MEDICINAL APPLICATIONS OF SESQUITERPENES: A REVIEW

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A

Report submitted in partial fulfilment of the requirement for the degree of Master of Science in Chemistry

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DECLARATION

I, **Deepshikha Jain**, a bonafide student of M.Sc. Chemistry of K. R. Mangalam University, Gurgaon would like to declare that the dissertation entitled **"Medicinal Applications of Sesquiterpenes: A review"** submitted by me in partial fulfillment of the requirement for the award of the degree of Master of Science in Chemistry is my original work.

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CERTIFICATE

This is to certify that the dissertation entitled **"Medicinal Applications of Sesquiterpenes: A review"** is a bonafide record of the work done by **Deepshikha Jain (Roll No. 1903680004)** under my supervision and submitted to K. R. Mangalam University in partial fulfillment for the award of the degree of Master of Science in Chemistry.

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1. INTRODUCTION

Terpenoids comprise the biggest group of characteristic plant items with more than 40,000 members(Dubey et al., 2003).Terpenoids are essential for the growth of the plant, development and metabolism. Terpenoids are found in almost all plant species. The metabolic, physiological and structural roles include light-reaping pigments in photosynthesis or the regulatory activities of many terpenoid plant hormones. Furthermore, countless basically different plant terpenoids are known or accepted to have specific functions related with interactions of sessile plants with different living organisms with regards to proliferation, defence or symbiosis. These interactions include particular plant terpenoids, for instance, in the form of attractants, toxins, anti feeds, antibiotics or repellents. The terpenoid-interceded collaborations of plants with different living organisms include species from all kingdoms and trophic levels. The compound variety of plant terpenoids is presumably a impression of their numerous organic exercises in nature, which have made them a broadly utilized asset for conventional and current human abuse, for instance, as drugs, flavors, aromas, food supplements as nutrients or sugars, or pesticides. Terpenoids likewise fill in as enormous volume feedstocks for the creation of a set-up of mechanical materials. In light of their a wide range of structures, plant terpenoids as a gathering incorporate mixtures with various physical and synthetic properties. They might be lipophilic or hydrophilic, volatile or non-volatile, cyclic or non-cyclic, chiral or achiral. The synthetic variety of plant terpenoids starts from frequently complex terpenoid biosynthetic pathways (Bohlmann& Keeling, 2008). Terpenoids are multi cyclic constructions that contrast from each other in their functional groups as well as in their fundamental carbon skeletons (Christianson, 2017).

Terpenoids, otherwise called isoprenoids, are the most various and primarily assorted common items found in numerous plants. The diverse collection of terpenoid structures and functions has provoked increased interest in their commercial use resulting in some with established medical applications being registered as drugs on the market (Ludwiczuk et al., 2017). Terpenoids are maybe more natural to us as significant parts of fundamental oils, which contain the steam-, hydro-, or dry distillable portions, or divisions acquired through mechanical treatment, answerable for the trademark aroma, scent, or potentially smell of numerous plants (Maffei et al., 2011).

Isomerism is basic among terpenoids, and sets of the isomeric structures can be secluded from plants. Isomers are molecules which have similar empirical formulae, however vary in atomic binding or conformation in space. There are five chief types of terpenoid isomerism: structural, positional, geometrical, conformational, and stereoisomerism (figure1).

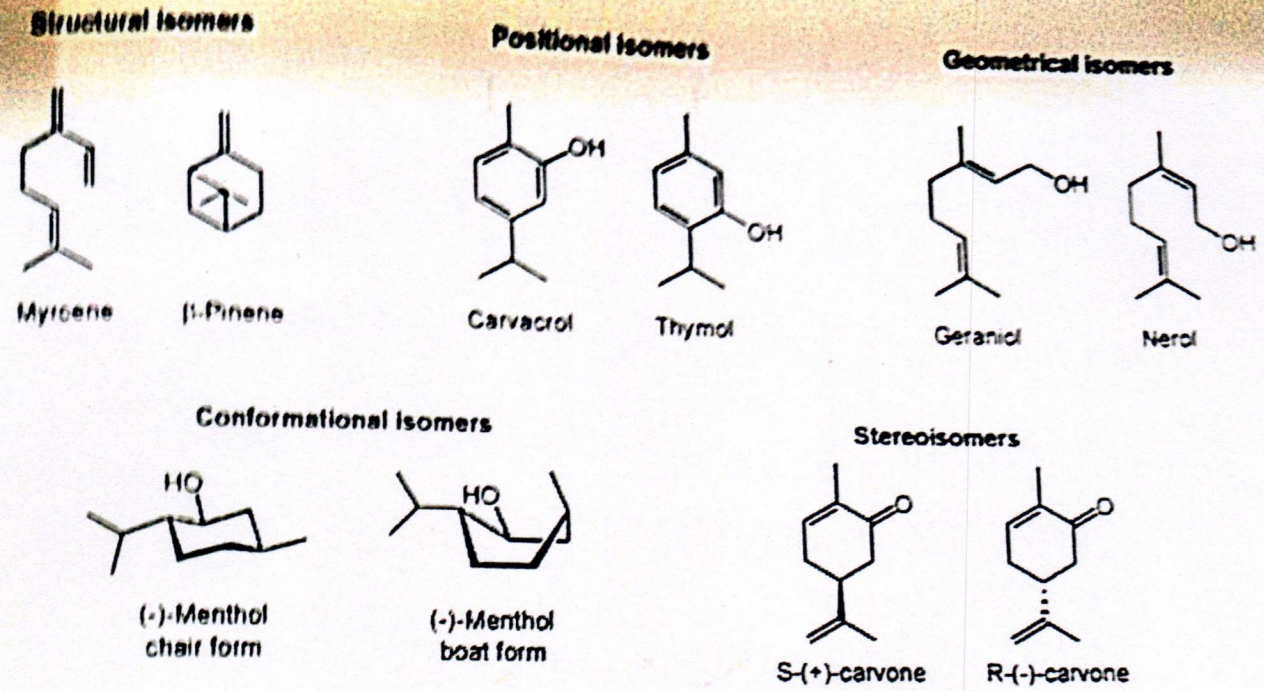

Figure1: Chief Types of Isomerism Among Terpenoids.

1.1 Classification

Classification of terpenesis based on the number and structural organisation of carbons formed by linear arrangement of isoprene units followed by cyclisation and rearrangements of the carbon skeleton with an empirical feature known as the isoprene rule (Zwenger&Basu, 2008). Isoprene is 2-methylbuta-1,3-diene the "building block" of terpenoids . The single isoprene unit represents the most basic class of terpenoids. The names of other terpenoid groups are shown in Table1.

According to isoprene rule all terpenoids are derived from the arranged, head-to-tail joining of isoprene units. A head-to-tail combination is the most well-known; nonetheless, non head-to-tail buildup of isoprene units additionally happens. Head-to-head fusions are commonly found in triterpenoids and carotenoids (Bernards, 2010). Figure 2 shows the most common combinations of isoprene units, and how the isoprene units and the first spine can be followed in three example terpenoids.

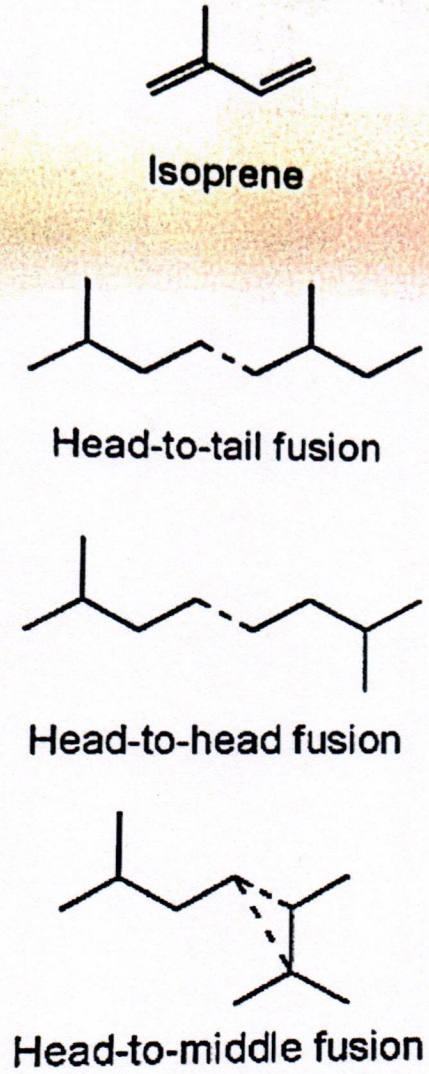

Figure 2: Coupling of Isoprene Units

Terpenes form structurally and functionally different classes of compounds that are formed by coupling different numbers of isoprene units, while terpenoids represent terpenes containing oxygen and the main structural classes of the terpenes are:

Table1: Classification of Terpenoids

S.No.	Class	Isoprene units	Number of carbon atoms	Examples
1.	Monoterpenoids	2	10	Camphor, menthol,piene, thymol
2.	Sesquiterpenoids	3	15	Caryophyllene, eudesmol, curumene
3.	Diterpenoids	4	20	Abieticacid,cafestol,phytol
4.	Sesterpenoids	5	25	Geranylfarnesol, haslene
5.	Triterpenoids	6	30	Saponins, morolic acid, oleanolic acid
6.	Tetraterpenoids	8	40	Carotenoids and xanthophylls
7.	Polyterpenoids	>8	>40	Natural rubber, guttapercha

1.2 Types of terpenoids

1.2.1 Hemi Terpenoids

The simplest terpenoid among all is hermiterpenoid. Isoprene, the most visible hemiterpene, is emitted by the leaves of a variety of trees (including coniferous trees, ferns, pines, and maples) and plants (such as Hamamelis japonica) (Croteau& Johnson, 1985). tiglic, radiant, isovaleric, and senecio acids, as well as isoamyl liquor, are further recognised hemi terpenoids found in plants .

1.2.2 Monoterpenoids

Monoterpenoids comprise 2 isoprene units and 10 carbon backbone. Acyclic, monocyclic, and bicyclic monoterpenoids are the three types of monoterpenoids. The monoterpenoids in each group could be simple hydrocarbons or functional groups like ketone alcohol and aldehyde. Myrcene, citral, geraniol, lavandulol, and linalool are examples of aliphatic monoterpenoids. -terpineol, limonene, thymol, menthol, carvone, eucalyptol, and perillaldehyde are some of the most important monocyclic monoterpenoids.

Bicyclic monoterpenoids are further split into three types based on the size of the second ring. A six-membered ring belongs to the first class, while a three, four, or five-membered ring belongs to the second.

1.2.3 Sesquiterpenoids

The most diverse group of terpenoids are sesquiterpenoids. They are made up of three isoprene units and can be in a variety of shapes and sizes, including linear, monocyclic, bicyclic, and tricyclic structures.

Acyclic sesquiterpenoids include farnesol and beta nerolidol. Monocyclic sesquiterpenoids include β-bisabolene, α-zingiberene and α-humulene. Bicyclic sesquiterpenoids are β-santalol, β-caryophyllene, Artemisinin, Alantolactone, Chamazulene, and Nootkatone. Tricyclic sesquiterpenoids involve patchoulol, khusimol and thujopsene.