- Application Note -

Title

Raman spectroscopy as a non-invasive, label-free analysis method of mesenchymal stem cell differentiating into osteogenic and adipogenic cell

Introduction

Requirements of label-free, non-invasive biological analysis method have been increased because of the regulation which restricts the use of animal models for development of pharmaceutics and cosmetics. Raman spectroscopy is a non-invasive vibrational spectroscopy technique and does not require any labels. Therefore, Raman spectroscopy is found appropriate alternative method of conventional biological assay methods. Conventional cell assay methods like polymerase chain reaction (PCR), fluorescence staining, histological staining and immuohistochemical staining are not only destructive but time-consuming and operator-dependent methods. Here, we applied Raman spectroscopy on the analysis of differentiation of mesenchymal stem cells into osteogenic cells and adipogenic cells.

Mateirlas & Methods

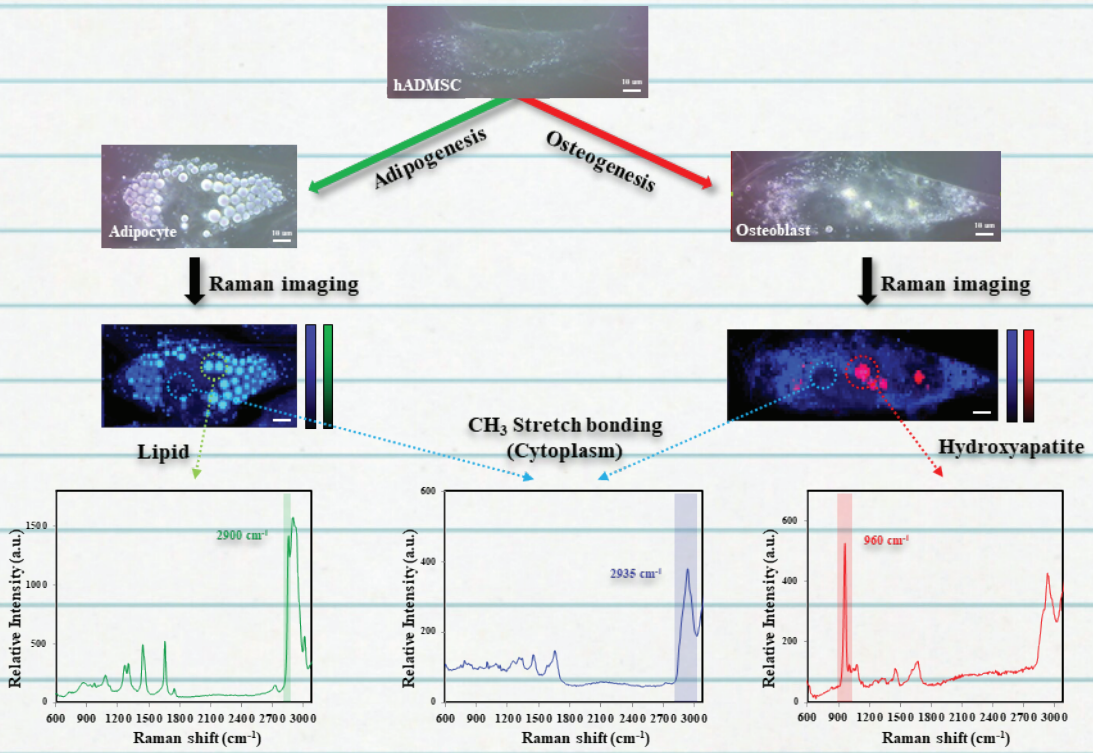
Human adipose derived mesenchymal stem cells were cultured and differentiated into adipogenic and osteogenic cell. Raman spectrum and Raman images were obtained by a micro-Raman spectroscopy system, **XperRam S Series (XperRam S500)**. The Raman peak of CH_3 stretching bonding were found in both cell types` cytoplasm. Remarkably, assigned Raman peaks of the lipid and hydroxyapatite (HA) were found on adipogenic cell (fat cell) and osteogenic cell (bone cell) each. By combining the Raman peak of CH_3 stretching bonding and cell type specific compounds (e.g. lipid and HA), single cell Raman images of differentiated fat cell and bone cell from human mesenchymal stem cell could be obtained.

Conclusion

Single cell colored Raman images can be obtained by Raman spectroscopy instrument, **XperRam** and cell differentiation was detected by analyzing of Raman spectrum of a single cell with no any label and non-invasive method. Hence, the Raman spectroscopy has high potential for real time mo-

nitoring tool of in-vitro and in-vivo stem cell differentiation as a label free and non-invasive method. In addition, it may also facilitate to reduce the animal test for development of pharmaceutics and cosmetics by in-situ monitoring of organoids or organ-on-a chip.

Figure



Acknowledge-ment

Sample courtesy of Prof. Hyungbin Son and Prof. Tae-Hyung Kim (School of Integrative Engineering, Chung-Ang University).

Reference

[1] Suhito, Intan Rosalina, et al. "In situ label-free monitoring of human adipose-derived mesenchymal stem cell differentiation into multiple lineages." Biomaterials 154 (2018): 223-233.

[2] Marques, Marco PC, et al. "Microfluidic devices towards personalized health and wellbeing." Journal of Chemical Technology & Biotechnology (2019).

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