The chemical toxicity of plastic leachates on the embryonic development of the green sea urchin *Strongylocentrotus drœbachiensis*

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From 1.5 millions of tons in the 1950s to **359Mt**, 70 years later, diverse types of plastics take part in the daily life objects : Polyethylene (**PE**), Polypropylene (**PP**), Polyvinyl chloride (**PVC**), Polystyrene (**PS**), Polyurethane (**PU**), phenolic resin...
Why? Because of their **durability**, **low cost**, **versatility**, **elasticity**, **resilience and longevity**. So many qualities that also represent a real ecological problem (UNEP 2018).

Sea urchins are currently used species in ecotoxicology for **economical issues** related to their importance in the catering and tourism industries. They are **important ecological elements** that regulate the macroalgaes forests density. Finally, they are animals easy to breed with a relatively short reproduction cycle where **the larvae stage is reached in only 120h**. The green sea urchin *S.drœbachiensis* occupies the rocky substrates and the cold waters of the North Sea, the swedish shores, the Arctic Sea and the north-american coasts (WoRMS).

The embryonic stages of sea urchins are used in **lethal toxicity tests**, while their larvae stage enables the application of sublethal toxicity. In this study, we observed the interruption of the embryonic development in the presence of **washing gloves leachates**.

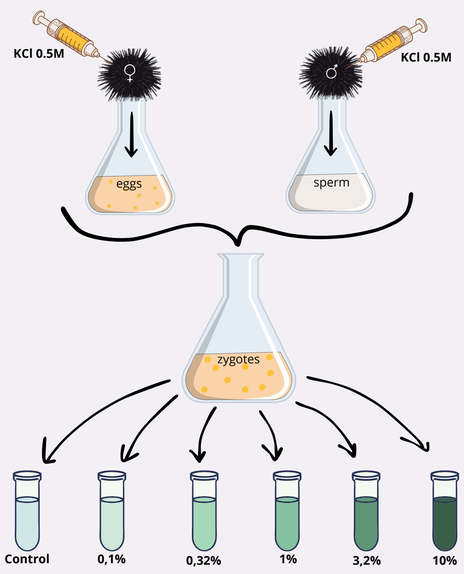
Material & Methods

Leaching

Particles cut from washing gloves were mixed (150rpm) for 2 weeks in natural seawater at 20°C and in the dark before filtration at 0,2µm and storage at -20°C.

Spawning

The spawning of 16 sea urchins *S.drœbachiensis* from Solbergstrand marine station (Norway) have been carried out, for which the 3 best male and female gametes were selected according to size, shape and mobility criteria.
1h30 after the fertilization, 300 zygotes were put into 30mL vials containing the concentration range of leachates [0,1%-10%].



x4 replicates
+ Monitoring of the physicochemical parameters drift

Once the test finished, 10mL of the vials were distributed in 5mL Petri dishes and 2 drops of Paraformaldehyde 4% were added to stop the development. The dishes were kept in the dark at 4°C until the scoring day.

Tests

10°C
8/16h
120h

Scoring

The shooting of at least 50 individuals per replicate was made with an Olympus CX43 microscope in order to score the number of embryos/larvae of each stages in all treatment (Fig.1).

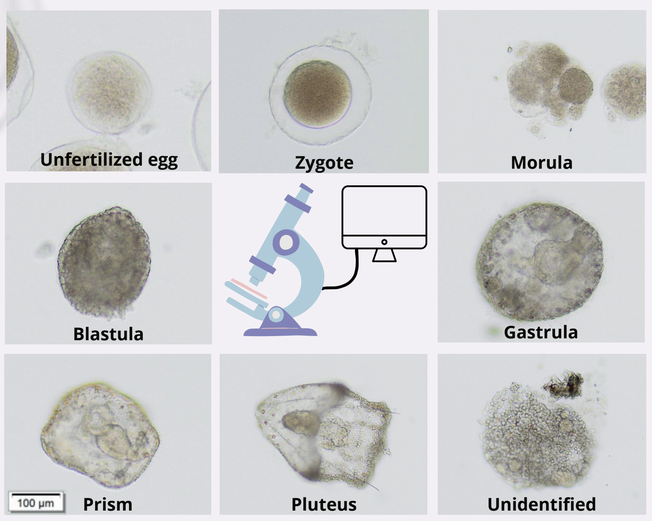


Fig.1 Embryonic stages observed in the microscope x20 magnification

Results

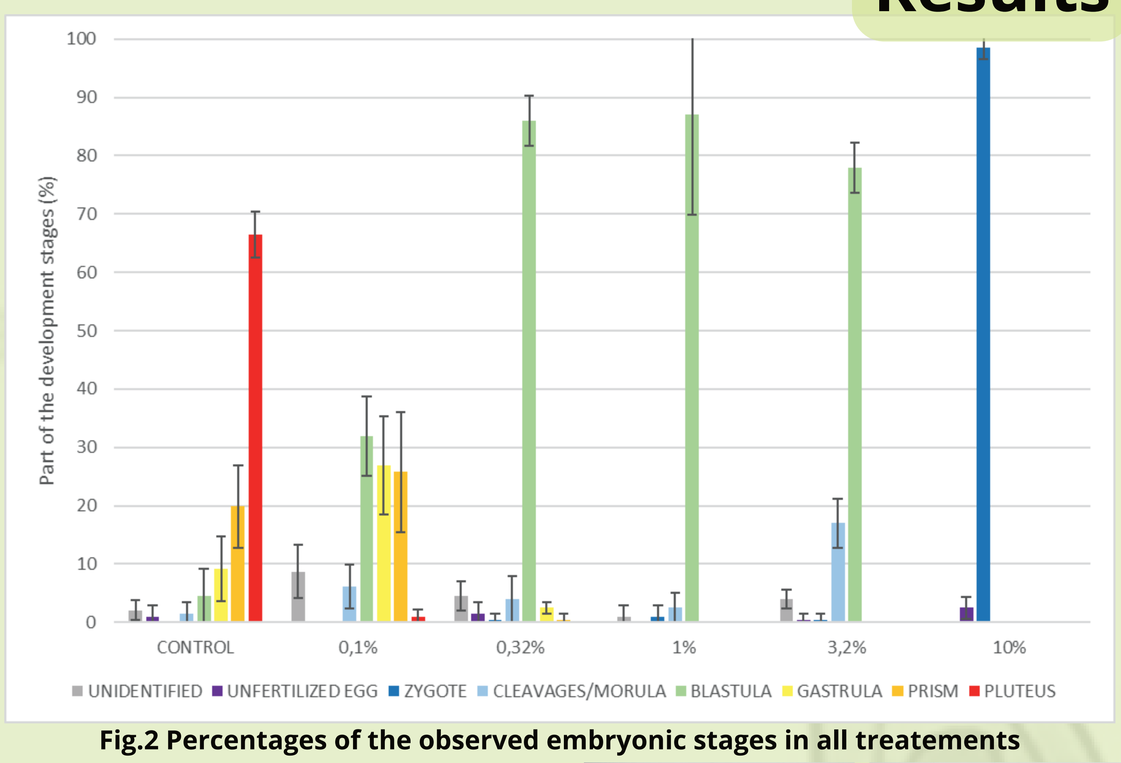


Fig.2 Percentages of the observed embryonic stages in all treatements

- The tests were successful with the correct development of the pluteus larvae reached in the controls. The pluteus represented **65%** of the controls after 120h and by adding the number of prism, the proportion was more than **85%**.
- A **strong inhibition** of the larval development of *S.droebrachiensis* was observed at concentrations above **0.1% of leachates** (Fig.2).
- At the highest concentration tested (**10%**), **no more development** was observed.
- Figure 3 shows images of the more developed stages of leachate used.

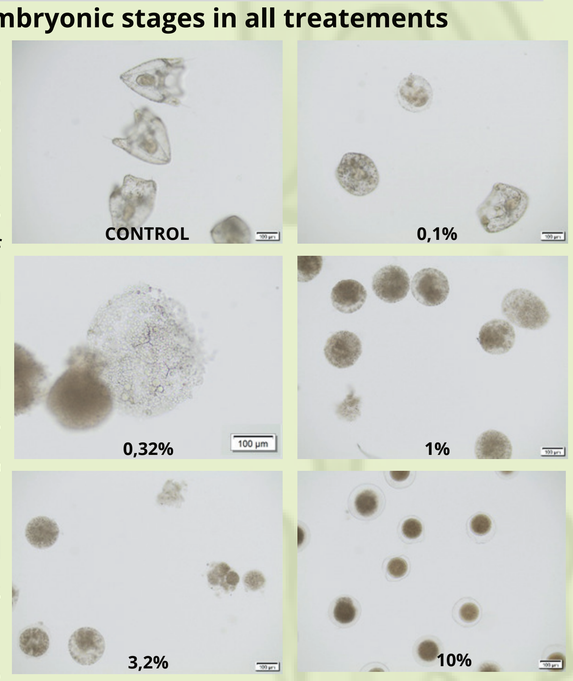


Fig.3 Highest embryonic stages observed in relation with the concentration of washing gloves leachates (expressed as a percentage

Discussion & Conclusions

- To sum up, this work enabled to show that sea urchins, and especially *Strongylocentrotus drœbachiensis*, are **good bioindicators** to measure the toxicity of plastic leachates.
- The ones from the washing gloves seem particularly noxious even at low concentrations. This toxicity might be related to the **metallic composition** of the gloves (Zn, Cd, Sn, Cr, Co) and to the organic compounds as **butylated hydroxytoluene** (BHT) and **benzothiazoles** (Sørensen et *al.*, 2023). The **cocktail** effect of these diverse pollutants might be potentially hazardous for marine fauna and flora.
- Washing gloves are a largely used object on a daily basis, especially for doing the dishes. The increased toxicity seen in this study suggests that their use might cause the **release of toxic compounds** to the environment and thus cause harm to organisms.
- This impact of chemicals present in plastic products add to that of **plastic litter** in nature, especially due to their **degradation** with the waves action, the changes of temperature, the rocks, the microbiological activity and the photodegradation.

References :

Sørensen, L., Gomes, T., Igartua, A., Lyngstad, I. L., Almeida, A. C., Wagner, M., & Booth, A. M., 2023. Organic chemicals associated with rubber are more toxic to marine algae and bacteria than those of thermoplastics. Journal of Hazardous Materials, 458, 131810. https://doi.org/10.1016/j.jhazmat.2023.131810
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