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Relationships between water quality parameters and geosmin contamination in water bodies in North Central and Eastern Provinces in Sri Lanka

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Geosmin (a tertiary alcohol) is a secondary metabolite of aquatic cyanobacteria and actinomycetes. Geosmin contamination produces earthy taste and odour in drinking water. Geosmin cannot be removed by heating the water at 100ºC. Human sensory threshold range of geosmin is 5 to 40 ngL^{-1}, therefore trace levels in the drinking water leads to consumer rejection. In this study, water samples collected from 12 water bodies in North Central (Anuradhapura, Pollonnaruwa) and Eastern provinces (Ampara, Batticcaloa and Trincomalee) in Sri Lanka were analyzed for geosmin content using gas chromatography–mass spectrometry coupled with solid-phase micro extraction. Water pH, temperature, dissolved oxygen (DO) and electrical conductivity (EC) were measured on site and nitrate-N, nitrite-N, ammonia-N, total phosphorous, hardness and total cell density of cyanobacteria were measured off site using standard methods. Water quality was evaluated with an empirical approach using Principal Component Analysis (PCA) which identified three different clusters based on geosmin content, total odour and taste forming cyanobacteria cell density and physico-chemical parameters. Nuwara wewa, Tissa wewa and Nachchadoowa wewa were clustered together with high geosmin, pH, EC, total phosphorous and total odour and taste forming cyanobacteria whereas Unnichchi tank, Kondawatuwana tank and Kanthale tank were clustered together with nitrate–N and DO values. The third cluster consisted of Jayanthi wewa and Sagama tank with nitrite – N values. The highest geosmin level was recorded in Nuwara tank (10.9 ngL^{-1}) and the lowest was detected in Nallachchiya tank (7.8 ngL^{-1}). Geosmin levels in the water from Jayanthi tank, Sagama tank, Kondavatuwana tank, Unnichchi tank and Kantale tank were below the detection limit (<1.5 ngL^{-1}). Water pH, EC, hardness, total phosphorous, N-Nitrate and N-ammonia levels were within the SLSI drinking water standard range. Tissa wewa had a high N-nitrite content (16.54 mgL^{-1}) exceeding SLSI drinking water standards (3 mgL^{-1}). All other water bodies had a safe N-nitrite range for drinking purpose. A significant positive correlation ($p<0.05$) between total phosphorus and geosmin content was found indicating total phosphorus may be the limiting factor for the production/existence of geosmin. In addition, geosmin content was positively correlated ($p<0.05$) with EC and pH indicating high dissolved ions and high alkalinity might support geosmin content in water. Geosmin and total odour and taste forming cyanobacteria cell density were correlated positively ($p<0.05$) showing their positive association. The results revealed that it is necessary to use modern treatment facilities in the drinking water treatment plants in order to remove geosmin contamination prior to distribution of drinking water for general public.

Keywords: Gas chromatography–mass spectrometry, Geosmin, PCA analysis, Solid-phase micro extraction

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