

## Abstract

Peppermint (*Mentha piperita* L.) has 1.2-1.5% essential oil. Fundamental components of peppermint essential oil is menthol that is certainly the best known of the monoterpenes. Menthol has a soothing quality and it is useful for localized pain and antiseptic. In the biosynthesis of terpenes called the methyl erythritol phosphate (MEP) menthol comes by eight steps that in the final pathway menthone converted to menthol by menthol dehydrogenase (menthon reductase). The effects of manganese and salicylic acid on gene expression of menthol dehydrogenase (MR) and menthol in *Mentha piperita*, were investigated. The research was conducted in a bio-center at the University of Zabol and a factorial experiment design in a randomized complete block with three replications was used. Mn treatment and salicylic acid were used and plant samples were harvested three times for 1, 3 and 5 days after spraying. The results of ANOVA indicated that manganese and salicylic acid treatments over three times had significant effect on gene expression of menthol dehydrogenase and menthol. The lowest gene expression of MR and menthol on treated manganese was at the third time, which was significantly different from control. The maximum gene expression and menthol was about salicylic acid at the third time too. The interaction of manganese and salicylic acid, salicylic acid partially reduces manganese toxicity was observed in the expression levels of MR and menthol, respectively. The results of this experiment showed that menthone reductase gene is a direct correlation with the amount of menthol in peppermint so that over time with increased on salicylic acid treatment of MR and menthol oil also rose. Furthermore, it was observed that salicylic acid acts as a potent hormone caused regulating the amount of manganese in gene expression of MR and menthol in peppermint (*Mentha piperita*).

Key words: essential oil, gene expression, menthol dehydrogenase, menthone, peppermint.



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**The effects of manganese and salicylic acid on gene**  
**expression of Menthol dehydrogenase in *Mentha***  
***piperita* by Real-Time PCR**

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