1

Classification, General Methods of Extraction and Isolation of Terpenoids

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

DOI: 10.1201/9781003008682-1

CONTENTS

Printed by: abhishekt1983@gmail.com. Printing is for personal, private use only. No part of this book may be reproduced or transmitted without publisher's prior permission. Violators will be prosecuted.

* Roland Institute of Pharmaceutical Sciences, Berhampur affiliated to Biju Patnaik University of Technology (BPUT), Rourkela, Odisha, India. drbiswamohansahoo@gmail.com.

† Department of Mathematics and Natural Sciences, College of Sciences and Human Studies, Prince Mohammad Bin Fahd University, Al Khobar, Kingdom of Saudi Arabia. bimalbanik10@gmail.com and bbanik@pmu.edu.sa

‡ Pharmacy Academy, IFTM University, Lodhipur Rajput, Moradabad, U.P. 244102.

1.1 Introduction

Terpenes are the natural products present in essential oils of different plant parts such as fruits, flowers, seeds, leaves, barks, roots, etc [1]. These are pleasant smelling in nature. Chemically, terpenes are the hydrocarbons, whereas terpenoids are oxygenated derivatives containing alcohols and their glycosides, ethers, aldehydes, ketones, carboxylic acids, esters, etc., hydrogenated and dehydrogenated derivatives of terpenes [2]. Terpenoids are also called as isoprenoids with general formula $(C_5H_8)_n$. Isoprene is the building block of all terpenoids and is chemically 2-methylbuta-1,3-diene (Figure 1.1). The analysis of oils of turpentine was carried out in 1818 by Houston. In 1866, Dumas proposed the term “terpene” derived from the plant resin turpentine [3]. Otto Wallach proposed that terpenoid build-up of isoprene unit in 1887 (Nobel prize in 1910). He developed the theory that the monoterpenes build-up of two, the sesquiterpenes of three and the diterpenes of four isoprene units. He also suggested that the simple terpenes possess a skeleton based on p-cymene, the sesquiterpenes are related to naphthalenes and the diterpenes are related to phenanthrenes.

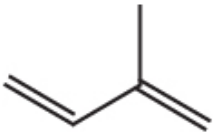

FIGURE 1.1 Structure of isoprene unit (2-methylbuta-1,3-diene).

Due to the development of various chromatographic and spectroscopic techniques, structures of different terpenoids are identified such as camphor, citral and pinene by Bredt (1893), Wagner (1894), Tiemann (1895) and Wackenrodder (1837), respectively [4]. In 1953, Leopold Ruzicka explained the isoprene unit based on the concept of the “isopren rule,” which was later identified by Lynen and Bloch. Ruzicka explained the structure elucidation of the sesqui- and diterpenes [5]. In addition, Rowland reported the first penta terpenoid solanesol (acyclic unsaturated alcohol) in 1956.

1.1.1 Properties of Terpenoids

Terpenoids represent the largest group of secondary metabolites obtained from the natural source. These are aromatic compounds responsible for flavor and fragrance. There are a number of comprehensive studies performed on its physical, chemical, phytochemical and pharmacological properties [6,7].

1.1.1.1 Physical Properties

- Most of the terpenoids are colorless, pleasant smelling liquid and lighter than water. But some of them are solid (e.g., camphor).
- These are soluble in organic solvents and insoluble in water.
- Most of the terpenoids are optically active.
- They are volatile in nature.
- Boiling point of terpenoids ranges from 150°C to 180°C.

1.1.1.2 Chemical Properties

- Terpenoids are open chain or cyclic unsaturated compounds with one or more double bonds.
- They undergo addition reaction with olefinic reagents like hydrogen, halogen, halogen acids, NOCl (Tilden’s reagent), NOBr to form addition products.
- They undergo polymerization and dehydrogenation.

- They undergo polymerization and dehydrogenation.
- They undergo Diel's Alder reaction due to the presence of conjugated double bonds in some of the terpenoids (e.g. Carvone, Farnesene and Ocimene).
- They are easily oxidized by all of the oxidizing agents due to the presence of olefinic bonds.
- Terpenoid produces isoprene as one of the products of thermal decomposition.

1.1.1.3 Phytochemical Properties

- Terpenoids react with chloroform and sulfuric acid producing reddish brown coloration (Salkowski's test).
- Terpenoids treated with copper acetate solution produce emerald green color.

1.1.1.4 Pharmacological Properties

Terpenoids possess various pharmacological properties such as anti-viral, anti-bacterial, anti-malarial, anti-inflammatory, anti-cancer, hypoglycemic, antioxidants anthelmintic, antidiabetic, etc.

1.1.2 Isoprene Rule

Terpenoid undergoes thermal decomposition to produce isoprene as one of the productd [8]. It was proposed by Tilden in 1884. So, isoprene rule states that all terpenoid molecules are made up of two or more isoprene units (Scheme 1.1).

SCHEME 1.1 Thermal decomposition of terpenoid.