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Use of fluoride-responsive riboswitch as a biosensor for determination of fluoride levels in drinking water

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Fluoride is a trace element that is obtained mainly through drinking water. Even though fluoride is beneficial for dental health, high levels of fluoride may cause health issues such as dental and skeletal fluorosis, low weight and height at birth, nephrotoxicity, and neurotoxicity. In Sri Lanka, high fluoride levels in groundwater have become a major problem as the majority of the population uses untreated groundwater as their main drinking water source. Therefore, it is essential to measure and evaluate the fluoride content of drinking water using an accurate, inexpensive, and selective method to prevent harmful effects on health. However, most of the currently available fluoride detection techniques lack sensitivity and selectivity whereas some analytical methods are labor-intensive and time-consuming. In this study, we exploit the fluoride-sensing regulatory RNA element called fluoride-riboswitch (FRS) as new approach for monitoring fluoride levels. A riboswitch is a non-coding part of the messenger RNA (mRNA) that can sense specific cellular metabolites such as fluoride ions and regulate the downstream gene expression *via* conformational changes in response to ligand binding. In this research, we used a bacteria (*E. coli*) harbouring FRS coupled to a reporter gene (encodes the enzyme β -galactosidase) to determine the fluoride concentration in drinking water. The β -galactosidase activity is proportional to the fluoride level in the water sample as the expression of the reporter gene is regulated by the binding of fluoride to FRS. According to our results, water samples obtained from Kurunegala, Jaffna, and Mulliathivu showed a high concentration of fluoride compared to other regions, and these values are close to the WHO recommended upper limit of fluoride levels in drinking water. Based on the data, authorities can take necessary measures to advice people in fluoride endemic areas to consume purified drinking water to avoid further fluorosis risk.

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