metals analyses of both muscle tissues revealed also that the highest Hg, Zn and Cd concentrations were found in Gabes and that the lowest were noted in either a northern (Chebba or Kerkennah Island) or a southern (Elbibane Lagoon) sampling site. Similarly to the case of *O. vulgaris*, the Cu analysis of both mantle and arms of *S. officinalis* showed that the highest concentration was recorded in Elbibane Lagoon; whereas the lowest in Gabes. We conducted a dendrogram of hierarchic classification using the concentrations of all metals analyzed both muscle tissues of the common octopus and cuttlefish and the result is given in Figure 1.

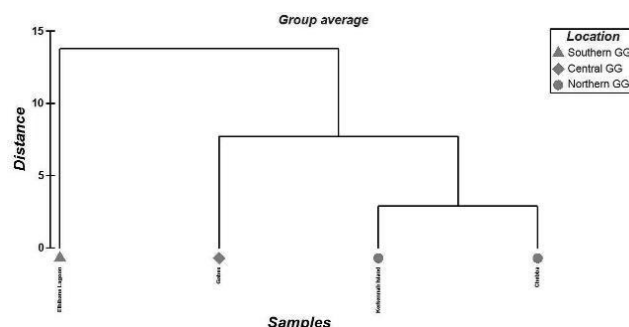


Fig. 1. Hierarchic classification dendrogram of GG sampling sites, performed using the concentrations of the four trace metals analyzed in the edible tissues of *Octopus vulgaris* and *Sepia officinalis*.

Two main clusters separated at a Euclidean distance of 7.5: while the first cluster was formed by only the southern sampling site (i.e. Elbibane Lagoon), the second was represented by those located in both central and northern GG areas (i.e. Gabes, Kerkennah Island and Chebba). At lower levels of Euclidean distance, these three latter sampling sites subdivided into two sub-clusters separating the central sampling site (i.e. Gabes) from the other two northern sites (i.e. Kerkennah Island and Chebba). It seems that the higher concentrations of metals observed in the two cephalopods collected from the central GG area are mainly due to the effects of the numerous coastal anthropogenic activities, represented particularly by the discharges of the industrial complex located between Gabes and Ghannouch [1].

References

1 - El Zrelli R., Courjault-Radé P., Rabaoui L., Castet S., Michel S. and Bejaoui N., 2015. Heavy metal contamination and ecological risk assessment in the surface sediments of the coastal area surrounding the industrial complex of Gabes city, Gulf of Gabes, SE Tunisia. *Mar. Poll. Bull.*, 101: 922-929.