1. INTRODUCTION

Plants are one of the two groups into which all living things were traditionally divided whereas the other one is animals. The division goes back at least as far as Aristotle (384 BC - 322 BC) who distinguished between plants which generally do not move, and animals which often are mobile for catching their food. Much later, Linnaeus (1707 - 1778) created the basis of the modern system of scientific classification, these two groups became under the kingdoms Vegetabilia (later Metaphyta or Plantae) and Animalia (also called Metazoa). Since then, it has become clear that the plant kingdom as originally defined included several unrelated groups, such as fungi and several groups of alga. However, these organisms are often considered as plants, particularly in popular contexts.

1.1 Phytochemistry

Plant metabolites are the phytochemicals which are essential for the metabolic processes of both human and animals.

They are grouped into two broad classes.

1. Primary metabolites
2. Secondary metabolites.

The primary metabolites are the products of primary metabolism. Primary metabolites are involved in growth, development, and reproduction of the organism. The primary metabolite is typically a key component in maintaining normal physiological processes; it is referred as central metabolite. Primary metabolites are typically formed during the growth phase as a result of energy metabolism and are deemed essential for proper growth. Some examples of primary metabolites: Carbohydrates, Lipids, Proteins, Enzymes, Vitamins, Minerals and Water etc., (Hartmann, 2007).
The secondary metabolites are produced by the secondary metabolic pathways. These are organic compounds it is very essential for the secondary metabolic processes of human and other living things. I.e. at the time of wound healing protection against microorganisms. They comes under the following categories namely, Alkaloids, Amines, Flavonoids, Nucleic acids, Phenols, Poly phenols, Quinones, Tannins, Terpenoids, Xanthones, Stilbenes, Sulfur compounds, Phenyl propanoids, Poly acetylenes and Chlorophylls etc., (Henderson et al., 1983).

Secondary metabolites are organic compounds that are not directly involved in the normal growth, development, or reproduction of organisms, but involved indirectly in life cycle of organisms (Fraenkel, 1959) unlike primary metabolites. Absence of secondary metabolites does not result in immediate death, but rather in long-term impairment of the organism's survivability, fecundity, or aesthetics, or perhaps in no significant change at all. Secondary metabolites are often restricted to a narrow set of species within a phylogenetic group (Stamp, 2003). Secondary metabolites often play an important role in plant defense against herbivore and other interspecies defenses.

Secondary chemicals are essential for plants and used by human. Most pharmaceuticals are based on plant chemical structures and secondary metabolites are widely used for recreation and stimulation (the alkaloids nicotine and cocaine; the terpene cannabinol). The study of such plant use is called ethno pharmacology. Psychoactive plant chemicals are central to some religions and flavors of secondary compounds shape our food preferences.

Many secondary metabolites are toxic or repellant to herbivores and microbes which help as defensive mechanisms for whole plants which produce them. Production decrease may be notified, when a plant is attacked by herbivores or pathogens. Some compounds are released into the air when
plants are attacked by insects; these compounds attract parasites and predators that kill the herbivores. Recent researches are identifying more and more primary roles for these chemicals in plants as signals, antioxidants and other functions, so "secondary" may not be an accurate description in the future.

A simple classification of secondary metabolites includes three main groups: terpenes (such as plant volatiles, cardiac glycosides, carotenoids and sterols), phenolics (such as phenolic acids, coumarins, lignins, stilbenes, flavonoids, tannins and lignin) and nitrogen containing compounds (such as alkaloids and glucosinolates). A number of traditional separation techniques with various solvent systems and spray reagents have been described for having the ability to separate and identify the secondary metabolites. This chapter proposes to discuss major secondary metabolite classes (terpenoids, phenolic compounds and alkaloids) with different chemical structures and functions being screened, separated, fractionated and purified Chromatography 132 and its Applications are analyzed using various adsorbents and eluents through column chromatography (CC) and thin layer chromatography (TLC).

Terpenoids

The terpenoids are synthesized via the five-carbon building block isoprene. Mono terpenoids consist of two isoprene units and sesquiterpenoids consist of three units. They are referred to as low-molecular-weight terpenoids and they represent the most diverse category of plant constituents with more than 25,000 individual compounds. These diverse phenyl propanoid are based on a nine carbon skeleton and are synthesized via another pathway. Compounds of all three groups are lipophilic and tend also to volatilize readily. They have strong odors and flavors. Their actions vary greatly, a range of which have been utilized in herbal remedies. Particular importance is antineoplastic, antibacterial, antiviral effects as well as
gastrointestinal stimulation. However they are not associated with toxicity unless they are concentrated as volatile oils. The plant family best known for these compounds is Lamiaceae (Thyme family) but is also present in a wide range of other families.

**Monoterpenes and sesquiterpenes (Plant volatiles)**

Plant volatiles are typically lipophilic liquids with high vapor pressures. Non-conjugated plant volatiles can cross membranes freely and evaporate into the atmosphere when there are no barriers to diffusion. The number of identified volatile chemicals synthesized by various plants exceeds thousand and is likely to grow as more plants are examined with new methods for detecting and analyzing quantities of volatiles. Studying the volatile fraction requires analytical methods and technologies that not only evaluate its composition exhaustively but also monitor variations in its profile and detect trace components characterizing the plant being investigated (Pichersky *et al.*, 2006).

**Diterpenoids**

Diterpenoids are composed of 4 isoprene units (20 carbons). They are very lipophilic and tend to have strong flavors, but are not volatile and, odorless. Much less toxicological information is available on the diterpenoids than on the lower molecular terpenoids. Several compounds possess the antineoplastic activity. Diterpenoids are found in several plants, among them *Coffea arabica* (Coffee) is one. Diterpenoids are also typically present in resins.

**Resins**

The resins are complex lipid-soluble mixtures usually both non-volatile and volatile compounds. The non-volatile fraction may consist of diterpenoid and triterpenoid compounds, and mono- and sesqui terpenoids predominate in
the volatile fraction. Most typical resins are secreted by wood, but resins are also present in herbaceous plants. They all are sticky and the fluidity depends on their contents of volatile compounds. When exposed to air they harden. Most resins are antimicrobial to wound healing, but their actions depend on the composition of the chemical mixture. Resins are generally safe, but contact allergy may occur.

**Lignins**

Lignins are composed of two phenylpropanoid units to form a carbon skeleton, with various functional groups are connected. They are generally lipophilic and have structural functions within the plant cell membranes. Lignins are present at highest concentrations in oil seeds, but also found in other parts of the plants of different families. Several lignins show clinical activity as phytoestrogenic, cathartic or antineoplastic effects.

**Pharmacological activities**

Pharmacology is the branch of medicine. The biology concerned with the study of drug action, where a drug can be broadly defined as any man-made, artificial natural, or endogenous (within the body) molecule which exerts a biochemical and/or physiological effect on the cell, tissue, organ, or organism. More specifically, it is the study of the interactions occurs between living organism and chemicals which affect normal or abnormal biochemical functions. If substances may have medicinal properties, they are defined as pharmaceuticals.

Natural antioxidants protect the human body from free radicals and retard the progress of many chronic diseases, as well as lipid oxidative rancidity in foods. The biological properties of these natural antioxidants have been largely attributed to their high levels of various terpenoid compounds, such as phenolic acids and flavonoids. The prevention of cardiovascular
diseases, inflammations and aging-related disorders can also be correlated by intake of fruits, because fruits are rich in terpenoid compounds, phenolic compounds and vitamins.

The terpenoids form a group of compounds, the majority of which occur in the plant kingdom; a few terpenoids have been obtained from other sources. More terpenes have been discovered as an efficacious compound in human disease therapy and prevention. Terpenoid compounds have been used to treat cancer, malaria, inflammation and a variety of infectious disease (Fungal, Bacterial and Viral).

**Carrot** (*Daucus carota* L.)

Carrots are basically root vegetables belonging to the Apectaeae or Umbelliferous family, which also includes parsley, parsnip, dill, cumin etc. A carrot plant has green leaves and a long slender orange root it is edible. It has a crisp texture when fresh. The most commonly eaten part of a carrot is a taproot, although the greens are sometimes eaten as well. It is a domesticated form of the wild carrot *Daucus carota*, native to Europe and southwestern Asia.

**Description**

The carrot is a variable biennial plant, usually growing up to 1 m tall and flowering from June to August. The umbels are claret-colored or pale pink before they open, then bright white and rounded when in full flower, measuring 3–7 cm wide with a festoon of bracts beneath; finally, as they turn to seed, they contract and become concave like a bird's nest. The dried umbels detach from the plant, becoming tumbleweeds. *D. carota* is distinguished by a mix of bi-pinnate and tri-pinnate leaves, fine hairs on its stems and leaves, a root that smells like carrots, and occasionally a single dark red flower in its center.
Systematic position of *Daucus carota* L.

Kingdom : Plantae  
Class : Dicotyledonae  
Sub class : Polypetalae  
Series : Calyciflorae  
Order : Umbellales  
Family : Apiaceae  
Genus : *Daucus*  
Species : *carota*

**Medicinal uses of terpenes in *Daucus carota***

Terpenoids and terpenes are aromatic compounds that are found in thousands of plant species, and are responsible for the various flavors and fragrances of cannabis. We have known about their presence in cannabis for decades, but it is only recently that awareness of their potential therapeutic properties has begun to expand could be used for their antiseptic and antimicrobial properties. Terpenes also play an incredibly important role by providing the plant with natural protection from bacteria and fungus, insects, and other environmental stresses.

**Tomato (*Solanum lycopersicum* L.)**

The *Solanum lycopersicum* commonly known as Tomato. It is an edible fruit. The plant which belongs to the family, Solanaceae. The species originated in Central and South America. Numerous varieties of tomatoes are widely grown in temperate climates region across the world, with greenhouses allowing its production throughout the year and in cooler areas. The plants are typically grow upto 1–3 meters in height and have a weak stem that often sprawls over the ground and vines over other plants. It is a perennial and grown as an annual in temperate climates. An average common tomato weighs approximately 100 grams. Its use as food. Originated
in Mexico and spread throughout the world following the Spanish colonization of the America. Tomato is consumed in diverse ways, including raw, as an ingredient in many dishes, sauces, salads, and drinks. While tomatoes are botanically berry type fruits, they are considered culinary vegetables, being ingredients of savory meals.

**Systematic position of Solanum lycopersicum L.**

- **Kingdom**: Plantae
- **Class**: Dicotyledonae
- **Sub class**: Gamopetalae
- **Series**: Bicarpellatae
- **Order**: polimoniales
- **Family**: Solanaceae
- **Genus**: Solanum
- **Species**: lycopersicum

**Medicinal uses of Solanum lycopersicum**

The Tomato is not acid forming it contains a great deal of citric acid but is alkaline forming when it enters the bloodstream. It increases the alkalinity of the blood and helps in removing toxins, especially uric acid, from the system. As a liver cleanser, tomatoes are wonderful, especially when used with the green vegetable juices.

The fruit is a familiar vegetable, but the fruit, leaf, and vine are also used to make medicine. Tomato is used for preventing cancer of the breast, bladder, cervix, colon and rectum, stomach, lung, ovaries, pancreas, and prostate. It is also used to prevent diabetes, diseases of the heart and blood vessels (cardiovascular disease), cataracts and asthma. Some people use tomato to treat high blood pressure, osteoarthritis, the common cold, chills and digestive disorders.
1.2 Antimicrobial activity

The prevention and treatment for diseases caused by microorganisms is known as Antimicrobial activity. It’s have following sub divisions they are virology (study of viruses), bacteriology (study of bacteria), mycology (study of fungi), phycology (study of algae) and protozoology (study of protozoa). For the treatment of diseases inhibitory chemicals employed to kill microorganisms or prevent their growth, are called antimicrobial agents. These are classified according to their application and spectrum of activity, as the germicides that kill micro-organisms, whereas micro-biostatic agents inhibit or reduce the growth of pathogens and enable the leucocytes and other defense mechanism of the host to cope up with static invaders.

The germicides may exhibit selective toxicity depending on their spectrum of activity. They may act as viricides (killing viruses), bactericides (killing bacteria), algicides (killing algae) or fungicides (killing fungi). The beginning of modern chemotherapy has largely been due to the efforts of Paul Ehrlich (1910), who used salvarsan, as arsenic derivative effective against syphilis. Paul Ehrlich used the term chemotherapy for curing the infectious disease without injury to the host’s tissue, known as chemotherapeutic agents such as antibacterial, antiprotozoal, antiviral, antineoplastic, anti-tubercular and antifungal agents. Later on, Domagk (1953) prepared an important chemotherapeutic agent sulfanilamide.

Mode of action

Antimicrobial drugs interfere chemically with the synthesis of function of vital components of microorganisms. The cellular structure and functions of eukaryotic cells of the human body. These differences provide with selective toxicity of chemotherapeutic agents against microbes. The antimicrobial drugs may kill microorganisms or prevent their growth. There are several ways in which these agents exhibit their antimicrobial activity.
Antimicrobial drugs may either kill microorganisms outright or simply prevent their growth. Here are various ways in which these agents exhibit their antimicrobial activity. They may inhibit Cell-wall synthesis, Protein synthesis, Nucleic acid synthesis, enzymatic activity and Damage cytoplasmic membrane

The use of antimicrobial agents resulted in the selection of resistant bacteria. Since the advent of new mighty drugs is highly difficult, the proper use of currently available antimicrobial agents as well as efforts to minimize the spread of resistant bacteria through appropriate infection control would be quite important, and may represent a first step in solving the issue of resistant microorganisms (Tomoosaga et al., 2009).

1.3 Antioxidant activity

An antioxidant is a molecule capable of inhibiting the oxidation of other molecules. Oxidation is chemical reaction it transfers electrons from a substance to an oxidizing agent. Oxidation reactions can produce free radicals. These radicals can start chain reactions that damage cells. Antioxidants terminate these chain reactions by removing free radical intermediates and inhibit other oxidation reactions. They do this by being oxidized themselves, so antioxidants are often reducing agents such as ascorbic acid or polyphenols. Although oxidation reactions are crucial for life, they can also be damaging hence, plants and animals maintain complex systems of multiple types of antioxidants, such as glutathione, vitamin C, and vitamin E as well as enzymes such as catalase, superoxide dismutase and various peroxidases. Low levels of antioxidants, or inhibition of the antioxidant enzymes, cause oxidative stress and may damage or kill cells.

This stress might be an important part of many human diseases; the use of antioxidants in pharmacology is intensively explored, particularly as treatments for stroke and neurodegenerative diseases. However, it is unknown
whether oxidative stress is the cause or the consequence of disease. Antioxidants are used as ingredients in dietary supplements in the hope of maintaining health and preventing diseases such as cancer and coronary heart disease. Although initial studies suggested that antioxidant supplements might promote health, later large clinical trials did not detect any benefit and suggested instead that excess supplementation may be harmful. In addition to these uses of natural antioxidants in medicine, these compounds have many industrial uses, such as preservatives in food and cosmetics and preventing the degradation of rubber and gasoline.

Romaiana picoda et al., 2009 worked the antioxidant capacity of three species namely *Mellisa officinalis*, *Maticaria recutita* and *Cymbopogan citrates* used in Brazil to treat as neurological disorders. Phenolic compound was responsible for antioxidant effect present in plant extracts was assayed by 10-10 diphenyl-20 picrylhydrozyl (DPPH) method and Thin layer chromatography respectively. Quercetin exhibited the highest antioxidant activity present in *Mellisa officinalis* and the inhibition of peroxidation by *Mellisa officinalis* extract showed a reaction with phenol content.

**Types of antioxidants**

Antioxidants are divided into two main divisions, depending on the nature of soluble in water called hydrophilic and soluble in lipids called hydrophobic. In generally water-soluble antioxidants react with oxidants in the cell cytosol and the blood plasma, while lipid-soluble antioxidants protect the cell membranes from lipid peroxidation. These compounds may be synthesized in the body or obtained from the diet. The different antioxidants are present in wide range of concentrations in body fluids and tissues, with some such as glutathione or ubiquinone mostly present within cells, while others such as uric acid are more evenly distributed. Some antioxidants are
only found in a few organisms and these compounds can be important in pathogens and can be virulence factors.

Some antioxidant nutrients, like vitamin C can assume oxidant roles which may be toxic, like the Fenton reaction when it reduces metal ions as with iron. Several clinical trials now show that antioxidants, like β carotene which is a precursor of vitamin A, can increase the risk of cancer when administered as an isolated supplement. In the APPP (Australian Polyp Prevention Project) with interventions of a low fat diet, wheat bran or β-carotene, while the combination of low fat and wheat bran prevented the recurrence of large adenomatous polyps, β-carotene increased the risk of any polyp recurrence in women (Mark Wahlqvist 2013).

1.4 Anti diabetic activity

Diabetes mellitus is a group of metabolic diseases characterized by high blood sugar (glucose) levels that result from defects in insulin secretion, or action, or both. Diabetes mellitus is commonly referred to as diabetes, (as it will be in this article) it was first identified as a disease associated with "sweet urine," and excessive weight loss in the ancient world. Medicinal plants are the main source of organic compounds such as polyphenols, tannins, alkaloids, carbohydrates, terpenoids, steroids and flavonoids. These organic compounds represent a source for the discovery and development of new types of anti diabetic molecules. Many compounds are isolated from plant sources, it have been reported to show anti diabetic activity of plant extracts.

Drugs are used as prevent the diagnose, treat or to cure diseases or disorders. However, they must be used as safely with precaution to ensure that they are safe and effective. Many drugs owe to interacts with the body in different ways, like with our daily diet or lifestyle, which has significant impact on a drug's ability to show its effects which may be enhanced or decreased. Extensive literature surveys from all scientific sources revealed
that lycopene have antioxidant and anti-diabetic activity. But influence of lycopene on diabetic patients who are under the treatment is not clear. Hence, the present study is planned to find out the influence of lycopene alone and also on anti diabetic effect of glipizide and Metformin combination (Anurag Kuhad et al., 2008).

1.5 Seed treatment

Since ancient periods, farmers fought against disease and insects for good yield of the crop. More than 300 years ago, seed treatments were added to the arsenal for insect control weapons. The first seed treatments were simple inorganic chemicals, such as brine or lime solutions. Through a combination of accident and trial and error method, they were found to reduce the incidence of wheat stinking smut. In the early of 1800 AC copper sulfate solution was found superior to lime in controlling bunt. The 1920 AC, copper carbonate dust began replace copper sulfate dips because it was more convenient and safe for seeds.

In 1930 organic mercurial seed treatments achieved great success against a number of seed diseases. These mercury based treatments were abandoned in 1970 due to the risk of accidental mercury poisoning. After Second World War, a various types of useful non systemic, organic chemical fungicides and insecticides were developed. Beginning in the 1960 and 1970, so many groups of systemic organic seed treatments were synthesized. In the 1980 and 1990 the researchers developed the first biological seed treatments based on bio control with living microorganisms.

Seed treatments are defined as chemical or biological substances are applied to seeds or vegetative propagation materials to control disease organisms, insects or other pests. Seed treatment pesticides include bactericides, fungicides and insecticides. Many seed treatments are applied to true seeds such as corn, wheat or soybean, which have a seed coat
surrounding an embryo. Some seed treatments can be applied to vegetative propagation materials, such as bulbs, corms, or tubers (such as potato seed pieces).

Seeds are applied with nontoxic such as growth regulators, micronutrients and nitrogen fixing Rhizobium and Brady rhizobium. Treatments designed to protect stored food or feed grain are considered grain treatments rather than seed treatments. Pest control in stored grain and storage facilities requires additional licensing.

The four biochemical tests applied to assess the presence of seed borne bacteria on *Solanum lycopersicum* seed lots used in our work revealed the presence of detected pathogens XCV, CMM and PST but gave negative results for oxidase, arginine dehydrolase and nitrate reduction tests. With exception to CMM, was gram positive, XCV and PST was gram negative. The commercial *S. lycopersicum* seed lot had the least XCV contamination while ‘Tanya G2’ was more highly contaminated with PST than the other seed lots (Mtui *et al.*, 2010).

In this research, two commonly used vegetables have been taken namely *D. carota* and *S. lycopersicum*. This present study is done in the view to incorporate the bio-active compound on to a plant which does not possess the incorporated compound earlier thereby increases the pharmacological activity in the infused plant. The two vegetables have been tested for their initial phytochemical presence and subsequently the targeted compound had been identified and isolated from *D. carota*. Then the targeted plant namely, *S. lycopersicum*, had been treated with the isolated compound. The results tested with various techniques are tabulated and discussed in the forthcoming chapters.