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PHYTOCHEMICAL AND PHARMACOLOGICAL OVERVIEW OF *PLECTRANTHUS FRUTICOHUS* PLANT

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Abstract:

Secondary metabolites, which have a major impact on both conventional and modern medicine, are abundant in plants. Natural products, also known as secondary metabolites, are organic compounds with bioactivities that have been found to have therapeutic, commercial, and culinary value. Plectranthus species (Lamiaceae) are found all over the world and have a variety of well-liked therapeutic uses. The genus *Plectranthus fruticohus* was chosen from among the many plant species, and it is discussed in this chapter. The Plectranthus species' botanical traits, phytochemistry, ethnobotanical uses, ethnopharmacological uses, pharmacological uses, and other uses are detailed. With the wide variety of abietane diterpenoids synthesized by Plectranthus species, it is important to study their phytochemistry. The Plectranthus genus has been used for centuries in traditional therapy, and its value as a source of bioactive chemicals has been proved by scientific inquiry. Diterpenes are the most common and physiologically important class of secondary metabolites in this species. Several studies have looked into the potential health benefits of abietane diterpenes, in particular their anti-cancer effects.

Keywords: Plectranthus genus, Phytochemicals, Pharmacology activity, bioactive compounds

1. Introduction:

Several plant species are used in medical settings for the diagnosis, therapy, and fight against illness, and are thus considered a rich resource for new molecules with a wide range of biological roles. [1]

350 species of plants in the genus Plectranthus, which is a member of the tribe Ocimeae in the sage family *Lamiaceae*, range in size, leaf, and aroma [2]. Plectranthus species are distinguished by their two-lipped corolla and their scented, opposite-pair leaves [3]. There are over three hundred and fifty different species of *Plectranthus*, all of which are attractive and decorative but only thrive in warm climates [4]. Several of the species found in Southern Africa are used medicinally, and this includes *P. ambigus, P. amboinicus, P. barbatus*, etc. [5]. The Southern KwaZulu Natal region and the coastal region of the Northern Cape hold the highest number of species in South Africa. *Calceolanthus, Plectranthus, Burnatastrum, Coleus, Xerophilus,* and *Nodiflorus* are the six subgenera of the genus *Plectranthus*. *Coleus* and *Plectranthus* clades are the two major subclades [6]. However, the *Plectranthus clade*, which also contains several *Plectranthus* species like *P. fruticosus* and the genera *Aeollanthus, Tetradenia, Capitanopsis, Dauphinea*, and *Thorncroftia*, has less than 50 percent of bootstrap support. Most people are familiar with the *Coleus clade*, which included the remaining members of the genus *Plectranthus* and the genera *Anisochilus* and *Pycnostachys* [7]. Paton *et.al.* research's suggests that *Plectranthus* species belonging to the *Plectranthus clade* have calyces with a centrally fixed pedicel and roughly equal posterior and anterior corolla lobes, two characteristics that help to separate them from the other clade.

Plectranthus is found in most tropical and subtropical regions. There are more than 300 species in the genus *Plectranthus*. The vast majority of diterpenes are distributed throughout about 200 different genera. And only 19 of these families have been the focus of recent research. According to NCBI's database, the most studied species in these families are the *P. barbatu, P. edulis, P. amboinicus,* and *P. educulentus*. When it comes to published works, there have been a total of 1,514 *Plectranthus*-related articles accepted by NCBI. The majority of the work on *P. ornatus, P. amboinicus, P. hereoensis, P. babatus, P. Parviflorus henckel, P. neochilus, and P. tenuiflorus* is reflected in the 109 publications that have been accepted by Google Scholars. According to the 21 publications authorized by ACS, the most attention has been paid to the genus P. *ornatus, P.madagascariensis benth, and P.mutabilis*.

In Brazil's traditional medicine, P. barbatus leaves are brewed into an infusion or decoction and used to cure a range of ailments, including respiratory problems, liver diseases, heart conditions, and intestinal difficulties[8]. Also, various neurological system problems are treated with this plant species, which also reduces inflammatory reactions [9]. Forskolin, one of more than 67 diterpenoids discovered in *P. barbatus*, serves as the species' primary ingredient. Its wide range of pharmacological effects may help to explain why this species is used for so many different things. However, this substance's inability to dissolve in water restricts its therapeutic applicability [10]. *P. barbatus* was shown to contain a number of other phytochemicals, such as the phenolic derivatives nepetoidins A and B [11] and rosmarinic acid [12,13]. Phenolic plant-derived substances include a wide variety of chemicals, such as simple phenolics, phenolic acids, coumarins etc [14], and *P. barbatus* extracts have been used to identify some of these compounds [15].

Despite impressive advancements in the creation of novel therapeutic medications, cancer continues to rank among the world's leading causes of mortality [16,17]. Tumors are produced from cancerous cells, frequently with the ability to spread by metastatic processes, and are biologically defined by an aberrant expansion of damaged cells [18,19]. Drugs used to treat cancer are physiologically beneficial, but extensive research has been done on the host implications of these medications' intrinsic toxicity [20]. As a result, the main focus of contemporary cancer therapy is to eliminate only cancer cells without harming healthy cells [21]. Elsewhere in the world, especially by Asian and African populations, medicinal plants are employed in traditional medicine. The scientific community is now more interested in them as a result of their use in developing nations' primary healthcare systems since doing so will validate their use by revealing which substances are responsible for the predicted effects. Because of their bioactive secondary metabolites, plants from the genus *Plectranthus* have long been known for their potential as cytotoxic and anticancer agents [22,23]. There are a number of substances derived from plants whose use as chemotherapeutic agents is authorized, despite the fact that many of them have potentially harmful patterns and undesirable side effects. For this reason, there is a pressing need for new antitumor agents, a field in which plants feature prominently [24,25]. Alkaloids, flavonoids, isoflavonoids, tannins, coumarins, and terpenes are only a few of the secondary metabolites that plants can make, and that help them respond defensively to outside influences [26]. The greatest class of phytochemicals is the terpenoids [27,28]. They are classified into classes such as hemiterpenoids (C5), monoterpenoids (C10), sesquiterpenoids (C15), diterpenoids (C20), sesterterpenoids (C25), triterpenoids (C30), and tetraterpenes (C40) based on the five-carbon isoprene units that determine their biogenesis [29]. Diterpenes are made up of four branching methyl groups and 20 carbon atoms in total thanks to their four isoprene units. Their chemical classification is based on a number of classes based on the core's cyclization by geranylgeranyl diphosphate [30]. This class of metabolites is divided into acylic or linear, bicyclic, tricyclic, etc diterpenes [31]. Their bioactivity varies greatly, but they are united by their strong health-related qualities, which include, among many others, anti-inflammatory, antioxidant, etc [32,33]. These can be found all over the kingdom plantae, but especially in the Lamiaceae, Taxaceae, and Euphorbiaceae families [34]. They are sometimes esterified with aliphatic or aromatic acids, and they typically exist in polyoxygenated forms including keto or hydroxyl groups. Although abietane diterpenoids may be found in a wide variety of other species [35], many studies [36, 37] show that

they are particularly abundant in the leaf glands of Plectranthus species. Hence, we zero attention on the cytotoxic abietane diterpenes present in these families with the overriding aim of explaining the underlying mechanism by which cell death occurs upon exposure to these metabolites.

2. Botanical identification:

Plectranthus species, which include *P. argentatus*, *P. oertendali*, *P. madagascariensis*, and *P. fruticohus*, are scented, well-branched shrubs that grow as annuals or perennials [38]. (**Figure 1**)

Figure 1: Leaves of P. argentatus, P. oertendali, and P. madagascariensis, P. fruticohus

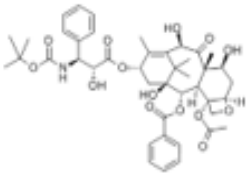
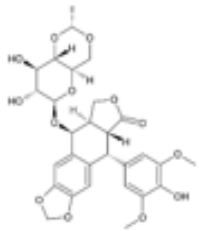
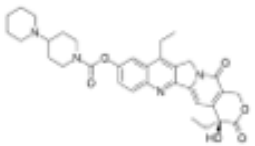
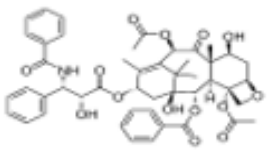
The opposite, oval leaves of these 100-centimeter-tall evergreen herbaceous plants contain 3–7 pairs of rounded teeth and a slightly hairy texture [39]. Plectranthus species have very aromatic roots that are thick and tuberous with a spindle shape and a conical tip [40]. Tube-shaped blossoms can be anywhere from 7 and 18 mm in diameter and come in shades of white, light yellow, or pastel lavender. The inflorescence is a tall raceme that blooms from the very tip [39]. Smooth, roundish, flattened, pale-brown seeds (nutlets) measuring between 0.5 and 0.7 mm are contained in the calyx, which measures between 2-4 mm in length before elongating to 5 mm after the bloom falls [39]. The flowering season in Southern Africa is from the months of February to May. These plant descriptions apply to all seventeen species of *Plectranthus* found in Southern Africa. The leaves, sizes, and regional names of these plants are what set them apart from one another.

Burns are treated in Rome with *P. fruticosus* [41]. The primary constituent of *P. fruticosus* essential oil, has a profoundly foetotoxic and teratogenic impact because of the oil's opulent nature [42, 43].

3. PLANT-DERIVED NATURAL PRODUCTS THAT ARE ALLOWED TO BE USED IN CHEMOTHERAPY:

The pharmaceutical industry has made a lot of money because more than half of the anticancer drugs that are currently used come from plants [44]. Yet a disadvantage is their highly hazardous characteristics and related side effects. Given the wide range in geography and biology of plant life, it stands to reason that researchers would be interested in finding ways to selectively target plants using novel compounds having lethal potential. As a result, numerous investigations have long been centered on certain natural ingredients. This investigation has uncovered novel cellular targets and elucidated their mode of action, resulting to their accepted and long-standing use in chemotherapy (**Table 1**). The therapeutic use of cytotoxic terpenoids is not frequent. Paclitaxel stands out as a major player because it is used a lot in chemotherapy to treat many different types of solid cancer [45].

***Table 1*:** The chemotherapeutic drugs originating from plants are outlined in Table

Natural Derivative Approved for Chemotherapy	Mechanism of Action	Chemical Structure (Class)/Botanical Source	Cancer Treatment Application
Docetaxel 	Microtubule disruptingagent	Diterpenoid derivative (Taxane)/ *Taxus brevifolia*	Breast cancer, Non-small cell lung cancer, Hormone Refractory prostate cancer, Gastric adenocarcinoma, Squamous cell carcinoma of the Head andNeck Cancer
Etoposide 	Topoisomerase II inhibitor	Semisynthetic derivative of podophyllotoxin (Lignan)/ *Podophyllum peltatum*	Refractory testicular tumours,small cell lung cancer
Irinotecan 	Topoisomerase I inhibitor	Alkaloid (Camptothecan analog)/*Camptotheca acuminata*	Metastatic carcinoma of the colon or rectum
Paclitaxel 	Microtubule disruptingagent	Diterpenoid derivative (Taxane)/ *Taxus brevifolia*	Breast cancer, Ovarian cancer, Non-small cell lung cancer

Phytochemicals:

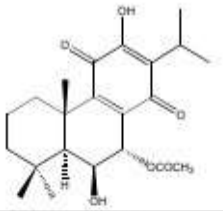
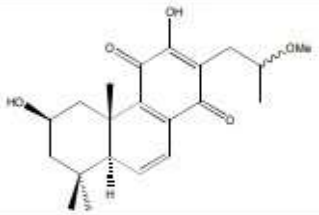
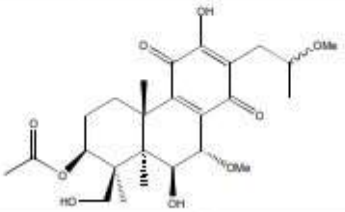
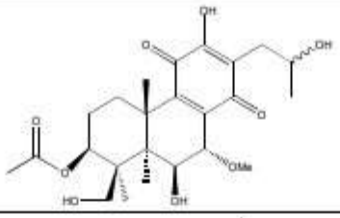
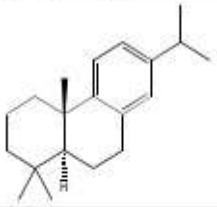
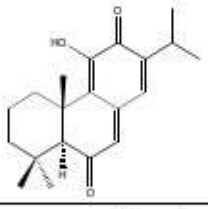
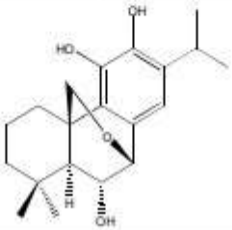
4.1 Different variety of Diterpenes based chemicals from Plectranthus genus:

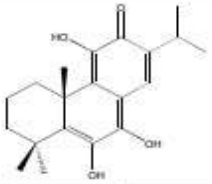
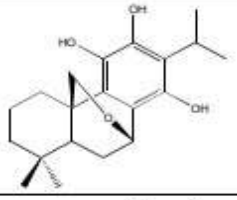
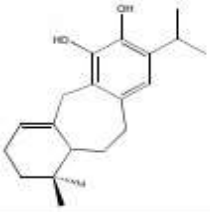
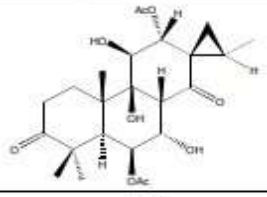
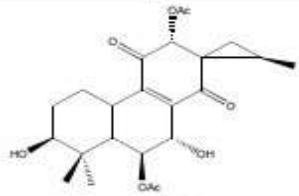
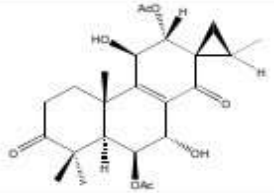
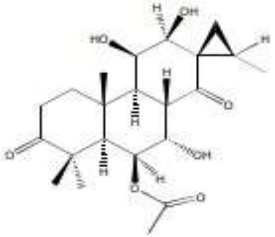
Most terpenes are diterpenes, which exhibit a wide range of chemical diversity, in the extensive and complex chemical makeup of the *P. fruticosus* genus. 7-acetoxy-6-hydroxyroyleanone has been described as part of *P. actites*' secondary metabolism [46]. *P. africanus* is native to African countries like Uganda, Cameroon, and Guinea-Bissau. Three novel modified abietanes—Plutranthroyleanones—were discovered in a recent phytochemical investigation [47]. Plectranthroyleanone shows weak antibacterial activity against both Gram-positive and Gram-negative microorganisms. Nonetheless, the moderate activity of plectranthroyleanones, particularly against Klebsiella pneumoniae, is shared by both. *P. amboinicus* essential oil, which is indigenous to parts of India, has chemotherapeutic benefits in addition to antifungal and antioxidant properties [48]. 7-acetoxy-6-hydroxyroyleanone was also detected in its extract after the examination. This plant's leaves were the subject of a phytochemical investigation that revealed the existence of the acyclic diterpene phytol, whose actions were linked to antibacterial, diuretic, anti-inflammatory, and anticancer characteristics [49]. Traditional medicine frequently treats digestive troubles, liver tiredness, respiratory problems, cardiac conditions, and a few conditions of the central nervous system with P. barbatus. The abietane-type dehydroabietane, taxodione, was isolated from this plant for the first time. Furthermore, 6-didehydro-7-hydroxytaxodone was isolated from P. barbatus [50]. The plant's anti-secretory acid impact and well-known anti-ulcer activity [51] may be explained by the fact that compounds like barbatusol, cyclobutatusine, barbatusin (13), etc., were isolated from it. Research into the pharmacology of *P. barbatus* has uncovered that the plant's major components are abietanes, such as the labdane-type diterpene forskolin [52].

4.2 ABIETANE DITERPENES WITH ANTITUMOR ACTIVITY:

The *Plectranthus fruticosus*'s chemical makeup has been thoroughly described by Mogib *et. al.* Despite this genus's biological richness and high diterpene concentration, not all of its chemicals have the same potential for having an anti-proliferative impact. Not only do we highlight all of the diterpenes that have been isolated from this genus in this review, but we also put a lot of effort into finding the cytotoxic *Plectranthus-fruticosus* abietane diterpenes. In 1962, a yellow pigment was isolated from the plant Inula royleana and given the name "royleanones," which is shorthand for hydroxy-paraquinone-modified abietane-type diterpenes. The inclusion of a benzoquinone moiety is responsible for the chromophoric system shared by these diterpenes and the subsequent creation of their natural colour [53]. This collection of substances is thought to be one of the primary components of the *Plectranthus* genus species. Many enzymes are responsible for the reductive bioactivation of quinones via a one-electron pathway to the corresponding semiquinone free radicals, which is necessary for their cytotoxic potential [54,55]. Moreover, horminone, which has a long history of being classified as a cytotoxic abietane, has been shown to be moderate to highly toxic to 3T3 cells, and murine cells. It demonstrated moderate anti-human breast, anti-human lung, and anti-human colon cancer cell line activities [56]. Both sugiol and 7-ketoroyleanone were investigated and found to be highly effective in inhibiting human DNA topoisomerases I and II. However, the first protein was preferable to be inhibited. By having an IC_{50} lower than that of the standard topoisomerase I inhibitor camptothecin, these compounds proved to be more potent inhibitors [57].

Table 2: *Natural occurring diterpene from Plectranthus fruticosus chemical composition*

Diterpene	Chemical Structure of the Diterpene
7α-Acetoxy-6β-hydroxy-royleanone (**1**)	
Plectranthroyleanone A (**2**)	
Plectranthroyleanone B (**3**)	
Plectranthroyleanone C (**4**)	
Dehydro-abietane or abietatriene (**5**)	
Taxodione (**6**)	
6α, 11, 12, -trihydroxy-7β, 20-epoxy-8, 11, 13-abietatriene (**7**)	

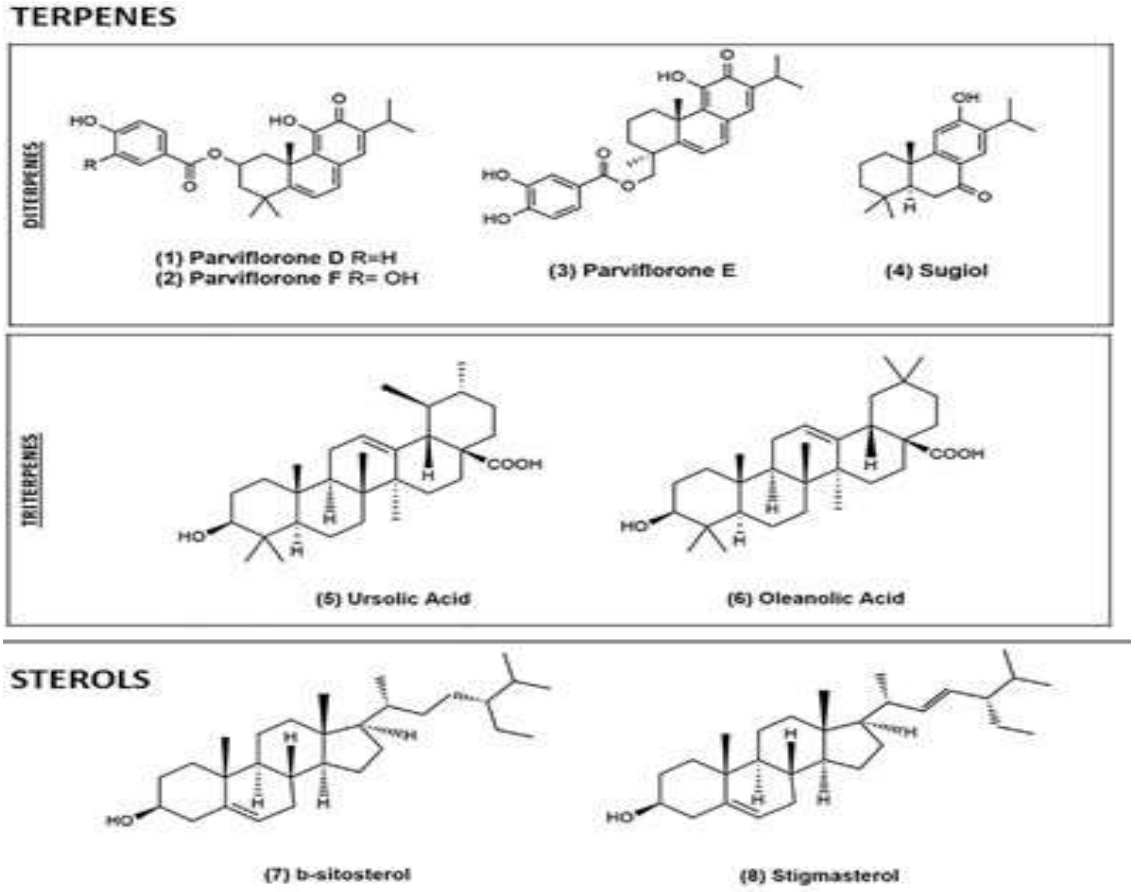
Diterpene	Chemical Structure of the Diterpene
5, 6-didehydro-7-hydroxy-taxodone **(8)**	
20-Deoxocarnosol **(9)**	
Barbatusol **(10)**	
Cyclobutatusine **(11)**	
3β-hydroxy-3-deoxybarbatusin **(12)**	
Barbatusin **(13)**	
7β-acetyl-12-deacetoxy-cyclobutatusine **(14)**	

4.3 Triterpenes:

Common triterpenes such as ursolic acid, oleanolic acid, betulin, and betulinic acid have been isolated from plants in the *Plectranthus* genus. Triterpenic acids have a number of significant biological and pharmacological effects, including those that are anti-inflammatory, antibacterial, antiviral, cytotoxic, and cardiovascular. UA and OA are two isomers of the identical triterpenic acid, differing only in the location of the methyl (CH_3) group on carbon 29 [58].

4.4 Phenolics:

Phenolic chemicals are significant secondary metabolites found in plants and are essential for the spread of many species as well as disease resistance and insect defense. They are widely used as ingredients in beverages and plant-based foods. There are ten primary types of phenolic compounds, which include phenolic acids, flavonoids, and tannins. These chemicals typically have a role in a plant's defense against ultraviolet (UV) radiation or aggressiveness from diseases, parasites, and predators, as well as in the development of the plant's color. The hydroxycinnamic acids and their derivatives, including rosmarinic[59], chlorogenic, carnosic, and salvianolic acids, have been discovered as the primary phenolic constituents in the extracts of Salvia and Plectranthus. Caffeic acid (3,4-dihydroxycinnamic acid) is one of the most common cinnamic acids [60] and has several beneficial biological effects. These include antioxidant, antithrombotic, antihypertensive, antifibrotic, antiviral, and antitumor effects.



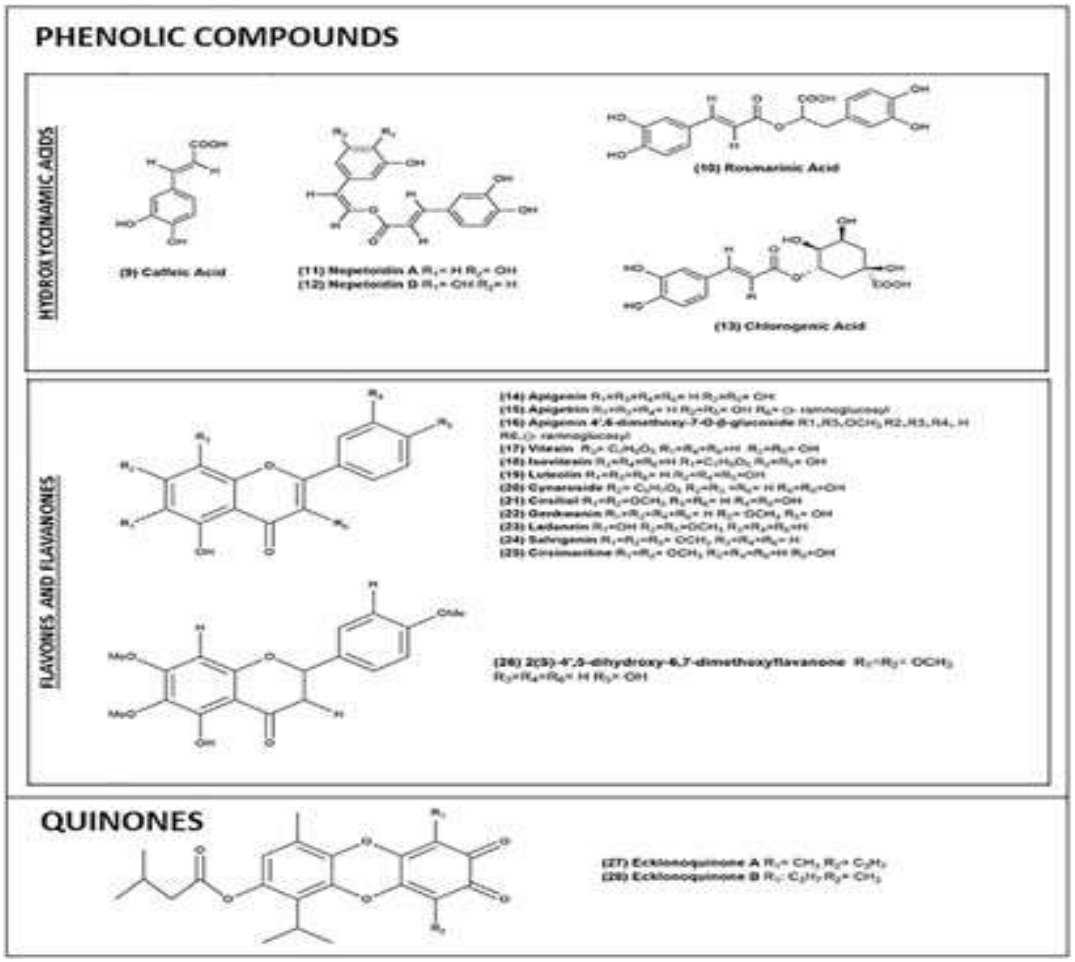


Figure 2: Chemical compounds isolated from the *Plectranthus* family **[61]**

4. Pharmacology activity:

5.1 THE ANTICANCER POTENTIAL OF THE *PLECTRANTHUS* GENUS:

The majority of the diterpenes are found in the *Lamiaceae* family of plants, which has roughly 200 genera. There are more than 300 species of *Plectranthus*, many of which are found in tropical regions of Asia, Australia, and Africa. This genus has a wide range of species and is found in many different places, so it's not surprising that it has a lot of biological diversity. Its many uses in traditional medicine have also had a big impact on its ethnopharmacology [62]. Several species have also been described as having the potential to be cytotoxic and antitumor, as well as having many other effects like being antibacterial, anti-inflammatory, and antioxidant. Because of this, several studies have been done on the Plectranthus genus to find out if its extracts or chemicals can kill cells. Many different Australian plant species have been studied, and some, like *Plectranthus* spp. (*P. amoenus*, *P. fasciculatus*), have shown strong cytotoxic effects [63]. A phytochemical study of Plectranthus spp. also examined the cytotoxicity of a total of 26 *Plectranthus* extracts on breast cancer cells [64]. *P. madagascariensis* acetonic extract demonstrated reasonably positive outcomes, and its constituent parts were separated and evaluated with promising outcomes [65]. Overall, the fact that extracts and compounds from *P. fruticosus* are cytotoxic or stop cell growth strongly suggests that this plant has a wide range of biological uses because it has so many different chemicals. So, it is very important to look into this genus for more chemicals that are good for living things.

5.2 Pharmacological activity of Plectranthus:

Several Plectranthus species are plants with decorative, commercial, therapeutic, and a wide range of other ethnobotanical applications. Several species are used in various parts of the world as purgatives,

antiseptics, vermicides, remedies for vomiting and nausea, and treatments for ear infections, toothaches, and stomachaches, among a wide range of other illnesses [66]. Some instances: Indications for the treatment of pneumonia include *P. barbatus* and *P. bojeri*, and *P. amboinicus* showed anti-MTB action. Moreover, numerous respiratory disorders are treated with *P. aegypticus*, *P. ambiguus*, *P. caninus*, etc [67]. This genus has been linked to numerous biological processes, with antibacterial activity receiving a lot of attention [68]. Several more instances include gastroprotective impact, acaricidal activity [69], and herpetic inhibitory and antioxidant capabilities. The primary antibacterial activity, antioxidant activity, acetylcholinesterase inhibitory activity, and anti-inflammatory activity of *Plectranthus fruticosus* will be given.

5.3 Antimicrobial activity:

Natural products have given researchers many ideas for how to make medicines to treat bacterial infections. Unfortunately, there haven't been many novel compounds discovered since the 1970s, when the synthetic lead oxazolidinone and the natural substance thienamycin were discovered. (see **Figure 3**)

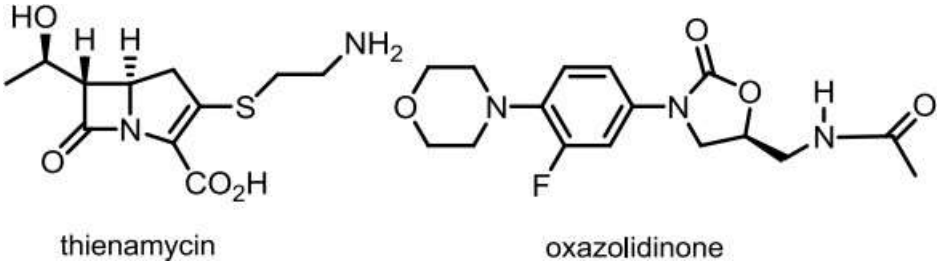


Figure 3: Thienamycin's and the synthetic lead, oxazolidinone's, chemical composition.

Today, several natural products are still in use, including aspirin and morphine (see **Figure 4**).

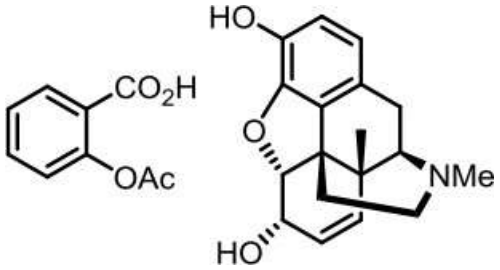


Figure 4: Chemical structure of aspirin and morphine.

It has been found that diterpenes, a class of naturally occurring chemicals found in plants, have anti-staphylococcal action. The genus from the *Lamiaceae*, or mint, plant family is one of the most well-known instances of the plant taxa and diterpene classes that are exceptionally well-represented. In 2002, Ulubelen A. *et al.* [70]. Two other members of the mint family, *Plectranthus hereroensis* and *P. elegans*, produce acetylated abietane quinones similar to horminone (**Figure 5**) [71] and show similar anti-Gram-positive bacterial action. These chemicals may play a part in *Plectranthus*'s chemical defense, according to the scientists' hypothesis. The abietane diterpene class and its taxonomic group may profit from the usage of diterpenes of the abietane type as potential antibacterial lead compounds [72].

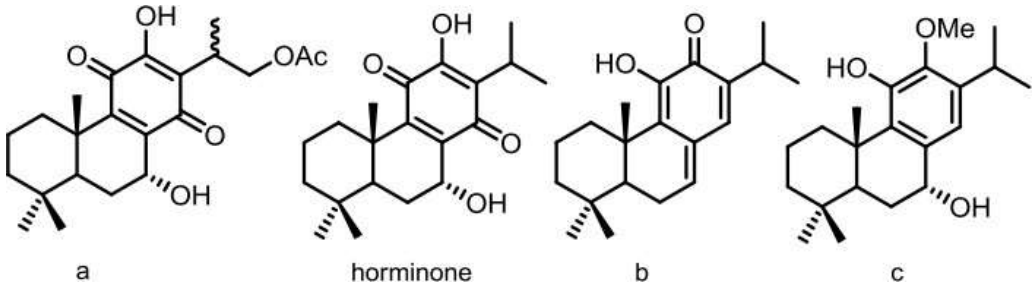


Figure 5: Chemical structure of abietanes a,b,c and horminone

5.4 Antioxidant activity:

Antioxidants are essential in the fight against free radicals, which can seriously disrupt cell metabolism and harm human cells under conditions of oxidative stress. Due to their unpaired electrons, free radicals are unstable entities that seek stability by partnering their unpaired electrons with biological macromolecules [73]. Active oxygen, which includes the radicals hydroxyl, peroxyl, and singlet oxygen, is extremely hazardous and a major factor in the development of many diseases, such as cancer, heart disease, cataracts, and congestive conditions [74]. antioxidant chemicals prevent the oxidation processes that result in free radicals, which are linked to various chronic diseases and aging.

In addition to isolated diterpenoids with the ent-kaurane structure, oxidized on carbons C-7, C-15, and C-18, chemical research on *Lamiaceae* plants and their antioxidant activity was also conducted [75]. Two new antioxidative diterpenoids with the abietane nucleus and two well-known diterpenoids, parvifloron E and F, were discovered as a result of other research. The substances were found in the *Plectranthus* leaves.

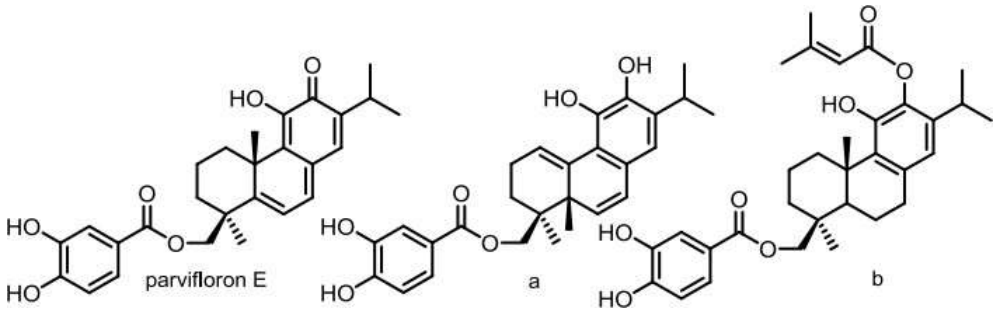


Figure 6: Chemical structure of diterpenoids a,b and parvifloron E.

5.5 Anti-inflammatory activity:

The extracts of *Plectranthus* plant species, such as *Plectranthus barbatus* [76] or *Plectranthus amboinicus*, which have historically been utilized to treat illnesses of an infectious and/or inflammatory origin, have been screened. To support the widespread usage of this medicinal plant, the anti-inflammatory activity of the extracts was evaluated [77]. Terpenoids have been investigated extensively as potential anti-inflammatory agents. Traditional medical practices that employ terpenoids-rich plant extracts suggest that there are potential candidates for strong anti-inflammatory medications. Precise molecular patterns that are widely present in these terpenes and are responsible for their anti-inflammatory effect have proved challenging to pin down. Other terpenoids are secondary metabolites involved in host defense and the protection of plants and animals against dangerous pathogens, while certain terpenoids work as plant hormones controlling various physiological functions.

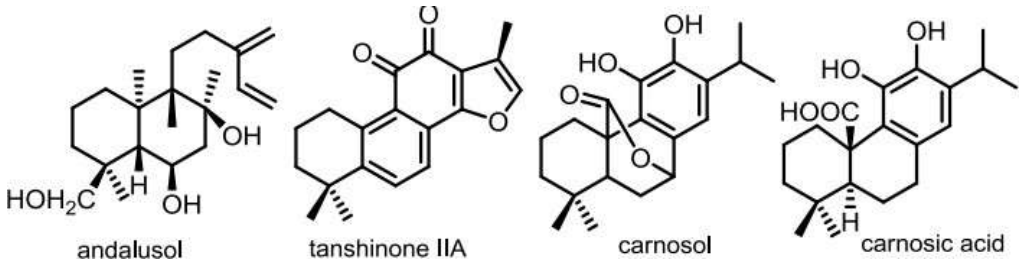
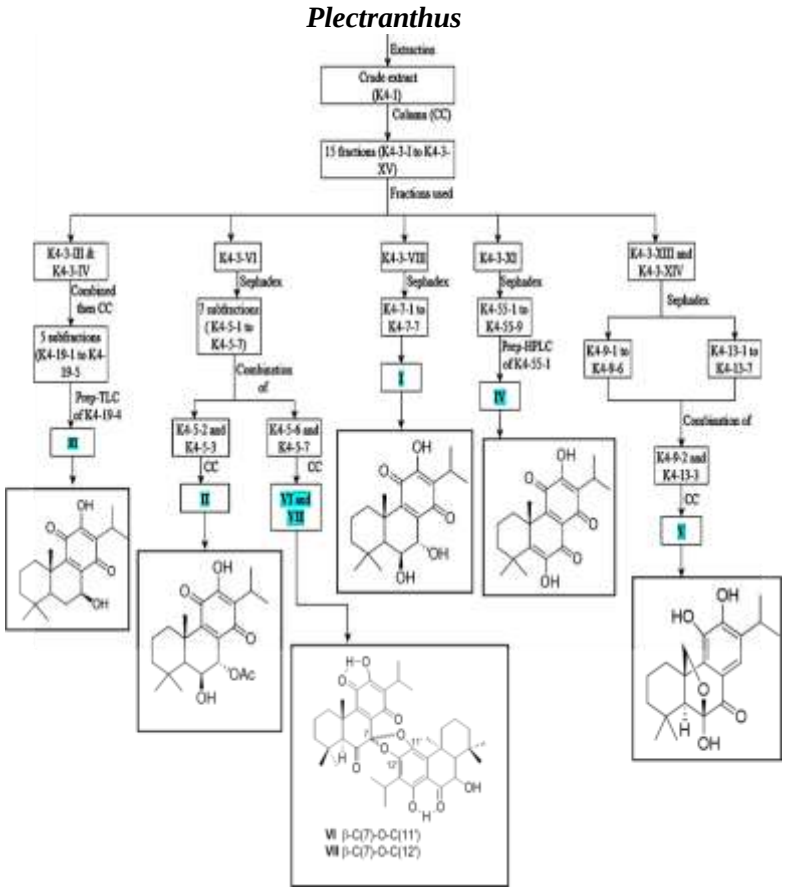


Figure 7: Anti-inflammatory compounds isolated from Plectranthus.

5. Isolation of bioactive compounds from *Plectranthus* species



6. Other uses:

Table 3 shows that in addition to their horticultural value, certain species of *Plectranthus* have also been used as food, food additives, insect repellent, material to ward off evil spirits, and in other culinary and culinary-related contexts.

Table 3: Other uses of Plectranthus species

***Plectranthus* species**	**Uses**
P. amboinicus	Food (Vegetables) Food additives (Food stuffings; mask the odor ofstrong smells associated with fish, goat, and shellfish; and spices dishes containing tomato) Insect repellent
P. barbatus	Horticulture Food (vegetables)
P. ecklonii *P. elegans* *P. madagascariensis*	Horticulture
P. esculentus	Food (starch, minerals and vitamin A) Food additives (to sweeten porridge)
P. fruticosus	Fly repellent
P. hadiensis	Fodder (to feed rock rabbits in Tanzania) Fish poison Charm
P. laxiflorus	Food (vegetable) Mosquito repellent Materials (to drive away evil spirits in India, Kenya, and Tanzania)

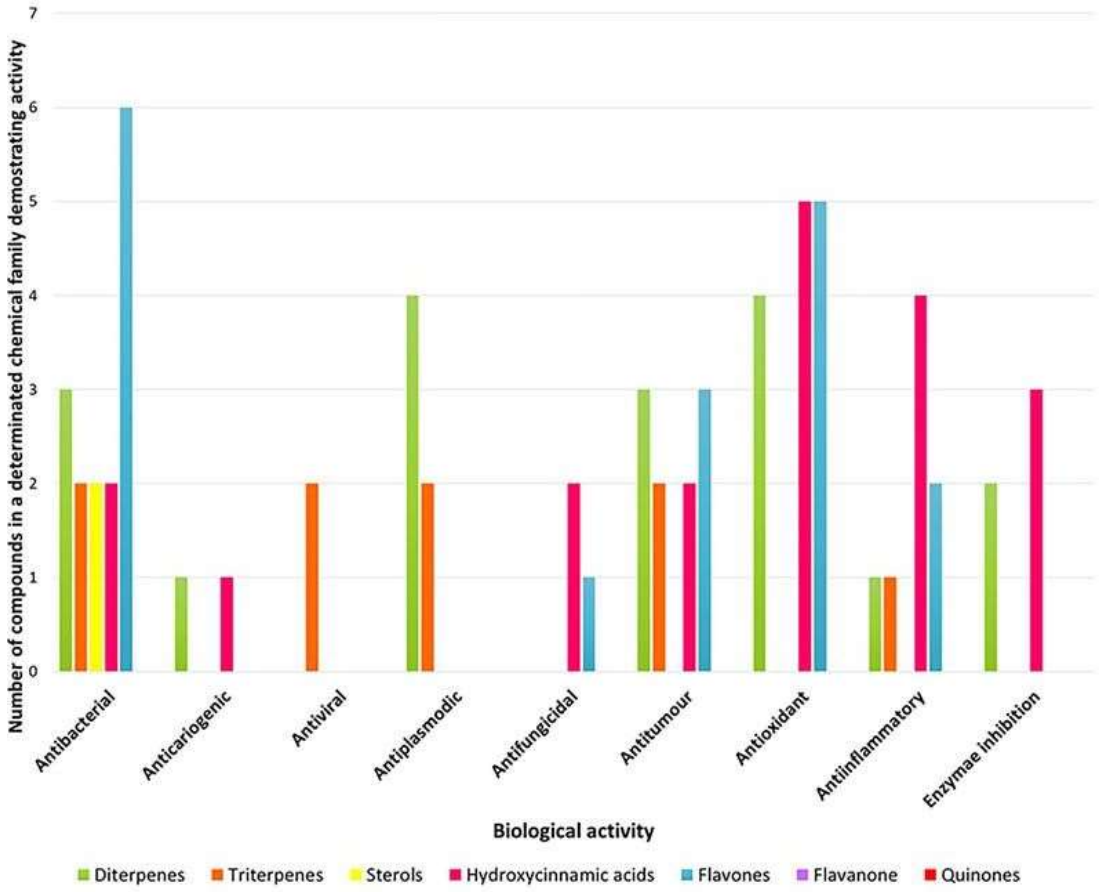


Figure 8: Depicts the summary diagram of the biological activities demonstrated by each family of compounds derived from Plectranthus species

Figure 8 shows the biological functions of the *Plectranthus* species and the phytochemicals that have been extracted from them. This helps us understand not only how the plant has been used in the past, but also how it might be used in the future.

7. Conclusion:

New standards are also emerging as the adoption of complementary therapies, such as traditional medicine, grows. To identify the molecules responsible for biological activity and to formally confirm common plant usage, compound screening is required. Plants produce a vast array of structurally varied molecules with corresponding bioactivities in their secondary metabolites. The genus *Plectranthus* has been proposed as a prospective source for the discovery of bioactive chemicals due to its varied ethnobotanical applications and its numerous biological properties (antimicrobial, antioxidant, anti-inflammatory, and anti-tumor). In this regard, it is essential to isolate secondary metabolites from *Plectranthus* species and comprehend the source of their therapeutic activities in order to ensure efficient and secure application. The findings of this review indicate that this plant can be utilized to cure a variety of ailments. Although the plant has been successfully employed in traditional systems of medicine since ancient times, further study is needed to determine its uses and develop therapeutic applications. One of the key characteristics of this plant is that it works better when used in conjunction with other therapeutic plants. Due to their antioxidant, antifungal, antibacterial, and anti-inflammatory properties, they have been used to treat a variety of ailments. Several *Lamiaceae* species also have insect-repelling, environmental remediation (phytoremediation), and heat protection properties (green roofs). This botanical family is incredibly diverse, which calls for additional research on its constituents because it has enormous pharmacological potential and a bright future. This review thus stimulates the use of alternative natural resources for various purposes and advances future research on the *Lamiaceae.*

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Conflict of Interest

The authors declare that there is no conflict of interest.

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