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Impact of the heavy metals (Cd, Fe, Cu, Pb, Zn, Ni) concentration on the edible sea urchin *Paracentrotus lividus* (Lamarck, 1816) at the level of the bay of Honaïne (W.de Tlemcen – North West Algerian)

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Abstract

The sea urchin Paracentrotus lividus (L), is a type opportunist that has an important ecological role in the ecosystems, widely are considered as of good informers of the contamination of the sea environment in which they live, since they possess the property to accumulate the contaminators present in this environment until it attains the balance.
The goal of this study is to complete the data on marine pollution of the Algerian coastal zones, in particular metallic pollution in the sea organisms. Thus, the principal objective of this work is the impact of the six heavy metals (Cd, Cu, Fe, Pb, Zn, Ni) concentration on the edible sea urchin Paracentrotus lividus (Lamarck 1816) removed at the level of the bay of Honaïne during a period of three months going from the months of April in the month of July 2012. Three organs were considered to know: (Gonads – pricking - tests), which were mineralized by two methods (dry way and humid way) then analyzed by spectrometry of atomic absorption with flame (S.A.A.A.F). The sea urchins are easy to collect and are found up spread alongside the Algerian coastal zone. Used as biological informers, these Echinoderms allow elucidating the characteristics of local contamination by the metals. The obtained data reveal that the supposed zone of sampling to be reference region, the results show that the hard parties (test and pricking) constitute the privileged target of this metallic pollution.

Keywords: *Echinoidea - Paracentrotus lividus (L) - heavy metals – Honaïne - Tlemcen – North West Algerian.*

1. Introduction

The study of the interaction between contaminating and the biological barriers is therefore of a considerable interest for the eco-toxicology comprehension phenomena, the interpretation of the bioaccumulation and effects through the trophic chains. The concentration of the metals with the sea organisms are rather complex processes, the degrees of assimilation and retention of the metals tracks vary between the different kinds and types depending on the biochemical property of every element. To constitute a good «quantitative bio informer. The sea urchin *Paracentrotus lividus* (Lamarck) (Echinodermata: Echinoidea) is a type opportunist that has an important ecological role in the ecosystems, widely are considered as of good informers of the contamination of the sea environment in which they live, since they possess the property to accumulate the contaminators present in this environment until it attains the balance.

The goal of this study is to complete the data on marine pollution of the Algerian coastal zones, in particular metallic pollution in the sea organisms. Thus, the principal objective of this work is the impact of the six heavy metals (Cd, Cu, Fe, Pb, Zn, Ni) concentration on the edible sea urchin *Paracentrotus lividus* (Lamarck 1816) removed at the level of the bay of Honaïne during a period of three months going from the months of April in the month of July 2012.

Three organs were considered to know: (Gonads – pricking - tests), which were mineralized by two methods (dry way and humid way) then analyzed by spectrometry of atomic absorption with flame (S.A.A.A.F).

2. Equipment and methods

Every sampling, about twenty living sea urchins are collected in their natural environment. The individuals are detached from the rocks at depths of 1 to 3 m. After the collection, the sea urchins are preserved in the refrigerator for 24 hours waiting their treatment in the laboratory usually, the following day. The collected specimens are dissected at the level of the laboratory in order to avoid any contamination by the heavy metals; before any manipulation by biological equipment, all the instruments must be cleaned successively with detergents, then soaked in tangy water (solution d'HNO3) for a night and rinsed in distilled water. The sea urchins are dissected and the sampling concerns the two following tissues:

A hard part: pricking + test
A soft part: gonads with confused sexes

The Preparation of the sample for the analysis was done by two different methods, two ways of mineralization, to know the mineralization by dry way, and by humid way.
Experimental protocol of the mineralization of the samples by dry way:

- Steams drying:

After the dissection of the samples (gonads, pricking and tests) are weighed (1g) and placed in the steams at a temperature of 110°C for 3 hours.

- Reduction in ashes:

The obtained samples after drying are placed in an oven to pulley block, first for 15 minutes at 450° C, then moistened with the nitric acid and replaced in the oven at 350°C during 1 hour and 30 minutes.

- Filtration and put in solution:

The obtained ashes are filtered by a solution of nitric acid. The obtained filtrate is adjusted to 25 ml by nitric acid to 1% and preserved cool in labeled pints until the analysis by spectrophotometer of atomic absorption with flame.

Experimental protocol of the mineralization of the samples by humid way:

From every organ (gonads, pricking and tests) removed at the time of dissection, we take 1 g of fresh weight apart with 1 ml of nitric acid. The mixture is placed on a mineralization device. This phase lasts 1 hour and 30 mns then the mineralized is recovered which is adjusted to 4 ml by bi-distilled water; the same operation is repeated for the body of the targets.

3. Results and discussions

According the average metallic concentrations with the edible sea urchin (*P.lividus*) obtained after the mineralization by the dry way.
The hard parts (pricking- tests) of this Echinoderm are the more accumulative of the metals with the exception of the Zn that concentrates at the level of the soft parts (gonads), attains a maximum value of 0.94mg/kg. The gradients are presented as follows:

At the level of the:

Pricking: Fe> Ni> Pb> Zn> Cu> Cd
Tests: Fe> Ni> Pb> Zn> Cu>Cd
Gonads: Fe> Zn> Ni> Pb> Cu = Cd

Whereas the average metallic concentrations with the edible sea urchin (*P.lividus*) obtained after the technique of the analysis by humid way, the hard parts (pricking-tests) of *Paracentrotus lividus* are the more accumulative of the total analyzed metals.

The gradients are presented as follows:

At the level of the:
Pricking: Fe> Zn> Ni> Pb> Cd> Cu
Tests: Fe = Pb> Cd> Zn> Ni> Cu
Gonads: Fe> Pb> Zn> Ni> Cd> Cu

The results of the ANOVA according to chart 01 ($F_{th}>F_{ob}$) do not reveal any significant difference between the averages of the metallic concentrations for the different studied organs (P>0.05), with the edible sea urchin *Paracentrotus lividus*. Comparison of the dry and humid analytical methods for the different organs:

On one hand, according to the results of chart 2 of test t, reveals that there is not a significant difference between the averages of the metallic concentrations ($F_{th}>F_{ob}>0.05$), for the metals study at the level of the three organs of the edible sea urchin *Paracentrotus lividus*. (There is a not method effect).

Nevertheless, the humid method gives results of less metallic variable concentrations in comparison with the dry method. This is revealed by the values of the coefficients of variation with the exception of the Zn and Fe that give higher values by the humid method than the dry method (chart 03)

The consistency of the averages for the two methods is observed for the metals and the organs studied. We can suggest according to our results that the humid method remains more reliable than the dry method with the exception of certain metals (Fe, Zn) as for the repeatability of the values (chart 03).

Distribution of the pollution at the organism level:

If we consider the body of the obtained results for the six analyzed metals, we note that the tests and pricking represent the tissue field of the organism the more contaminated by these metals; the gonads come in second position.

Distribution of the pollution at the station level:

The Cadmium, Copper, Lead and the Nickel more studied at the level of the hard parts (pricking, test) than the one on the soft part (gonads), as for Iron and Zinc, their contents are clearly more important at the level of the gonads than the one of the pricking and test. The examination of the results obtained by DELMAS (1988) on the batches of harvested sea urchins to Marseilles shows important contents in heavy metals in the gonads in comparison with the one of our samples. We note in Marseilles: 1.86 mg/kg of P.F. of Copper as for Honaïne, the rate is of 0.02 after mineralization by the dry way and of 0,01 mg/kg of P.F by humid mineralization. And this, at the level of the gonads; while at the level of the test and pricking, they are close to the 6.62 mg/kg P.F. in Marseilles as for Honaïne, it varies between 0.04 and 0,24 mg/kg of P.F. Only for another Algerian region, Ain Franin and Beni saf, BENDIMERAD (1996) gives results in Copper that is very close to ours. These results show a relation between the industrial and urban movements pollution, the 3 stations: Ain Franin, Beni saf and Honaïne. In the matter of the gonads, one there raises values that can be 4 to 6 times higher in Copper than our samples then almost equal with other carried out works to the previous one (AUGIER, 1992), and 12 to 30 times higher for the Lead and this in Beirut (Lebanon) where we recorded a value of Lead at the level of the gonads of 31.3 mg/kg of P.F. (SHIBER, 1979) , while Honaïne gives only 0,05mg/kg of P.F by the dry way and 1.20 mg/kg of P.F by the humid way. This can be explained by industrial damages caused during the conflict that lasted more than 15 years. While for Zinc and the Nickel, the difference is not very important between our results and those of AUGIER (1992) at the level of Ponteau (Marseilles) and Carry-le-Rouet when It finds 0.26 mg/kg of P.F. in Carry-le-Rouet. And in Ain Franin 0,08 mg/kg P.F and 0,53 mg/kg P.F in Beni saf (BENDIMERAD, (1996), while we obtained 0.41 mg/kg P.F by the dry way and 0,28 mg/kg of P.F. in Honaïne for the Nickel in the matter of Zinc, the difference is too important between our results and those of AUGIER (1992) it notes 10.9 mg/kg P.F. in Carry-le-Rouet at the level of the gonads. While BENDIMERAD. (1996) finds 13.10 mg/kg P.F. in Ain Franin and 25.68 mg/kg P.F jn Beni saf. In contrast to the presents study that gives 0.94 mg/kg P.F by the dry way and 2,26 mg/kg P.F. by the humid way. Besides the values are recorded at the level of the pricking and test for Zinc, the difference is very important between our results and those of AUGIER (1992) it records 9.65 mg/kg P.F. in Carry-le-Rouet. And 4,2 mg/kg P.F Ain Franin BENDIMERAD(1996), while we obtained values varying between 0,37 and 0.75 mg/kg P.F for the two analytical ways, that are besides very close of the one recorded at the level of the station of Beni saf BENDIMERAD (1996) (0.53 mg/kg P.F.). For the Nickel the difference is not too important between our results and those of AUGIER (1992) to the level Carry-le-Rouet and the one of BENDIMERAD (1996) at the level of the two stations of Ain Franin and Blessed saf. One notices that the values seem to direct themselves towards the same direction and do nothing but to confirm what one had advanced beforehand that is to say that is at the level of the hard parties of the sea urchin that generally are located the most important rates of metals.

4. Conclusion

The heavy dosage of six metals (Cd, Cu, Fe, Pb, Zn, Ni) in three organic parties of the edible sea urchin *Paracentrotus lividus* (Lamarck, 1816), shows that this marine type concentrates comparatively quantities of toxic metals in proportion with the pollution of the of sea water. The sea urchins are easy to collect and are found up spread alongside the Algerian coastal zone. They can remain alive in extremely polluted environments (DELMAS, 1989). Used as biological informers, these Echinoderms allow elucidating the characteristics of local contamination by the metals.

The obtained data reveal that the supposed zone of sampling to be reference region, the results show that the hard parties (test and pricking) constitute the privileged target of this metallic pollution.

On the other hand, the estimation of the incurred risks for their consumer is not simple to quantify because of the lack of official and specific standard.

To have an idea of the originating ones from dangers after the consumption of this seafood, we referred to the data of the foods, shellfish, mollusks and fish elaborated by the O.M.S and the F.A.O, the Corporation of the Experts Chemists and the G.I.P.P.M. Nevertheless, the approximations not being able to be furnished because of the important difference between the data, we have, nevertheless, simply noticed that certain D.M.A proposed by the latter researchers are superior To the one of our samples, with the exception of the Zinc at the level of the soft parts (edible). Moreover, it is not only a question of quantity of ingested soft roe or a frequent consumption of sea urchins but also cumulative effects and the association to other substances that must be taken in consideration to estimate the limits of the poisons of the metals. In fact, it is urgent to define values limits or precise and specific norms for these seafood's notably in the matter of the maximum authorized doses. It springs from this study that the metals content tracks of the sea urchins of the bay of Honaine, are not important, to reflect the degree of pollution of our coasts and of our water resources. This is a virgin zone.

Marine pollution with all its forms constitutes a threat of depopulation of the sea ecosystem. It becomes urgent to consider a taken in charge by scientific corp of the questions linked to the marine resources and their impacts on public health. A priority should be granted to the known census of all the sources of pollution and newly creates affecting the coastal band, the realization of stations of treatment of worn waters specialized according to the nature of the rejection, whether it is urban, domestic, industrial, or mixed, the rehabilitation of the stations of treatment of not functional worn waters, as well as set it up of a Network of Bio surveillance of the impacts of pollution Alongside the Algerian coast and at different levels of ecological organization.

Chart 01: Results of the ANOVA analysis of the factors: organs, time F1: factor organs, Fob: Observed factor F2: Factor time Fth: Theoretical Factor

		F1	F2
Cd	F_{ob}	1,625	1,636
Fe	F_{ob}	0,930	0,313
Cu	F_{ob}	0,313	1,591
Pb	F_{ob}	1,134	2,909
Zn	F_{ob}	1,419	0,554
Ni	F_{ob}	0,961	3,191
	F_{th}	3,837	4,458
	ddl	4	2
	α	0,05	

Chart 02: Comparison of dry and humid analytical methods for the different organs by the Student test.

	tob			t_{th}	ddl	α
Organes Métaux	*piquants*	*tests*	*Gonades*			
Cd	0,345	0,0002	0,011	2,048	28	0,05
Fe	0,229	0,057	0,062			
Cu	0,305	0,660	0,564			
Pb	0,957	0,081	0,130			
Zn	0,399	0,288	0,657			
Ni	0,963	0,114	0,440			

Chart 03: Variation coefficients of different metals for both analytical ways

C.V.S: Variation Coefficient of the dry method.
C.V.H: Variation coefficient of the humid method

	C.V.S	C.V.H
Cd	154,889	47,522
Fe	37,243	46,721
Cu	200,756	83,548
Pb	61,974	81,568
Zn	97,023	136,954
Ni	88,867	64,192

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