Effects of Davallia formosana Hayata and differentiation on the proliferation of osteoblastic MC3T3-E1 cells

1-Chia-Feng Wu, 2-Chen-Yu Chen, 3-Ming-Chang Wu, 4-Jen-Shinn Lin, 5-Wen-Chang Chang
1Department of Medicinal Plant Development, Yupintang Traditional Chinese Medicine Foundation, Taiwan
2Department of Food Science, National Pingtung University of Science and Technology, Pingtung, Taiwan

Abstract
In Taiwan, osteoporosis has become a serious health concern in the society due to the imbalance of bone resorption and formation. Partial bone fractures are common clinical signs caused by osteoporosis in the elderly population. Thus, finding new strategies that contribute to bone formation is imperative and indispensable. Davallia formosana Hayata is a native Taiwanese fern which is mainly used to stimulate osteogenesis and repair damaged osteocytes. To date there have been no results on MC3T3E1 studies regarding this plant, therefore the aim of this study was to evaluate the positive effect. Davallia formosana Hayata water extracts (DFWE) on proliferation and differentiation of pre-osteoblast cells. Pre-osteoblast MC3T3E1 cells were treated with different concentrations of DFWE (10ppm, 25ppm and 50ppm) for 24 hours and survival ability and protein expression of disease-associated membrane receptors were evaluated. Results showed that DFWE enhanced cell survival ratio of MC3T3E1 cells to 100%, 110% and 112%, respectively. DFWE 25ppm and 50ppm in cell survival has increased significantly (P<0.05). Proteins expression of bone morphogenetic protein 2 (BMP), collagen 1 (COL-1), alkaline phosphatase (ALP) and runt-related transcription factor 2 (RUNX-2) are 102%, 162%, and 216%, 134%, 210% and 228%, 111%, 148% and 148%, 106%, 165% and 204% compared to the control group, respectively. (-)-Epicatechin-3-O-d-allopyranoside (CP) was isolated using column chromatography of DFWE. This compound, at the concentration of 0.01mg/mL, exhibits the higher survival ability and mineralization in MC3T3E1 cells. We postulate that CP is an active component in DFWE that may promote cell proliferation and differentiation in MC3T3E1 cells. Water extract of Davallia formosana Hayata may have potential to be used by patients with osteoporosis in the future.

Keywords: Davallia formosana Hayata, osteoporosis

Materials and methods

Results

Conclusions
BMP interacts with various downstream proteins including Runx-2, which induces bone differentiation factors. Additionally, ALP and COL-1 are produced as early osteogenic markers of matrix maturation while the late osteogenic mineralization markers are osteocalcin and osteopontin in our study. We isolated an active compound from DFWE identified as (-)-Epicatechin-3-O-d-allopyranoside (CP), which significantly increased the mineralization in MC3T3E1 cells. Therefore, CP could be useful for preventing osteoporosis and as marker compound to figure out the quality of DFWE.