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Linalool and linalool nerolidol synthases in roses, several genes for little scent.

Jean-Louis Magnard[1*], Aurélie Rius Bony[1], Fabienne Bettini[2], Ausilia Campanaro[3†], Bernard Blerot[2], Sylvie Baudino[1], Frédéric Jullien[1]

Aurélie Rius Bony and Jean-Louis Magnard contributed equally to this work.

[1]: Univ Lyon, UJM-Saint-Etienne, CNRS, BVpam FRE 3727, F-42023, SAINT-ETIENNE, France
[2] : International Flavors and Fragrances – Laboratoire Monique Rémy (IFF-LMR Naturals), Parc Industriel des Bois de Grasse 18/20 avenue Joseph Honoré Isnard F-06130 Grasse, France
[3]: Università degli Studi di Torino, Dipartimento di Scienze Agrarie, Forestali e Alimentari, e Dipartimento di Scienze Della Vita e Biologia dei Sistemi, Torino, Italy

Abstract

Roses are widely appreciated for the appearance of their flowers and for their fragrance. This latter character results from the combination of different odorant molecules among which monoterpenes are often prevalent constituents. In this study, we report the cloning and characterization of three rose monoterpene synthases. In vitro functional characterization of these enzymes showed that one is a (-)-(*3R*)-linalool synthase whereas the others have a dual (+)-(*3S*)-linalool nerolidol synthase activity. However, given that the characterized rose cultivars were only able to produce the (-)-(*3R*)-linalool stereoisomer, the linalool nerolidol synthases are probably not active in planta. Furthermore, these three enzymes were also characterized by a weak expression level as assessed by RT-qPCR and by the low abundance of the corresponding sequences in an EST library. This characteristic is likely to explain why linalool is generally a minor constituent in rose flowers' scents. On this basis, we propose that in roses the monoterpene biosynthesis effort is focused on the production of acyclic monoterpenes derived from geraniol through the recently characterized Nudix biosynthesis pathway, at the expense of conventional monoterpene biosynthesis via terpene synthases such as linalool or linalool nerolidol synthases.

Keywords:
Rosa chinensis; Flower fragrance; Monoterpene biosynthesis pathways; Terpene synthases; (-)-(*3R*)-linalool; (+)-(*3S*)-linalool; nerolidol

Abbreviations:
DMAPP: dimethylallyl diphosphate, EST: expressed sequence tag, FPP: farnesyl pyrophosphate, GFP: green fluorescent protein, GP: geranyl monophosphate, GPP: geranyl pyrophosphate, IPP: isopentenyl diphosphate, RPKM: reads per kilobase per million, TPS: terpene synthase

1. Introduction

* Corresponding author: jean.louis.magnard@univ-st-etienne.fr

† Present adress: Università degli Studi di Milano-Bicocca, Dipartimento di Biotecnologie e Bioscienze, Piazza dell'Ateneo Nuovo, 1 - 20126, Milano, Italy