Rapid Osteoporosis Risk Assessment: Non-invasive Detection Kit of Calcium, Phosphate and pH in Human Sweat

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Osteoporosis is a hard-to-detect disease involving bone degeneration. Most of the people living with osteoporosis are unaware of it until complications occur. Detection of calcium and phosphate ions (major constituents of bone scaffold) in sweat secretion is a possible monitoring method for bone conditions because high levels of calcium and phosphate in sweat could indicate a high chance of osteoporosis. Therefore, we developed colorimetric detection kits for calcium, phosphate and pH in human sweat to assess the risk of osteoporosis. The o-cresolphthalein complexone, molybdate and universal indicator were used for the three analytes respectively. High sensitivity and specificity for the colorimetric detection of calcium, phosphate and pH were illustrated. The limit of detections (LoD) in our preliminary UV-Vis experiments with the artificial sweat solution were 7.77 x 10-2 mM for calcium and 3.99 x 10-3 mM for phosphate. To optimize for the most suitable condition for the colorimetric detection, a foldable kit prototype comprising a sweat zone, a reaction zone and an interpretation zone was developed. The color intensities were enhanced by a TiO2 nanoparticles-coated sweat zone due to its anti-wetting rose petal like-surface. The sweat bandage kit was also developed for easy skin attachment. Smartphone RGB application was employed to interpret the color results in terms of quantitative analysis. The final result was that the completed colorimetric results were rapidly detectable in 72 seconds. To the best of our knowledge, this is the first non-invasive method for screening of osteoporosis. The promising results from this work are potentially applicable in the biomedical field for rapid osteoporosis risk assessment in the future.

Awards Won:
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