



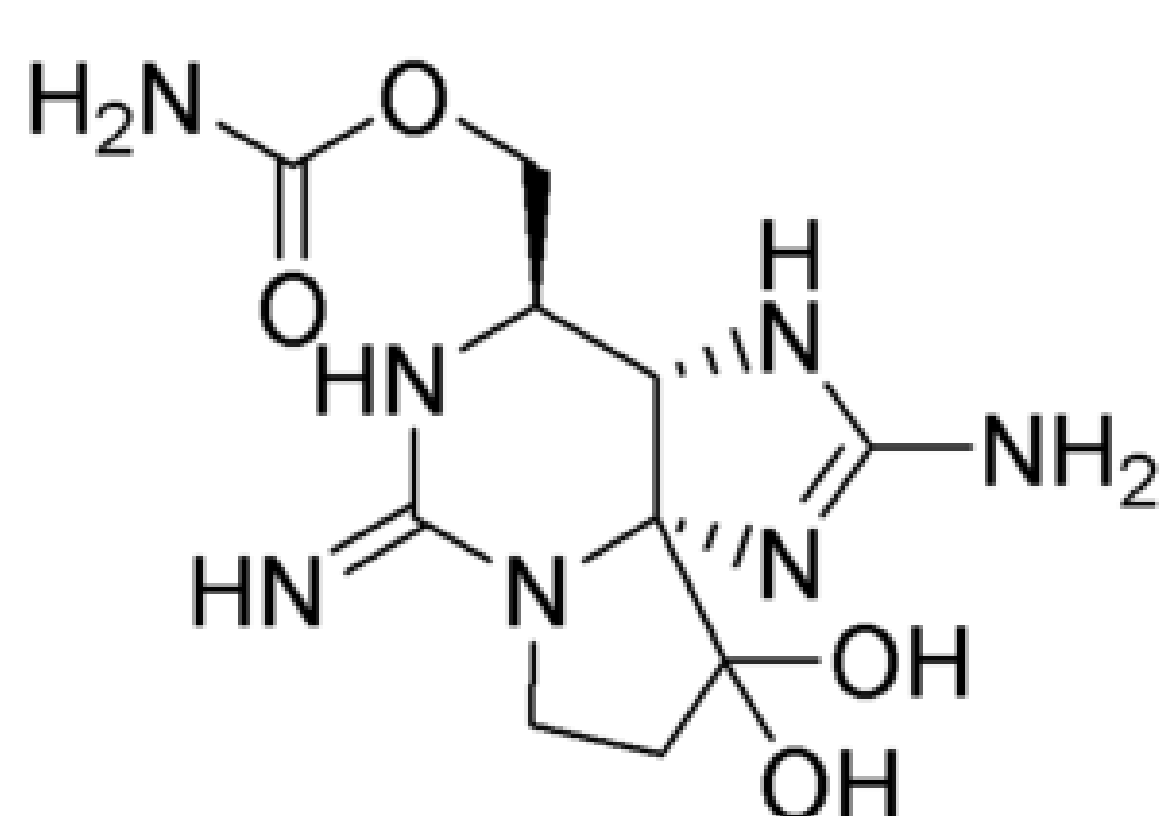
# Green carbon dots developed from biomass for sensing Marine Biotoxin

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## INTRODUCTION

Biomass waste has a lot of promise for creating inexpensive carbon-based nanomaterials for electrochemical sensing applications. This study presents the preliminary results of an immunosensors for a seafood biotoxin detection using Screen Printed Electrodes (SPEs) modified with green nanostructures to enhance their electrochemical performances. With this goal, two green CDs compounds, derived from fish and cork powder, were used to modify the graphite SPEs. These electrodes provide an economical and sustainable way to create carbon-based sensors using biomass sources.



C<sub>10</sub>H<sub>17</sub>N<sub>7</sub>O<sub>4</sub> PM 299.3

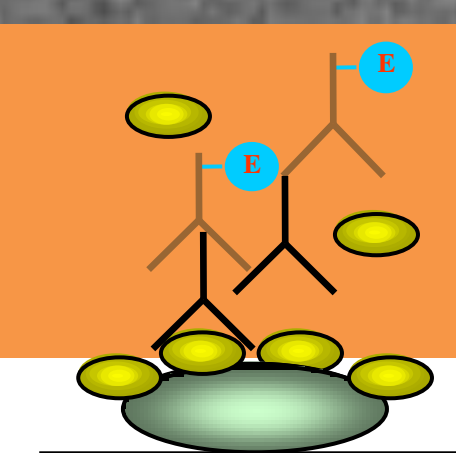
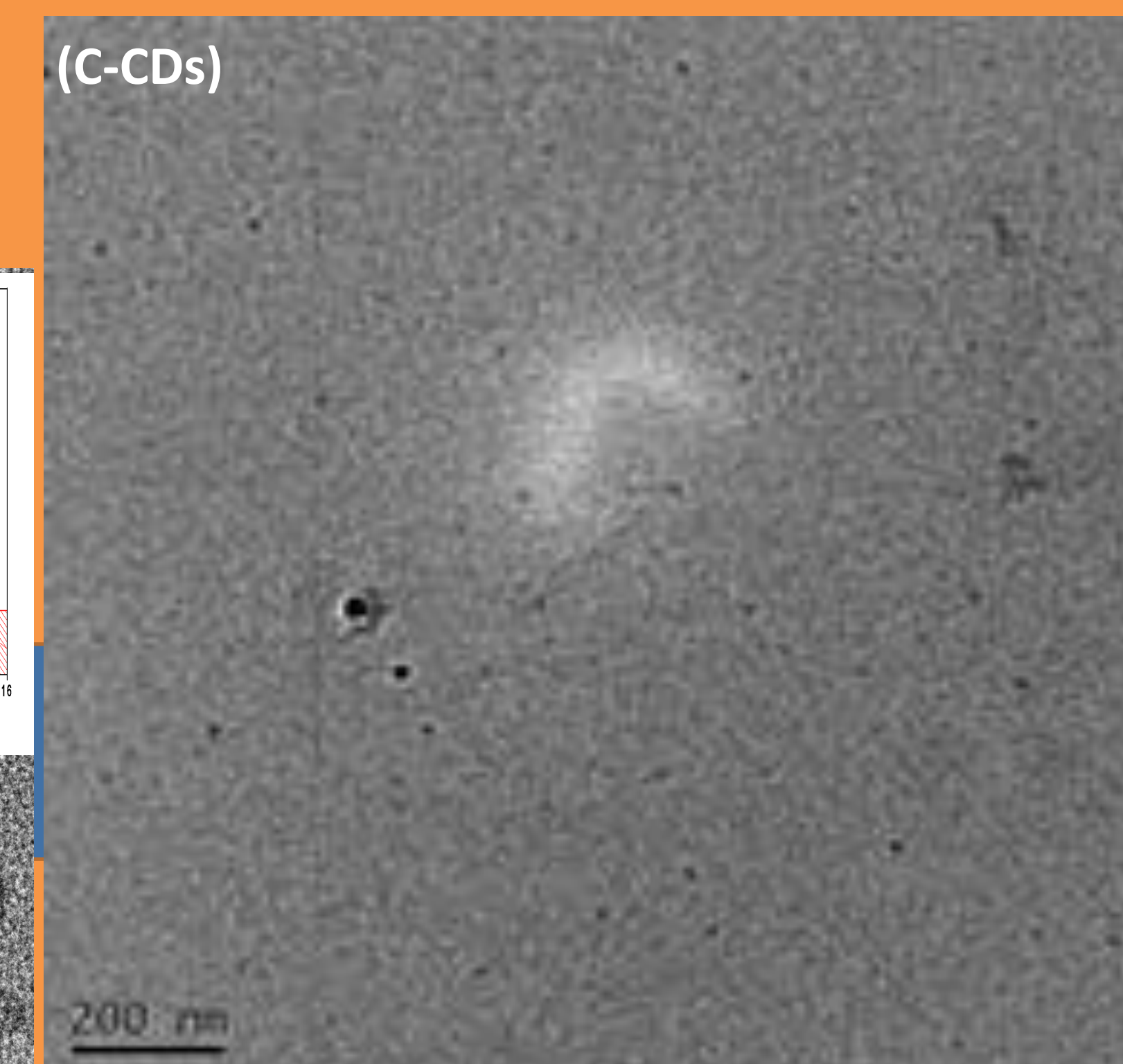
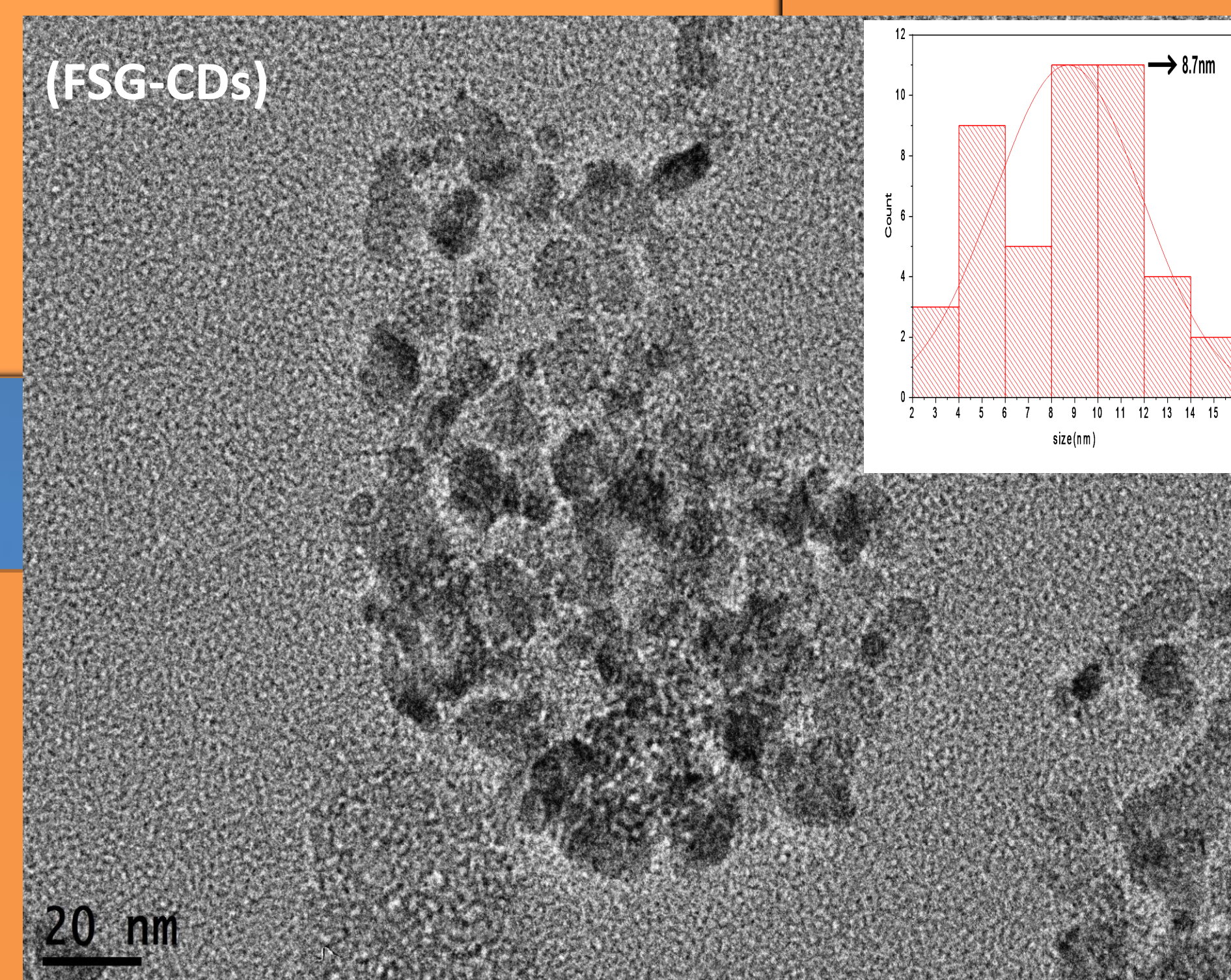
## OBJECTIVE

The purpose of this study is to assess the development of an electrochemical immunosensor for saxitoxin (STX) based on SPE modified with green carbon dots (CDs) made from Cork powder and Fish scales (poster by Gustavino - *Cytogenotoxicity studies on green carbon dots developed from biomass for biosensing applications*) with label free approach. Saxitoxin is one of the most lethal non-protein toxins (LD<sub>50</sub> 9 mg Kg<sup>-1</sup>)<sup>1,2</sup> and is known as one of the "Paralytic Shellfish Poisons" (PSP), produced by several marine dinoflagellates and freshwater algae. Contamination of shellfish with saxitoxin has been associated with harmful algal blooms throughout the world. In humans, PSP causes dose-dependent perioral numbness or tingling sensations and progressive muscular paralysis, which may result in death through respiratory arrest<sup>3</sup>. For these reasons it is very important to develop an innovative nanosystem integrating ultrasensitive saxitoxin (STX) detection with sustainable bionanomaterials. This system enables rapid, ultrasensitive monitoring of marine biotoxins to safeguard seafood safety and marine ecosystems, while valorizing industrial byproducts to reduce waste and align with circular economy goals—bridging environmental stewardship with cutting-edge analytical science and aquatic biotechnology..

## METHODS AND MATERIALS

**Preparation of green carbon dots from Fish Scale & Gill (FSG-CDs) and cork (C-CDs):** FSG-CDs & C-CDs prepared by the hydrothermal method – using just water as green solvent – of the FSG powder of the Nile tilapia (*Oreochromis niloticus*) & cork powder by applying the heating programs in a Teflon-based autoclave at 200°C for 12 h.

**Preparation of label-free electrochemical immunosensor for STX detection:** The green FSG-CDs & C-CDs are used to modify by drop casting the surface of screen-printed electrodes (SPEs). Electrochemical characterisation using cyclic voltammetry and square wave voltammetry are used in order to optimise the amount of the deposition, the solvent, the better green material and the storage.



## RESULTS

### ❖ Key Results:

➤ The electrochemical immunosensor functionalized with green carbon dots from cork (C-CDs) confirmed good analytical performance for saxitoxin (STX) sensing:-

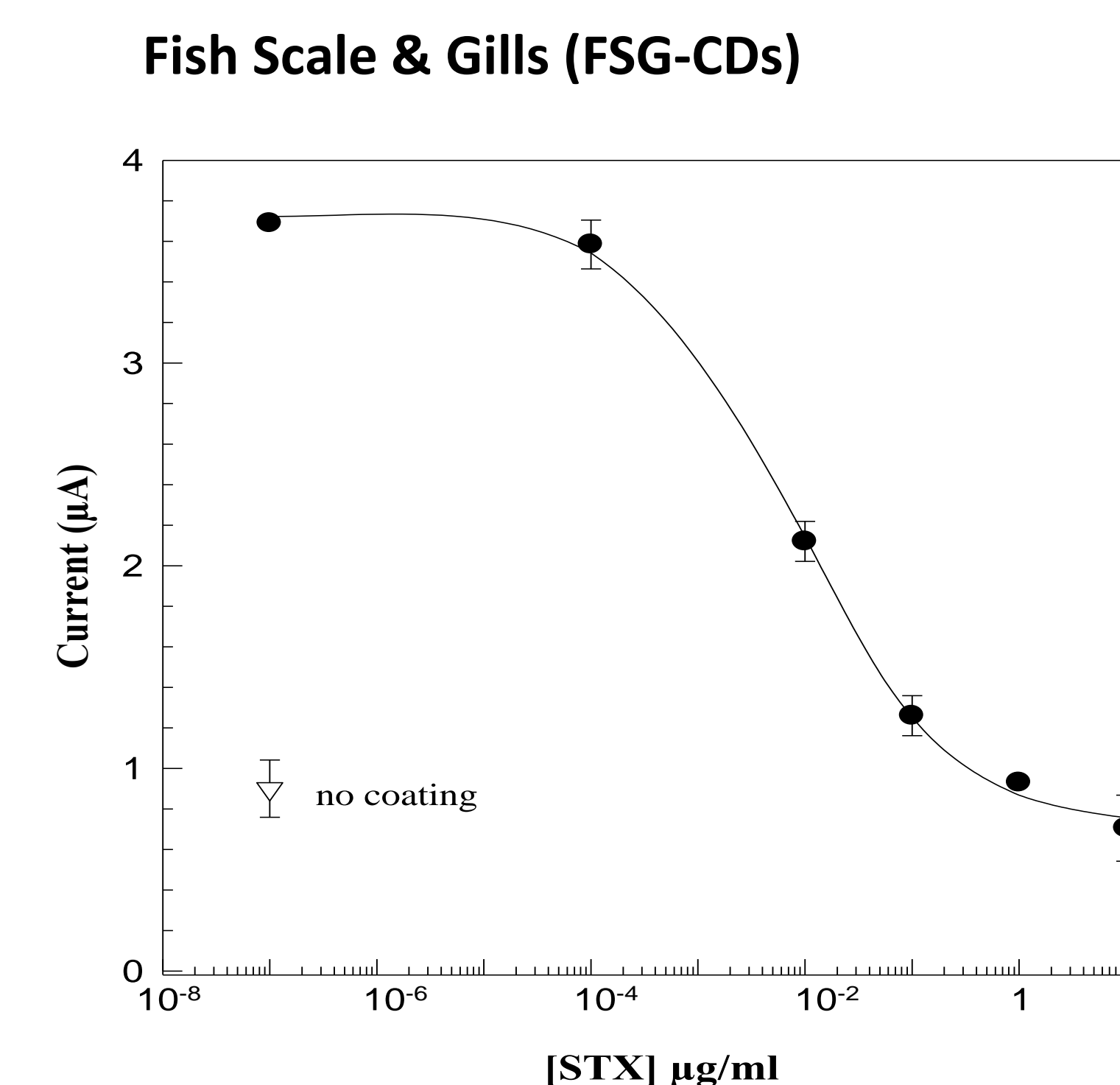
- **Wide Working Range:** Linear detection from 10<sup>-4</sup> to 2×10<sup>-7</sup> µg/mL, enabling quantification across environmentally relevant concentrations.
- **Ultrahigh Sensitivity:** Achieved an IC<sub>50</sub> of 10<sup>-6</sup> µg/mL, reflecting picomolar-level affinity for STX.
- **Robust Performance:** Exhibited excellent selectivity, reproducibility (RSD 8%).

➤ The electrochemical immunosensor modified with green carbon dots from Fish Scale & Gill (FSG-CDs) demonstrates state-of-the-art performance for saxitoxin (STX) sensing:-

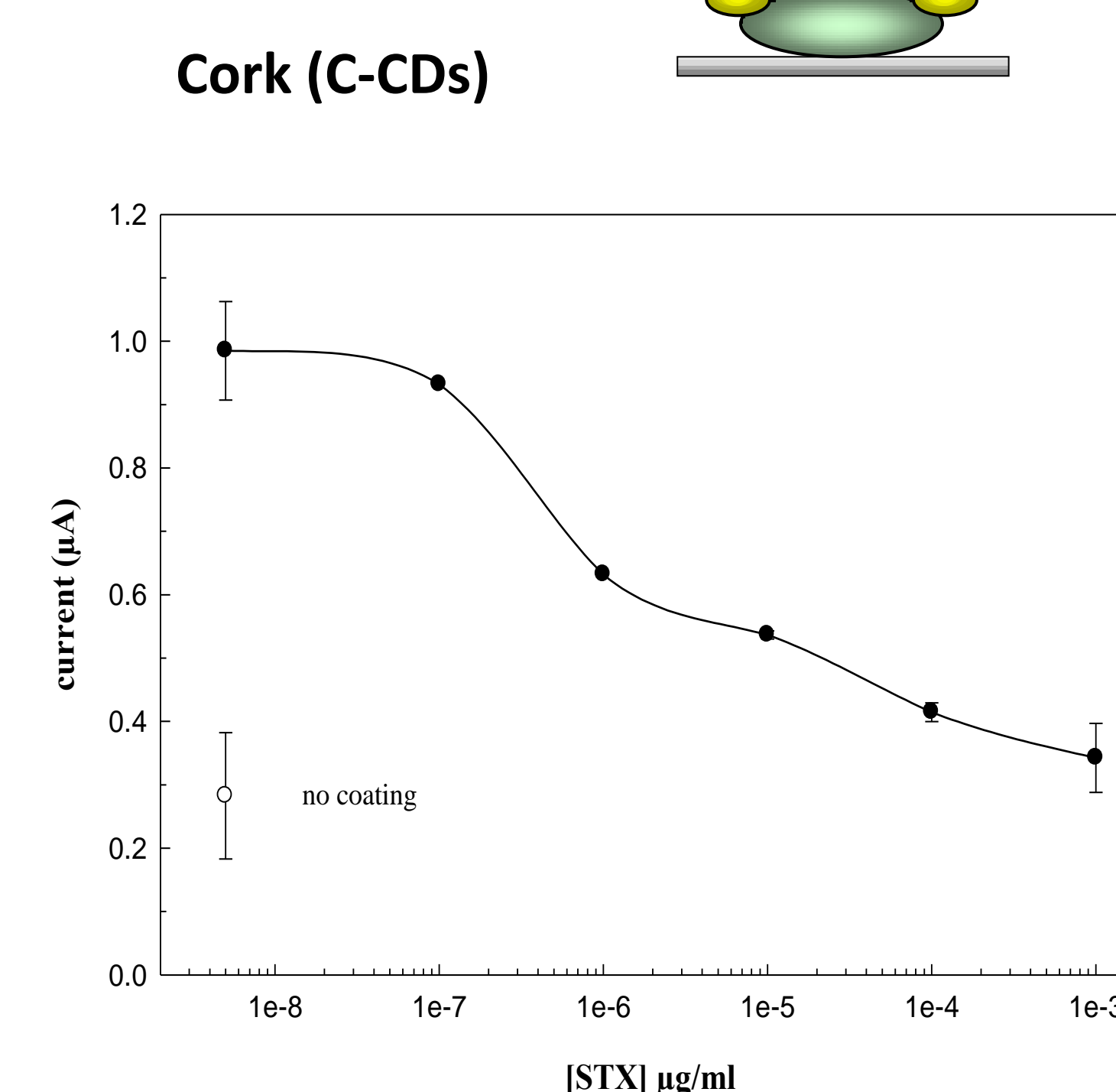
- **Wide Working Range:** Linear detection from 10<sup>-4</sup> to 10<sup>-8</sup> µg/mL.
- **Ultrahigh Sensitivity:** Achieved an IC<sub>50</sub> of 10<sup>-6</sup> µg/mL, for STX.
- **Robust Performance:** Exhibited excellent selectivity, reproducibility (RSD 10%).

## CONCLUSIONS

In this work, a disposable, simple and low-cost platform for immunosensing applications is reported using SPE modified with green CDs. The serigraphic sensor exhibited a satisfactory working range, good sensitivity, reproducibility, selectivity and storage stability with both proposed materials, paving the way for its potential exploitation for the monitoring of STX in a wide range of real matrix samples, such as water or mussel.



**Working range:** 10<sup>-4</sup> ÷ 10<sup>-8</sup> µg/ml  
**IC<sub>50</sub>:** 10<sup>-6</sup> µg/ml



**Working range:** 10<sup>-4</sup> ÷ 2 × 10<sup>-7</sup> µg/ml  
**IC<sub>50</sub>:** 10<sup>-6</sup> µg/ml

## REFERENCES

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