

5

Biogenesis of Terpenoids

Bimal Krishna Banik^{*}, Biswa Mohan Sahoo[†], and Abhishek Tiwari[‡]

DOI: [10.1201/9781003008682-5](https://doi.org/10.1201/9781003008682-5)

CONTENTS

[5.1 Introduction](#)

[5.2 Biogenesis Pathway](#)

[5.2.1 Biosynthesis of Carvone](#)

[5.2.2 Biosynthesis of Limonene](#)

[5.2.3 Biosynthesis of Geraniol](#)

[5.2.4 Biosynthesis of Iridoids](#)

[5.2.5 Biogenesis of Pimarane](#)

[5.2.6 Biogenesis of Lycopene](#)

[5.2.7 Biosynthesis of Terpene Indole Alkaloids](#)

[5.2.8 Biosynthesis of Monoterpenoid by Engineered Microbes](#)

[5.2.9 Strategies for Improving Biosynthesis of Terpenoids](#)

[5.2.9.1 Protein Engineering Strategies for Biosynthesis of Terpenoids](#)

[5.2.9.2 Biosynthesis of Terpenoids via Genome Engineering](#)

[5.2.9.3 Biosynthesis of Monoterpenes via Recombinant Technology](#)

[5.2.10 Regulation of Biosynthesis of Terpenoids](#)

[5.3 Conclusion](#)

[Abbreviation](#)

[References](#)

5.1 Introduction

Terpenoids are a large group of natural products produced by several plants, algae, fungi, sponges, bacteria, cyanobacteria and animals. Terpenoids are the major constituents of essential oils with diverse chemical structures and biological activities including antimicrobial, antifungal, antiviral, anti-parasitic, anti-hyperglycemic, anti-allergenic, anti-inflammatory, antispasmodic, antimalarial, anti-cancer, etc [1]. Several environmental conditions such as temperature, sunlight, habitat and harvest time affect the composition and quantity of the active constituents present in essential oils of plant origin [2]. Plant sources such as eucalyptus, caraway, clove, citrus, lemon grass, peppermint mainly contain terpenes that are extracted, isolated from different parts of the plant (foliage, leaves, fruits and seeds) by steam distillation and subsequent fractional distillation. Various chromatographic methods (TLC, HPTLC, column and HPLC) are utilized for identifying and separating individual terpenoids (monoterpenes, sesquiterpenes, diterpenes, sesterpenes, triterpenes, etc) [3]. In 1887, O. Wallach proposed that terpenoids are the polymerized products of 2-methyl-1,3-butadiene or isoprene with molecular formula of C_5H_8 . Further, L. Ruzicka explained the isoprene rule and the biogenesis of terpenoids in 1953 [4].

Terpenoids occur with several chemical structures in a sequential arrangement of linear hydrocarbons or chiral carbocyclic skeletons with different chemical modifications such as hydroxyl, ketone, aldehyde and peroxide groups [5]. The efficiency of terpenoid biosynthesis is affected by high