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Born in 1981 in Kumasi, Ghana

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Progress toward the Development of Artificial Tongues for Smart Detection and Removal of Toxic Metals from Water

The pollution of waterbodies with chemicals remains a global threat, but the pollution of waterbodies with heavy metals is much more alarming. This is because of the transversal nature of heavy metal pollution. Once present, heavy metals can easily make their way into soils, aquatic organisms, and eventually the food chain. Additionally, heavy metals cannot be removed once ingested or taken up and can bioaccumulate in organisms, causing devastating health implications even when present at very low concentrations. Amongst the known heavy metals that can pollute waterbodies, the most toxic are mercury, lead, cadmium, and arsenic. To ensure public health safety, it is important that vulnerable waterbodies are constantly monitored for "high" levels of these toxic metals and that efforts are made to remove them. Although technologies exist for both monitoring and removing these toxic metals, they require expensive equipment, infrastructure, and training of personnel and often involve laborious procedures. Handy and sensitive but relatively cheaper alternatives that can be used at the point of sampling are crucial to ensure safe water for all.

My research goal is to investigate and develop inexpensive, environmentally friendly electrochemical sensors for detecting, quantifying, and removing toxic metals in water. Sensors can be modified to not only detect, but also remove targeted contaminants. So, the focus of my research is to develop artificial or electronic "tongues" (to detect and remove) rather than "noses" (to merely detect). This will be achieved using DNA aptamers, which are single-stranded nucleic acids that can bind to targets with affinity and specificity. The use of the DNA aptamers as recognition elements will ensure that only the specific targeted metals will be removed, so that other beneficial metal ions like calcium and magnesium remain intact.

I will use my residency at the Wissenschaftskolleg to continue to develop my research ideas, analyse some data I have already generated for the project, and prepare manuscripts for publication.

Recommended Reading

Emahi, Ismaila, Paige R. Gruenke, and Dana A. Baum (2015). "Effect of Aptamer Binding on the Electron-Transfer Properties of Redox Cofactors." Journal of Molecular Evolution 81: 186–193. https://doi.org/10.1007/s00239-015-9707-7.

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Emahi, Ismaila, Patrick O. Sakyi, Pennante Bruce-Vanderpuije, and Abdul Rasheed Issifu (2019). "Effectiveness of Raw versus Activated Coconut Shells for Removing Arsenic and Mercury from Water." Environment and Natural Resources Research 9 (3): 127–134. https://doi.org/10.5539/enrr.v9n3p127.

KOLLOQUIUM, 02.11.2023

Towards the Development of Smart, Sensitive Biosensors for Improving Drinking Water Quality

Like many developing countries, Ghana faces chronic heavy metal pollution of waterbodies from destructive, industrial activities such as mining and heavy manufacturing. Most rural populations depend for their domestic activities on untreated water from rivers and streams often containing these toxic heavy metals. In most urban areas, groundwater is the dominant source of drinking water, but these sources are equally threatened by heavy metal pollution from untreated industrial effluent. Accurately monitoring the presence of toxic metals in drinking water is essential, but requires the use of highly selective and sensitive techniques. Traditional analytical methods for such assessment are extremely expensive and require laborious laboratory procedures, making them impractical for rapid, in situ measurements that benefit both the rural and urban poor who depend on such water for drinking and irrigation. There is therefore the need for handy, cheaper, but equally sensitive alternatives that can be used by end users at the point of collection or of the use of water to detect and remove toxic heavy metals.

My research ambition is therefore to develop inexpensive, environmentally friendly biosensors based on DNA aptamers for detecting, quantifying, and removing toxic metals in drinking water. In this presentation, I will highlight the efforts I am making towards achieving this ambitious objective. The challenges associated with this work will also be discussed.

PUBLIKATIONEN AUS DER FELLOWBIBLIOTHEK

Emahi, Ismaila (Amsterdam,2024)

Improved greywater quality after biofiltration with a fibre-biofilter derived from plantain pseudo stem

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Emahi, Ismaila (Oxford,2024)

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https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1887983953

Emahi, Ismaila (Toronto,2019)

Effectiveness of raw versus activated coconut shells for removing arsenic and mercury from water

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Emahi, Ismaila (Pennington, NJ,2017)

Electrochemistry of pyrroloquinoline quinone (PQQ) on multi-walled carbon nanotube-modified glassy carbon electrodes in biological buffers

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Emahi, Ismaila (New York, NY,2015)

Effect of aptamer binding on the electron-transfer properties of redox cofactors

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