UNIVERSITI TEKNOLOGI MARA

ASSESSMENT OF CHEMICALS AND RADIONUCLIDES COMPOSITIONS IN HOT SPRINGS WATER OF PENINSULAR MALAYSIA

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Thesis submitted in fulfilment
of the requirements for the degree of
Master of Science

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

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ABSTRACT

Hot springs water has been associated with healing of various types of skin diseases. Despite their therapeutic effects which are known worldwide, there are limited reports on the physicochemical characteristics of hot springs water in Peninsular Malaysia. Therefore, an attempt was made to determine the concentrations of major cations, anions and sulphur including naturally occurring radioactive material (NORM). There are 43 locations of hot springs water with 67 sources identified in Peninsular Malaysia which cover almost all states. Chemicals and radionuclides compositions measured in this study include Na^+, K^+, Ca^{2+}, Mg^{2+}, S, Cl^-, SO_4^{2-}, U and Th. Concentrations of Na, K, Ca and S were analysed using Energy Dispersive X-ray Fluorescence (EDXRF) while Mg^{2+}, U and Th were analysed using Inductively Coupled Plasma Optical Emission Spectrometer (ICP-OES). Ion chromatography (IC) was used to analyse Cl^-, HCO_3^- and SO_4^{2-}. Results obtained from the analysis of Na, K, Ca and S done by Energy Dispersive X-ray Fluorescence (EDXRF) were verified using Inductively Coupled Plasma Optical Emission Spectrometer (ICP-OES). The results signified that locations of the hot springs water give different concentrations of chemical due to different geological formations that indirectly contributed to the different effects of therapeutic properties. From the PCA there could be two sources of the hydro chemicals in the hot water springs; granite rock for U and Th, and other cations and anions from other types of rock formation. Additionally, the hot springs water were also classified based on Piper diagram; which was later mapped based on the measured water hydrochemical data. The hot water springs generally can be classified into three types namely type I (Ca-HCO_3), type II (Na-Cl) and type III (Na-HCO_3). Out of 67 hot springs water sources, 61 of the locations fall into type III (Na-HCO_3). Furthermore, ingestion toxicity dose and annual ingestion dose were calculated to identify the dose could obtain if it had been used as a drinking water. In term of health and safety, in general most of hot springs water does not comply with the guidelines use for balneotherapy as well as for drinking. Air Hangat Langkawi, Gersik and Air Panas Terong which falls in type II (Na-Cl) has been identified based on physicochemical properties has been identified the most potent to be used for balneotherapy.

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