Ricin toxin chain A (RTA) is a byproduct of castor oil production that can be lethal at doses as low as 3 to 5 micrograms per kilogram of body weight. Our bio-sensor was designed based on a known aptamer that binds to the hydrolase protein in ricin toxin. We have successfully designed an E-DNA bio-sensor that is sufficiently sensitive to accurately detect and quantify ricin toxin chain A (RTA) at nanomolar concentrations, with an apparent dissociation constant of 2 nM. In square wave voltammetry, we observe a peak current from methylene blue redox. This data was fit with a custom peak-fitting software. The aptamer was used as the core sequence of a rationally designed DNA oligonucleotide scaffold to allow for the coupling of RTA binding to a conformational change. This change was predicted using Quikfold and no known antidotes exist for ricin toxicity. The most common currently used detection methodologies involve time-consuming ELISA or RIA methods. By designing an E-DNA bio-sensor that is sensitive to ricin or other biological toxins, the length of time needed to detect the presence of these toxins in diagnostic samples may be greatly reduced.

Conclusions
We have successfully designed an E-DNA bio-sensor that is sensitive to ricin toxin chain A (RTA) at nanomolar concentrations, with an apparent dissociation constant of 2 nM. Additionally, this bio-sensor has robust specificity, as the measured current was not significantly affected upon the addition of off-target proteins including bovine serum albumin (BSA) and botulinum neurotoxin variant A (BoNT/A). Although sensor response was decreased in the complex media of bovine blood serum (data not shown), strategies have recently been demonstrated which allow E-DNA bio-sensors to function in whole blood via a laminar flow separation methodology. In the future, these types of optimizations will be explored to allow this sensor to function well in biological media.

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References