

## Regular Article

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# Enhancing Production of Terpenoids in Metabolically Engineered Transgenic Spearmint (*Mentha spicata* L.) by Salt and Fungal Elicitors

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## Abstract

Forest tree species usually takes for long periods to be harvested and cultivated but spearmints are a good model system for woody plant because of reducing and shortening cultivation time. Spearmints are good model plants (*Mentha* species) for research about terpenoids production and industrial essential oil manufacture. Isopentenyl pyrophosphate isomerase (*Iso*) and limonene synthase (*Limo*) are the key enzymes of terpenoid biosynthesis pathway. Transgenic and wild spearmints (*Mentha spicata*, MS) were cultured *in vitro* and assessed for the essential oil contents. The content of essential oil of transgenic spearmint also was enhanced slightly depending on the target terpenoid genes. In an attempt to increase productivity of terpenoids further, salt and fungal elicitation strategy was adopted on transgenic *Mentha spicata*. The salt (800 mM NaCl) as abiotic and two fungi (*Botrytis cinerea* and *Glomerella cingulata*) as biotic were used for elicitors. In the absence of salt stress four terpenoids were detected from the spearmint extracts, all of them being monoterpenes. On the other hand, the transgenic (*MSIso*) extracts contained eleven terpenoids (10 monoterpenes and 1 phenylpropene) while transgenic (*MSLimo*) extracts contained seven monoterpenes. After 3 days of fungal infection, the resistance indices further increased to 4.38, 3.89 and 2.04 for wild type, *MSIso* and *MSLimo*, respectively. The salt and fungal elicitors proved beneficial towards modifying both the terpenoids profile and improvement in the composition of essential oil. These results have important applications for the large-scale production of essential oils and forest biotechnology with respect to spearmint.

**Key Words:** Essential oils, Elicitors, Forest biotechnology, Metabolically engineered transgenic spearmint, Terpenoids

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