

〈Regular Article〉

Stimulation of Noggin Signaling in Keratinocytes by an Extract of Mulberry (*Morus alba* L)

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(Accepted: November 30, 2016)

Abstract

Traditional Chinese medicine has utilized various parts of *Morus alba* L (white mulberry) to ameliorate chronic sicknesses caused by organ or tissue disorders. We investigated the effects of the ethanol extract of mulberry fruits on the expression of the hair cycle-associated genes of cultured human keratinocytes to explore its potential as a hair-nourishment ingredient. Two types of cultured human cells were utilized: human epidermal keratinocytes (HEKs) and HaCaT cells (a cell line of keratinocyte). Cells were treated with mulberry extracts and its effects were evaluated in terms of growth capacity and the expression of 12 known hair cycle-associated genes. Mulberry extracts significantly stimulated the growth of HEKs and HaCaT cells. Among the 12 tested genes of HaCaT cells, the expression of noggin gene (*NOG*) was increased most prominently by the extract. The up-regulated expression of *NOG* induced by the extract was also observed in HEKs. In contrast, the expression of bone morphogenetic protein 4 gene (*BMP4*) and p27^{Kip1} gene, both genes associated with noggin signaling, was down-regulated in HaCaT cells by the extract, strongly suggesting that the extract may have stimulated keratinocyte growth through the suppressive effects of noggin on BMP-p27^{Kip1} signaling. Furthermore, HaCaT cells were exposed to oxidative stress using *t*-butylhydroperoxide or UV and then treated with the extract in order to determine whether the extract mitigates oxidative stress-induced alterations. HaCaT cells significantly decreased the *NOG* expression when exposed to oxidative stress. The extract was able to recover the oxidative stress-induced suppression of *NOG*. These results suggest that mulberry extracts mitigate oxidative stress-induced damage in cells. Therefore the results in this study suggest the potential of the mulberry extracts as an ingredient in hair-nourishment products.

Key words: *Morus alba* L, hair growth, keratinocytes, noggin, oxidative stress.