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A Review On Phytochemistry In Medicinal Extract of Terpenoids Occurring in Family Compositae

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Abstract

Phytochemicals are not essential nutrients and are not required by the human body for sustaining life, but have important properties to prevent or to fight some common diseases. Many of these benefits suggest a possible role for phytochemicals in the prevention and treatment of disease, Because of this property; many researchers have been performed to reveal the beneficial health effects of phytochemicals. The phytochemicals present in plants are responsible for preventing disease and promoting health have been studied extensively to establish their efficacy and to understand the underlying mechanism of their action. Such studies have included identification and isolation of the chemical components, establishment of their biological potency both by in vitro and in vivo studies in experimental animals and through epidemiological and clinical-case control studies in man.

Introduction

Phytochemicals are biologically active, naturally occurring chemical compounds found in plants, which provide health benefits for humans further than those attributed to macronutrients and micronutrients[1]. They protect plants from disease and damage and contribute to the plant's color, aroma and flavor. In general, the plant chemicals that protect plant cells from environmental hazards such as pollution, stress, drought, UV exposure and pathogenic attack are called as phytochemicals [2]

Recently, it is clearly known that they have roles in the protection of human health, when their dietary intake is significant. More than 4,000 phytochemicals have been cataloged [1] and are classified by protective function, physical characteristics and chemical characteristics and about 150 phytochemicals have been studied in detail [4]. In wide-ranging dietary phytochemicals are found in fruits, vegetables, legumes, whole grains, nuts, seeds, fungi, herbs and spices. Broccoli,

cabbage, carrots, onions, garlic, whole wheat bread, tomatoes, grapes, cherries, strawberries, raspberries, beans, legumes, and soy foods are common sources.

Phytochemicals accumulate in different parts of the plants, such as in the roots, stems, leaves, flowers, fruits or seeds. Many phytochemicals, particularly the pigment molecules, are often concentrated in the outer layers of the various plant tissues. Levels vary from plant to plant depending upon the variety, processing, cooking and growing conditions[8]. Phytochemicals are also available in supplementary forms, but evidence is lacking that they provide the same health benefits as dietary phytochemicals[4] . These compounds are known as secondary plant metabolites and have biological properties such as antioxidant activity, antimicrobial effect, modulation of detoxification enzymes, stimulation of the immune system, decrease of platelet aggregation and modulation of hormone metabolism and anticancer property. There are more than thousand known and many unknown phytochemicals. It is well-known that plants produce these chemicals to protect themselves, but recent researches demonstrate that many phytochemicals can also protect human against diseases[9].

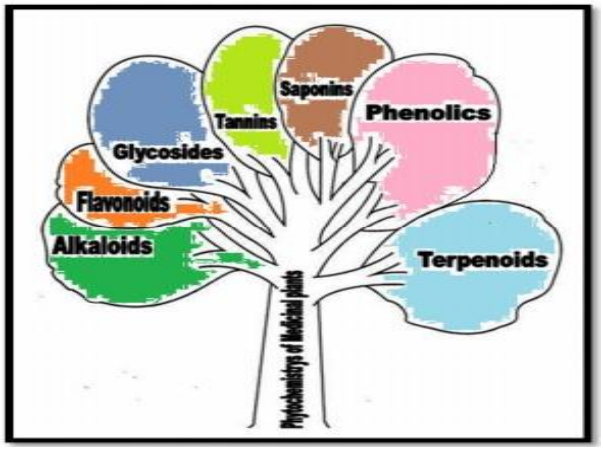

Figure 1: Phytochemistry of medicinal plants

Phytochemicals are not essential nutrients and are not required by the human body for sustaining life, but have important properties to prevent or to fight some common diseases. Many of these benefits suggest a possible role for phytochemicals in the prevention and treatment of disease, Because of this property; many researchers have been performed to reveal the beneficial health effects of phytochemicals. The purpose of the present review is to provide an overview of the extremely diverse phytochemicals presents in medicinal plants[2].

The Journey of Medicinal Plant

Plant Research An assessment of the previous trends and impact of research into the phytochemistry on medicinal plants of the world is quite desirable before considering recent trends. After centuries of empirical use of herbal preparation, the first isolation of active principles alkaloids such as morphine, strychnine, quinine etc. in the early 19th century marked a new era in the use of medicinal plants and the beginning of modern medicinal plants research. Emphasis shifted away from plant derived drugs with the tremendous development of synthetic pharmaceutical chemistry and microbial fermentation after 1945. Plant metabolites were mainly investigated from a phytochemical and chemotaxonomic viewpoint during this period. Over the last decade, however, interest in drugs of plant and probably animal origin has grown steadily[10]. Utilization of medicinal plants has almost doubled in Western Europe during that period. Ecological awareness, the efficacy of a good number of phytopharmaceutical preparations, such as ginkgo, garlic or valerian and increased interest of major pharmaceutical companies in higher medicinal plants as sources for new lead structures has been the main reasons for this renewal of interest. With the development of chemical science and pharmacognosy physicians began to extract chemical products from medicinal plants. A few examples of the products extracted from medicinal plants are - in 1920, quinine was isolated from Cinchona by the French pharmacist, Peletier & Caventou. In the mid-nineteenth century, a German chemist, Hoffmann obtained Aspirin from the bark of the willow. With the active principles in medicinal plants identified and isolated, plant-based prescriptions began to be substituted more and more with pure substances, which were more powerful and easier to prescribe and administer[11].

Phytomedicine almost went into extinction during the first half of the 21st century due to the use of the 'more powerful and potent synthetic drug'. However, because of the numerous side effects of these drugs, the value of medicinal plants is being rediscovered as some of them have proved to be as effective as synthetic medicines with fewer or no side effects and contraindications. It has been proved that although the effects of natural remedies may seem slower, the results are sometimes better on the long run especially in chronic diseases[1-2].

Biological Activities of Phytochemicals

The phytochemicals present in plants are responsible for preventing disease and promoting health have been studied extensively to establish their efficacy and to understand the underlying mechanism of their action. Such studies have included identification and isolation of the

chemical components, establishment of their biological potency both by in vitro and in vivo studies in experimental animals and through epidemiological and clinical-case control studies in man.

Study findings suggest that phytochemicals may reduce the risk of coronary heart disease by preventing the oxidation of low density lipoprotein (LDL) cholesterol, reducing the synthesis or absorption of cholesterol, normalizing blood pressure and clotting, and improving arterial elasticity[3] . Phytochemicals may detoxify substances that cause cancer. They appear to neutralize free radicals, inhibit enzymes that activate carcinogens, and activate enzymes that detoxify carcinogens. For example, according to data summarized by Meagher and Thomson, genistein prevents the formation of new capillaries that are needed for tumor growth and metastasis[5]. The physiologic properties of relatively few phytochemicals are well understood and more many research has focused on their possible role in preventing or treating cancer and heart disease[3]. Phytochemicals have also been promoted for the prevention and treatment of diabetes, high blood pressure, and macular degeneration[4]. While phytochemicals are classified by function, an individual compound may have more than one biological function serving as both an antioxidant and antibacterial agent. Bioactive and Disease preventing phytochemicals present in plant are shown in Table 1

Classification	Main groups of compounds	Biological function
NSA (Non-starch polysaccharides.)	Cellulose, hemicellulose, gums, mucilages, pectins, lignins	Water holding capacity, delay in nutrient absorption, binding toxins and bile acids
Antibacterial & Antifungal	Terpenoids, alkaloids, phenolics	Inhibitors of micro-organisms, reduce the risk of fungal infection
Antioxidants	Polyphenolic compounds, flavonoids, carotenoids, tocopherols, ascorbic acid	Oxygen free radical quenching, inhibition of lipid peroxidation
Anticancer	Carotenoids, polyphenols, curcumine, Flavonoids	Inhibitors of tumor, inhibited development of lung cancer, anti-metastatic activity
Detoxifying Agents	Reductive acids, tocopherols, phenols, indoles, aromatic isothiocyanates, coumarins, flavones, carotenoids, retinoids, cyanates, phytosterols	Inhibitors of procarcinogen activation, inducers of drug binding of carcinogens, inhibitors of tumourogenesis
Other	Alkaloids, terpenoids, volatile flavor compounds, biogenic amines	Neuropharmacological agents, anti-oxidants, cancer chemoprevention

Table1. Bioactive Phytochemicals in Medicinal Plants

Terpenoids

The terpenoids are a class of natural products which have been derived from five-carbon isoprene units. Most of the terpenoids have multi cyclic structures that differ from one another by

their functional groups and basic carbon skeletons. These types of natural lipids can be found in every class of living things, and therefore considered as the largest group of natural products[1].

Many of the terpenoids are commercially interesting because of their use as flavours and fragrances in foods and cosmetics examples menthol and sclareol or because they are important for the quality of agricultural products, such as the flavour of fruits and the fragrance of flowers like linalool[2]. Terpenes are widespread in nature, mainly in plants as constituents of essential oils. Their building block is the hydrocarbon isoprene, $CH_2=C(CH_3)-CH=CH_2$. Terpene hydrocarbons therefore have molecular formula (C_5H_8) n and they are classified according to the number of isoprene units[3].

Hemiterpenoids: Consist of a single isoprene unit. The only hemiterpene is the Isoprene itself, but oxygen-containing derivatives of isoprene such as isovaleric acid and prenol is classify as hemiterpenoids[2]

Monoterpenoids: Biochemical modifications of monoterpenes such as oxidation or rearrangement produce the related monoterpenoids. Monoterpenoids have two isoprene units. Monoterpenes may be of two types i.e linear (acyclic) or contain rings e.g. Geranyl pyrophosphate, Eucalyptol, Limonene, Citral, Camphor and Pinene[3]

Sesquiterpenes: Sesquiterpenes have three isoprene units e.g. Artemisinin, Bisabolol and Fernesol, oil of flowers, or as cyclic compounds, such as Eudesmol, found in Eucalyptus oil[3]

Diterpenes: It composed for four isoprene units. They derive from geranylgeranyl pyrophosphate. There are some examples of diterpenes such as cembrene, kahweol, taxadiene and cafestol. Retinol, retinal, and phytol are the biologically important compounds while using diterpenes as the base[3]

Triterpenes: It consists of six isoprene units e.g. Lanosterol and squalene found in wheat germ, and olives[3]

Problem Definition

From the above study of review of literature I have studied the different problems that are as follows:

- Why are so numerous and involve such a variety of molecular structure that their rational classification is difficult. However, the best approach to the problem is to group them into families, depending on the type of heterocyclic ring system present in the molecule.

- Terpenoids have potential anti Inflammation activity is a localized physical problem in which a part of the body gets reddened or swollen. The purpose of inflammation is to eliminate the injured cells, removal of the necrotic cells and damaged tissues.
- Plant species is used in various applications especially for medicinal purposes. They are significant element of the world cultural heritage; they resort for treating health problems.

Literature Survey

A brief literature review is needed in order to understand work done by various scholars in this field.

Shakir Ullah *et al [*2018] described the Six medicinal plants species Rumex dentatus L., Rumex hastatus L., Verbascum Thapsus L, Solanum nigrum L., Cannabis sativa Linn, and Convolulus arvensis L. were collected from the mountain of Arrang Sari ghar War affected area of Bajaur agency, Pakistan. The selected medicinal plants leaves were washed, air dried and then powdered. The methanolic, ethanolic and chloroform extract of leaf samples were used for the phytochemical investigation both (qualitative and quantative) and antibacterial activity. The key objective of the present work was to check the antibacterial activity and presence or absence of the phytochemical constituents of all the selected medicinal plants. The results of the phytochemical investigation of these medicinal plants showed that the alkaloids, Phlobatannins, tannins, flavonoids, carbohydrates, phenols, saponin, cardiac glycosides, proteins, glycosides and terpenoids were found to be present in all selected medicinal plants. Highest amount of phenol was found in the methanolic extract in sample Rumex hastatus (0.81±0.10 mg/g) followed by Canabis sativa (0.68±0.11 mg/g), Convolulus arvensis (0.58±0.20 mg/g), lowest amount of flavonoids was found Solanum nigrum (0.10±0.11 mg/g). Maximum zone of inhibition was detected against Staphylococcus aureus and Salmonella typhi with zone of inhibition of 24.17 and 21.00 mm respectively by Rumex hastatus. Rumex hastatus showed 17.00 mm zone of inhibition against Escherichia coli. The secondary metabolite of the plants is very essential commercially and has more concentration in pharmaceutical companies for the manufacture of the new drugs for curing of several diseases[1]

Isaac John Umaru *et al* [2018] have been studied Medicinal plant over the years has been used to treat many diseases such as Diabetic, cancer, tumour, ulcers and bacterial. This study aimed at conducting the phytochemical analysis and in vitro antioxidant activities of the stembark extracts of selected medicinal plants (Leptadenia hastata, Barringtonia asiatica and Barringtonia racemosa). Material and Methods: All the plants were extracted by solvent maceration extraction

methods. The Phytochemical analysis for alkaloids, phenolic compounds, tannins, flavonoids, coumarins, steroids, terpenoids, cardiac glycosides, essential oils, saponins and resins by using the standard methods. The in vitro antioxidant property was evaluated by assessing the DPPH˙ radical scavenging ability. Results: The preliminary Phytochemical evaluation of these plant species exhibited that the Dichloromethane extracts of Leptadenia hastata, Barringtonia asiatica and Barringtonia racemosa (Stem-bark) contain alkaloids, Sterols, Phenols, Flavonoids, Essential oil, Tannins, Terpenoid, Carbon hydrate, Cardiac glycosides, Saponins, Proathocyanidins, Coumarins, with Sterol and essential oil absent in the Leptadenia hastata and Coumarin in the Barringtonia asiatica and Barringtonia racemosa. The in vitro antioxidant activity of the species of Leptadenia hastata, Barringtonia asiatica and Barringtonia racemosa from five solvent extract of stem-barks have prominent antioxidant activities. Conclusion: This study suggests the potential source of natural antioxidant in Leptadenia hastata, Barringtonia asiatica and Barringtonia racemosa. Further research is highly recommended on the isolation of the bioactive compounds from these species and also to understand their mode of action in controlling various dreadful diseases[2]

Gladis Raja Malar C *et al*[2017] have been an investigation was carried out to quantify the phytochemical constituents such as total flavonoid, total terpenoid and anti-inflammatory activity of aqueous stem extract of Salacia oblonga. Preliminary screening involved the qualitative methods to detect the availability of phenol, tannin, saponin, alkaloids, terpenoids, quinones, flavonoids, coumarins, steroids, glycosides etc. Total flavonoid and total terpenoids were quantitatively estimated. Since flavonoids and terpenoids have potential anti-inflammatory activity. Total flavonoid and total terpenoid contents of aqueous stem extract were found to be 19.82 mg quercetin equivalents per gram and 96.2 mg per gram respectively. In vitro anti-inflammatory activity of aqueous stem extract of S.oblonga was evaluated by albumin denaturation membrane stabilization tests. The percentage inhibition of denaturation at a concentration of 50 mg/ml of extract was 97.5% and the percentage inhibition of haemolysis shown 89.14%. From the result it was concluded that the availability of secondary metabolites in the stem extract of S.oblonga may be responsible for the antiinflammatory activity. Therefore our study supports the isolation and herbal usage of S.oblonga stem for treating inflammation[3]

S.Divya *et al* [2017] have been studied phytochemical screening reveals the presence of various bioactive compounds like alkaloids, terpenoids, reducing sugar, phlobatannins and flavonoids.

These compounds are used as drugs for curing various human diseases. These medicinal plants can also act as antimicrobial activities.This present study reveals the medicinal properties and phytochemical analysis of Mimosa pudica, Leucas aspera, Tridax procumbens, Punica granatum and Cymbopogon citratus. The leaves of these five medicinal plants were selected for the present study. The leaves samples were washed in fresh water, air dried at room temperature and then powdered using mixer. By using distilled water, the plants extracts are collected and used for phytochemical analysis. As a result, no plants have the presence of all the phytochemicals at the concentration of the extracting reagents. The results,shows that the plant Cymbopogon citratus shown the presence of three phytochemicals such as reducing sugar, alkaloids and terpenoids.Leucas asperashown negative results as absence of all phytochemicals.Punica granatum, Mimosa pudica, Tridax procumbensshown positive results as presence of two phytochemicals.Mimosa pudica shown the presence of phlobatannins and terpenoids. Punica granatum shown the presence of flavonoids and alkaloids. Tridax procumbens shown the presence of Reducing sugar and phlobatannins. The phytochemical analysis plays a major role in pharmaceuticals industries for production of drugs and vaccine for curing various human diseases.

V. Nandagoapalan *et al* [2016]described screening of phytochemicals is a precious stair in the detection of bioactive principles present in particular medicinal plant and may lead to novel drug discovery. In the present study, principal phytoconstituents of 25 traditional medicinal plants were identified in order to relate their presence with bioactivities of the plants. Screening of the plants was performed using standard methods and resulted in the detection of the presence of tannins, flavonoids, phenolics, saponins, steroids, cardiac glycosides and alkaloids. Flavonoids were present in 19 of 25 plants while alkaloids were present in sixteen plants. The presence of these phytochemicals can be correlated with medicinal potential of these plants. Further studies are needed with these plants to evaluate their pharmacological potentials, isolate, characterize and elucidate the structures of the bioactive compounds responsible for their activities and other medicinal values.

Farhana Jabin *et al* [2016] described the extract of leaves of Murraya koenigii, Punica granatum, Jatropa curcas, Lawsonia inermis, Capsicum annum, Syzygium cumini were investigated for its phytochemical analysis. Qualitative phytochemical analysis of these plants confirm the various secondary metabolites like saponins, terpenoids, steroids, anthocyanins,

tannis, flavonoids and alkaloids (Table no.1). Therefore these secondary metabolites had played fundamental role in controlling the vegetable diseases due to their antioxidant activities. This study provides the information for preventing the plant diseases at affordable cost and eco-friendly.

Rohit kumar Bargah *et al* [2015] conveyed the bioactive compounds present in the plant are responsible for the medicinal properties of the plant. The present investigation is aimed in screening the bioactive compounds present in the leaves, stem bark and flowers of Moringa pterygosperma an important ethnomedicinal plant. The qualitative analysis for the present phytochemicals was performed using ethanol and aqueous extracts of leaves, stem bark and flowers of Moringa plant by various standard techniques available. Phytochemical analysis revealed the presence of alkaloids, flavonoids, terpenoids, glycosides, steroids and phenols in all the extracts varying quantities. Since the plant contain high quantities of these new bioactive potential compounds, it is reliable to possess large number of pharmacological values like antioxidants, antifungal, antibacterial, anti abortifacient, anti-inflammatory, antiulcer, diuretics activities and are being employed for the treatment of different ailments in the indigenous system of medicine.

Manjulika Yadav *et al* [2014] have studied Preliminary screening of phytochemicals is a valuable step, in the detection of the bioactive principles present in medicinal plants and subsequently may lead to drug discovery and development. In the present study, chief phytoconstituents of the six selected medicinal plants of different families were identified in order to relate their presence with bioactivities of the plants. Screening of six selected medicinal plants was performed for the presence of tannins, flavonoids, terpenoids, saponins, steroids, phlobatannins, carbohydrates, glycosides, coumarins, alkaloids, proteins, emodins, anthraquinones, anthocyanins and leucoanthocyanins using standard methods. All the selected medicinal plants were found to contain tannins and flavonoids. Moreover, terpenoids were also present in all the selected plants except *P. dactylifera*. except *P. dactylifera*. On the other hand, saponins and steroids were absent in all plants except *S. chirata* and phlobatannins were absent in all plants except *R. sativus*. In addition, carbohydrates, glycosides and coumarins were present in all the selected plants except *P. dactylifera* and *R. sativus*. Alkaloids were present in all the selected plants except *F. religiosa, P. dactylifera* and *R. sativus*. Proteins were present only in *F.*

religiosa and *S. chirata*. Whereas emodins, anthraquinones, anthocyanins and leucoanthocyanins were absent in all the selected six plants.

Mamta Saxena *et al* [2013] proposed about Medicinal plants are a rich source of bioactive phytochemicals or bionutrients. Studies carried out during the past 2-3 decades have shown that these phytochemicals have an important role in preventing chronic diseases like cancer, diabetes and coronary heart disease. The major classes of phytochemicals with disease-preventing functions are dietary fibre, antioxidants, anticancer, detoxifying agents, immunity-potentiating agents and neuropharmacological agents. Each class of these functional agents consists of a wide range of chemicals with differing potency. Some of these phytochemicals have more than one function. There is, however, much scope for further systematic research in screening Indian medicinal plants for these phytochemicals and assessing their potential in protecting against different types of diseases.

Materials And Methods

Phytochemical Screening

Preliminary qualitative phytochemical screening was carried out with the following methods:

Alkaloids

Wagner's Test: About 1ml of leaf extract and 1ml of Wagner's reagent (dilute iodine solution) are added and mixed. Formation of reddish brown precipitates indicates the presence of alkaloids.

Flavonoids

Shinoda Test: To 1ml of the extract, add 8 - 10 drops of concentrate HCl and a pinch of magnesium powder or filing. Boil for 10 to 15 minutes and cool. A red colouration indicates the presence of flavonoids.

Steroids

Libermann Burchard Test: To 0.5 ml of the extract, add 2ml of acetic anhydride and 2ml of concentrate H2SO4 along the sides of the tube. The formation of green colour indicates the presence of steroids.

Glycosides

Keller-Killani Test: To 5ml of the extract is treated with 2ml of glacial acetic acid containing one drop of ferric chloride solution and 1ml of concentrated sulphuric acid. A brown ring at the interface indicates the presence of cardiac glycosides.

Terpenoids

Salkowski Test: To 5ml of the extract, add 2ml of chloroform and 3ml of concentrated H2SO4. Formation of yellow colour ring at the interface of the two liquids that turns reddish brown colour after two minutes, showed the presence of terpenoids.

Phenols

Liebermann's Test: To 1ml of extract add 1ml of sodium nitrite, few drops of diluted sulphuric acid and 2ml of diluted NaOH. Appearance of deep red or green or blue colour indicates presence of phenol.

Tannins

Modified Prussian Blue Test: To 1ml of the extract, add 1ml of 0.008M potassium ferricyanide and 1ml of 0.02M FeCl3 in 0.1 M HCl. Appearance of blue colour indicates the presence of tannins.

Saponins

Forth Test: About 2g of the powdered sample is boiled with 20ml of distilled water in a water bath and filter. 10 ml of the filtrate is mixed with 5 ml of distilled water and shake vigorously for a stable persistent forth. The frothing is mixed with 3 drop of olive oil and shakes vigorously. The formation of emulsion for the positive result can be observed.

Gum And Mucilage

To 1ml of extract add 2.5ml of absolute alcohol and stirring constantly. Then the precipitate was dried in air and examine for its swelling properties. Swelling was observed that will indicate presence of gum and mucilage.

Lignin

(Klason lignin) Phlorglucinol + Conc. HCl, Red colouration on the fibres of Xylem and phloem tissue.

Starch

50% Iodine solution, Blue black spot was observed.

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