Research and development of anti-hair loss products containing *Equisetum debile* Roxb. extract with pharmacological activity

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Abstract

Equisetum debile is a local plant widely distributed in the highland area of Thailand, especially in the Northern part. The aims of the present study were to investigate the inhibitory activity against 5-alpha reductase of *E. debile* extract and develop prototype anti-hair loss products from *E. debile* extract for commercial purposes.

The aerial part of *E. debile* was extracted by maceration using various solvents to give crude ethanolic extract, ethanolic extract, ethyl acetate extract, and hexane extract. Dechlorophyll extract was obtained by removing chlorophyll from the crude ethanolic extract using electrocoagulation method. The yields of the extracts were 16.13%, 1.25%, 4.22%, 3.62%, and 7.33%, respectively. The solubility of each extract was different. However, olive oil was a good solvent for all extract. The 5-alpha reductase inhibitions of the extracts were analyzed by using the enzyme from liver of Sprague-Dawley rat. The ethyl acetate extract showed the highest 5-alpha reductase inhibition with 71.62 ± 3.35% inhibition, comparing to 1 mM Ethinyl estradiol. Therefore, ethyl acetate extract was selected for further product development.

Among 14 formulations of hair serum bases, 6 formulations including formulation 3, 5, 6, 9, 10, and 11 were found to have good appearance and good stability. Therefore, they were selected for the incorporation of ethyl acetate extract. Because of the solubility limitation of the extract, it was prepared as microemulsion, composing of 10% olive oil, 54% Tween 85, 26% propylene glycol, and 10% water, before incorporating into the hair serum bases. Among 6 formulations of hair serum containing *E. debile* extract, 5 formulations including formulation 3, 6, 9, 10, and 11 were found to have good appearance and good stability. The selected formulations were formulation 3, 6, and 10 which were gel serum, cream serum, and liquid, respectively.

In conclusions, ethyl acetate extract of *E. debile* possessed high inhibitory activity against 5-alpha reductase which is an enzyme involved in the production of dihydotestosterone that responsible for hair loss in androgenetic alopecia. Therefore, the hair serum products containing *E. debile* extract would be attractive for anti-hair loss purpose.