APTAMER-BASED BIOSENSOR FOR RAPID DETECTION OF NAEGLERIA FOWLERI IN WATER

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Agenda

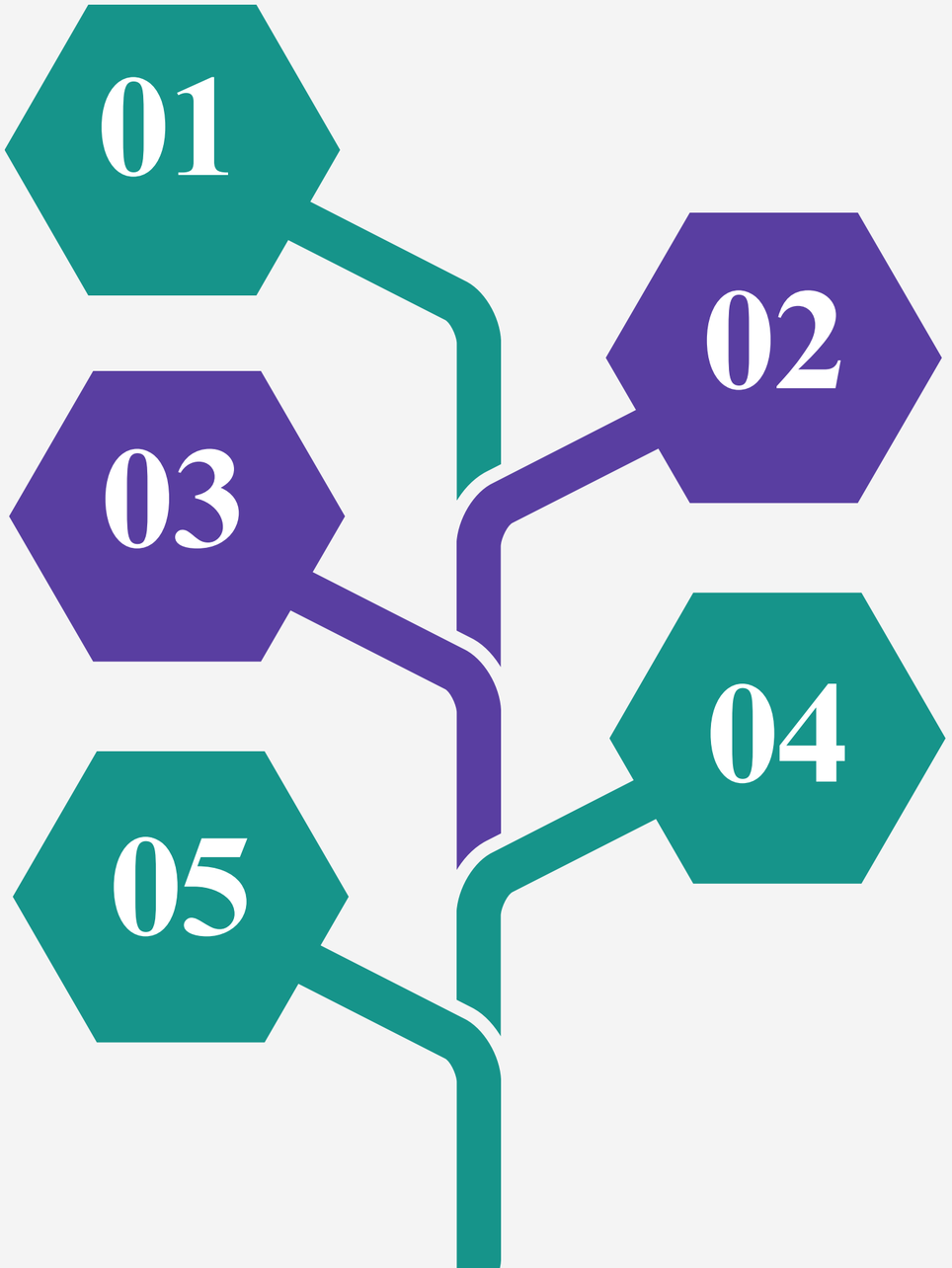
01 **Introduction**
Introduction of Naegleria fowleri and the health risks it poses (PAM).

02 **Problem Statement**
Challenge associated with Naegleria fowleri detection and need for change

03 **Aim of the Project**
Solution to the mentioned challenge in the form of aptamer-based biosensor

04 **Methodology**
Definition of aptamers and their role in targeting Naegleria fowleri proteins.

05 **Results, Discussion & Conclusion**
Importance of the solution and potential further development for commercial use.

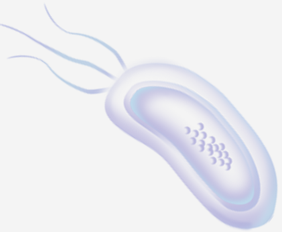


Naegleria fowleri

is a tiny, free-living amoeba typically found in warm freshwater environments, such as lakes, rivers, and hot springs.

Primary amebic meningoencephalitis (PAM) is a rare but severe brain infection caused by Naegleria fowleri. It occurs when the amoeba enters the body through the nose and travels to the brain, leading to the destruction of brain tissue.

Modern methods of N. fowleri detection



1. PCR

A molecular technique that amplifies the DNA of Naegleria fowleri, allowing for highly sensitive and specific detection of the amoeba in water samples.

2. IFA

A method that uses fluorescently labeled antibodies to detect Naegleria fowleri in water samples. The antibodies bind to the amoeba, allowing visualization under a microscope.

3. LAMP

A rapid and cost-effective molecular method that amplifies Naegleria fowleri DNA at a constant temperature, providing quick results in the field.

4. NGS

A high-throughput method that sequences the entire genome of organisms in a water sample, identifying Naegleria fowleri along with other microorganisms present.

PROBLEMS OF MODERN METHODS

HIGH COST

Modern detection methods like PCR and NGS are expensive due to the need for advanced equipment and reagents.

TIME-CONSUMING

Techniques such as PCR can take hours or days, delaying results and timely response.

LAB DEPENDENCY

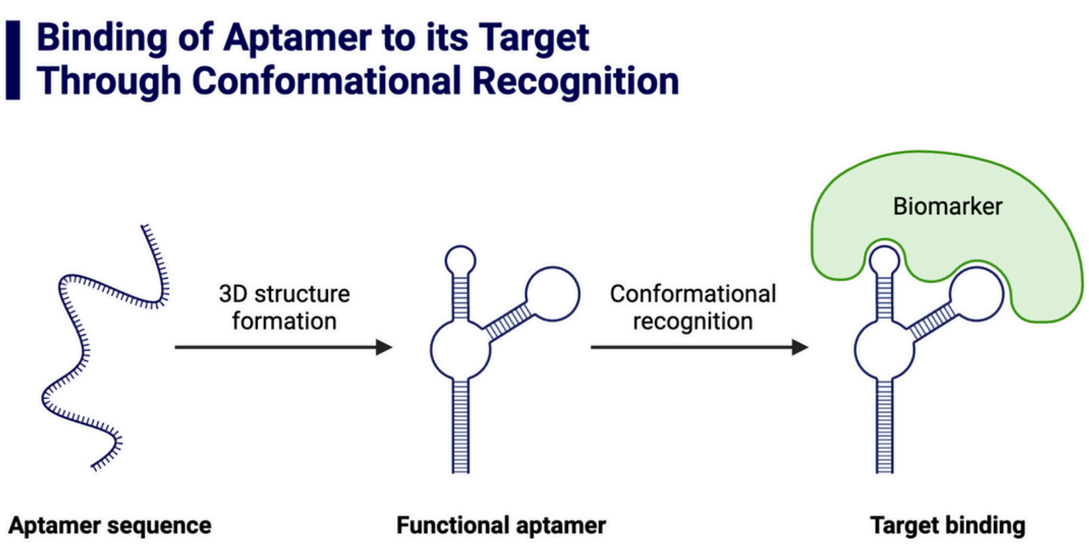
Most methods require specialized labs and trained personnel, making them inaccessible in remote or field settings.

Aim of the project

The goal of this project is to develop a portable, cost-effective, and rapid biosensor using aptamer technology for detecting Naegleria fowleri in water samples.

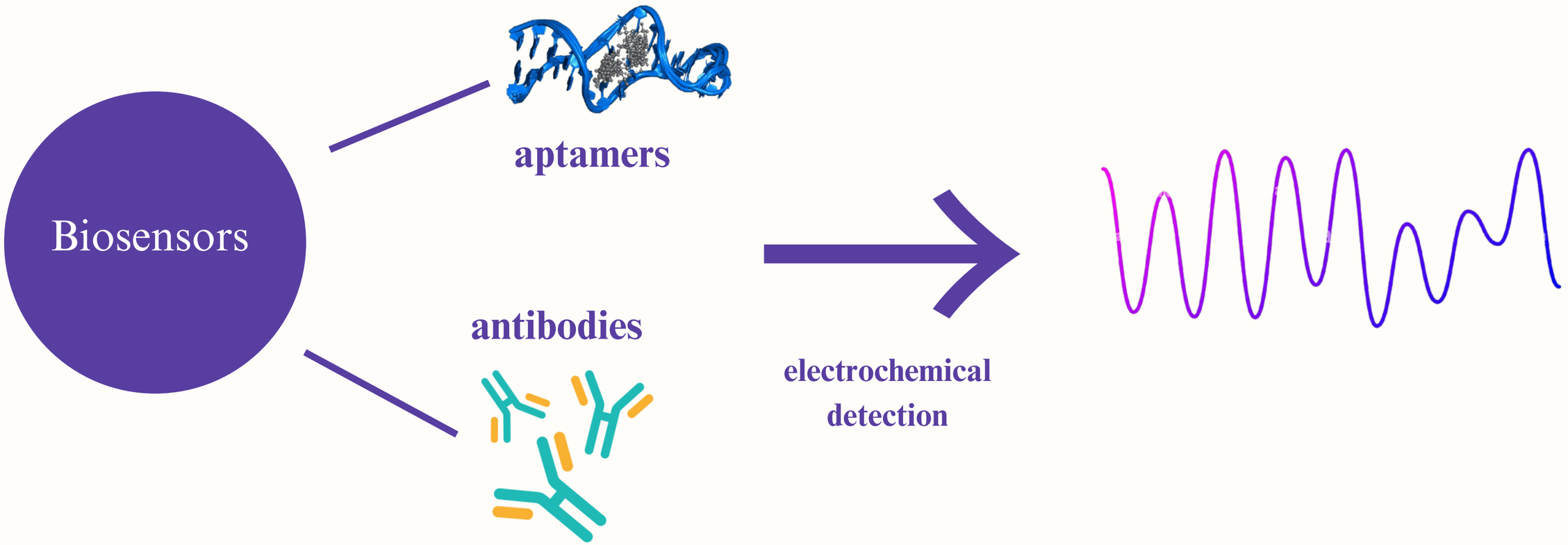
This method aims to provide a faster and more accessible alternative to current lab-dependent detection techniques.

What are the aptamers?



Aptamers are short, single-stranded DNA or RNA molecules that can fold into specific 3D shapes. They are designed to bind selectively to target proteins with high affinity, similar to antibodies. In our case, aptamers are engineered to specifically bind to proteins found on the surface of Naegleria fowleri, like NAGs (Naegleria Adhesion Glycoproteins) or Amoebapore Proteins, enabling the biosensor to detect the presence of the amoeba in water samples.

Why Use Electrochemical Detection?



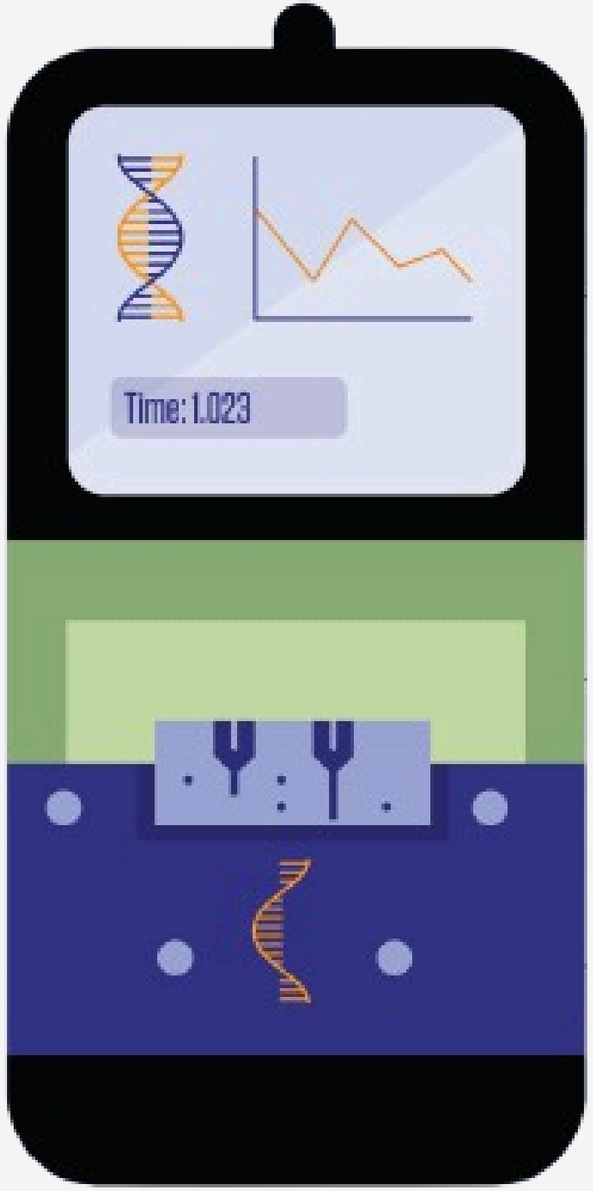
Electrochemical detection is chosen for this biosensor due to its sensitivity, rapid response, and simplicity. This method allows for real-time monitoring by translating specific binding events between aptamers and Naegleria fowleri proteins into measurable electrical signals.

Detection Process

Specific aptamers are designed to bind to surface proteins unique to Naegleria fowleri. The selected aptamers are immobilized onto the surface of an electrochemical sensor. This sensor can detect the binding interaction between the aptamer and amoeba proteins.

When a water sample containing the amoeba is introduced, the aptamers bind to the target proteins. In the electrochemical sensor, the binding of aptamers to Naegleria fowleri proteins triggers a change in the electrical properties of the sensor.

This binding event causes a shift in the electrical signal—such as a change in current or voltage—measured by the sensor. The sensor's readout system converts these changes into a quantifiable signal, indicating the presence and concentration of the amoeba in the sample.



Readout Mechanism

The readout mechanism of the biosensor involves a digital display integrated into the device or a connection to a smartphone. This mechanism converts the electrical signal changes detected by the sensor into clear, visual outputs, such as numerical values or graphs, indicating the level of contamination.

Results

1.

Based on the study "Development of Aptamer-Based Electrochemical Biosensors for Detection of Cancer Biomarkers", the research indicates that the biosensor successfully detects the presence of the amoeba in concentrations as low as 10 cells/mL.

2.

The biosensor demonstrates the ability to provide results within 10 minutes of sample introduction, confirming its efficiency and potential for rapid on-site detection of Naegleria fowleri.

Advantages and Applications

Advantage 1

Quick Detection

The biosensor offers fast results, detecting Naegleria fowleri in water samples within minutes. This speed allows for timely action to ensure water safety and protect public health

Advantage 2

Cost-effective

Compared to traditional laboratory methods, the biosensor is designed to be low-cost and portable, making it accessible for widespread use in both urban and rural areas.

Application 1

Drinking Water Monitoring

The biosensor can be used to monitor drinking water supplies in real time, particularly in areas at high risk of contamination.

Application 2

Recreational Water Testing

In swimming pools, lakes, and other recreational water bodies, the biosensor provides a practical solution for regular water testing to detect the presence of amoeba

Future Research

Future development will focus on increasing the aptamer-based biosensor's sensitivity to detect the amoeba at even lower concentrations, as well as on tool's multiplexing capabilities to detect multiple pathogens, not just Naegleria fowleri, in a single test.

Additionally, AI driven algorithms can be utilized in the displaying app to analyze trends in water quality data which could also provide predictive analytics for early warning systems.

Conclusions

1.

The aptamer-based biosensor offers a promising solution for the rapid and cost-effective detection of Naegleria fowleri in water, providing results within minutes.

2.

The integration of electrochemical detection allows for a highly sensitive and portable device, ideal for on-site water quality monitoring in both public and recreational water sources.

3.

Future developments, such as enhancing sensitivity and expanding detection capabilities, could make this biosensor a comprehensive tool for waterborne pathogen detection and public health safety.

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