IJPSR (2016), Vol. 7, Issue 11 **(Review Article)**

INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH

Received on 22 May, 2016; received in revised form, 26 August, 2016; accepted, 28 September, 2016; published 01 November, 2016

NATURAL RESOURCES: AN ECOFRIENDLY AND SAFER ALTERNATE TO CONTROL PLANT DISEASES

S. Mehta * and K. Sharma

Microbial Research Laboratory, Department of Botany Mohan Lal Sukhadia University, Udaipur Rajasthan, India.

Keywords:

Antifungal activity, Fungicides, Herbal formulation, Human pathogenic bacteria, Organic substances

Correspondence to Author:
Surbhi Mehta

Microbial Research Laboratory
Department of Botany,
Mohan Lal Sukhadia University,
Udaipur Rajasthan, India.

E-mail: surbhimehta27@gmail.com

ABSTRACT: As the focus of the world is shifting towards natural products and analogues, the demand of herbal medicine is also increasing and several plants have been screened for antifungal activity. Review of literature reports that plant extracts have been mostly screened for activity against human pathogenic bacteria and fungi. Compared to this, there are very few reports regarding inhibitory activity against plant pathogenic fungi. Although there are several reports of antifungal activity of plant products yet not much work has done to develop herbal bio-control agents or formulations using plant products or extracts. Herbal Products are cheaper than chemicals with minimal or practically no adverse side effects on hosts. *Eucalyptus globulus* extract has been screened for antifungal activity against human pathogenic fungi and bacteria but very few reports are available regarding plant pathogenic fungi especially early blight caused by *Alternaria solani.* Antifungal activity of organic substances has been reported by some workers but no study till date has been reported on preparation of herbal formulation by combining plant powder, extracts and organic substances. The present work proposes to develop a formulation by combining plant extracts/ plant powder with these traditionally used organic substances for control of early blight of tomato caused by *Alternaria solani*. This type of formulation will provide a cheap and environmentally safe herbal fungicide that can be further used as a commercial herbal bio-control agent.

INTRODUCTION: Inappropriate use of agrochemicals especially fungicides not only impose adverse effects on ecosystems, it also possess a possible carcinogenic risk higher than that of insecticides and herbicides put together [1-4]. Moreover, resistance by pathogens to fungicides has rendered certain fungicides ineffective [5]. Hence there is a need to search for an environmentally safe and economically viable strategy for the control of diseases and to reduce the dependence on the synthetic agrochemicals.

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.7(11).4327-40

Article can be accessed online on: www.ijpsr.com

DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.7 (11).4327-40

Nature has been a source of bio-control agents for thousands of years and an impressive number of antimicrobial compounds have been isolated from natural sources [6-8]. The use of natural products for the control of fungal diseases in plants is considered as an interesting alternative to synthetic fungicides due to their less negative impacts on the environment [9].

In addition to well known disease management methods, there are several traditional agricultural practices followed by farmers to control plant diseases such as crop rotation, use of resistant cultivars, planting disease free seeds, biological control, land preparation, pest control, storage, plant nutrients, grafting, soil selection, plant propagation, mixed cropping, crop rotation, intercropping, shifting cultivation, terrace farming and use of organic materials like cow dung, oil

cakes etc.[10] for control of fungal diseases [11-13]. Kautilya's Arthasastra was probably the oldest document, which described the use of organic materials to control the crop disorders [14-17].

Among all natural sources plants are the main and most popular source of natural products of medicinal interest. Since antiquity, man has used plants to cure common diseases. Plants have formed the basis of sophisticated traditional medicinal systems that have been in existence for thousands of years and continue to provide mankind with new remedies. The various traditional medicinal systems have been extensively reviewed by [18]. He described the African traditional medicinal systems, American traditional medicine, Australian and south east medicine, Ayurvedic medicine (Indian traditional medicine), Chinese traditional medicine, European medicine and classical Arabic or North African traditional medicines. African traditional medicine is the most oldest and diverse of all medical systems. Ayurveda is well known form of medicine originating from Asia.

Reports available on green plants represent a reservoir of effective chemo-therapeutants, these are non-phytotoxic, more systemic and easily biodegradable [19-20] that can be exploited either as leads for chemical synthesis of new agrochemicals, or as commercial products in their own right, or as a source of inspiration to biochemists for the development of new bioassays capable of detecting other, structurally simpler, compounds with the same mode of action[21]. Plant product preparations and bio-agents do not leave any toxic residues and therefore can effectively replace synthetic fungicides. Tomato is very important solanaceous crops in India either for local consumption and export. Tomato is considered as one of the highest nutritional crops because of its high contents of Vitamin C [22]. It is susceptible to infection by the blight disease caused by *Alternaria solani* during fruiting period [23-24]. Which causes great reduction in the quantity and quality of fruit yield. It is well known that tomato fruits are mostly consumed freshly, thereby spraying fungicides just before harvesting resulted in high fungicide residue in the fruits, which cause great hazard to the human health [25].

Therefore, the object of this study is to test the efficiency of herbal formulations in reducing the infection of early blight caused by *Alternaria solani* in tomato.

Foliar symptoms of early blight first appear small, irregular to circular dark brown spots on the lower (older) leaves, excessive defoliation may lead to death of the plant and consequent yield loss. The pathogen can also attack potato tubers and symptoms are circular to irregular lesions that are slightly sunken and often surrounded by a raised purple to dark brown border and produce a shallow, dry, corky rot [26-27]. Losses due to early blight typically are around 20-25%; however, there have been cases of 70-80% losses [28-29].

Eucalyptus globulus (Labill) also called Tasmanian bluegum, is one of the world's best known eucalyptus trees. One of the first tree species introduced to other countries from Australia, it is now the most extensively planted eucalyptus in the world. It is now primarily used in line plantings along roads and as windbreaks, but formerly, extensive plantations were established. Although bluegum eucalyptus has great climatic adaptability, the most successful introductions worldwide have been to locations with mild, temperate climates, or to high, cool elevations in tropical areas [30]. Due to isoprenoid accumulation eucalyptus plant has great antifungal, antibacterial, antitumor, antiviral, antmalarial and antioxidant properties. *Eucalyptus* essential oil is also used as natural pesticide [31]. The chemical compositions of the leaf oils of various *Eucalyptus* species had been reported [32]. Various organic substances such as cow dung, neem oil cake, mustard oil cake, coconut oil cake etc. are used by farmers as organic manure [33-34]. Some workers also reported the significant antifungal properties of the organic substances.

Bioformulation: Plants are rich in a wide variety of secondary metabolites such as tannin, terpenoids, alkaloids, flavonoids, phenols, steroids glycosides and volatile oils etc. These secondary metabolites posses antimicrobial property as well as play an important role in defense against attack by insects and herbivores [35]. Investigation of antimicrobial properties of plants identifies them as but for developing a medicinal formulation from plants.

It is essential to identify the phytochemical constituents present in plant extracts with antimicrobial properties. Fresh or dried plant materials can be used as a source for the extraction of secondary plant components.

Many authors had reported plant extract preparation from the fresh plant tissues [36-39].The logic behind this came from the ethno-medicinal use of fresh plant materials among the traditional and tribal people. But, mostly researchers preferred dried plant material for extraction of secondary plant metabolites [40]. Due to some problems associated with use of fresh plant material during antimicrobial screening of plants. The dried material can be used for large scale extraction of antimicrobial metabolites but fresh material cannot be used. Dried plant material contains only stable secondary metabolic components hence use of dried material is preferred during antimicrobial screening [41-42].

Indiscriminate use of fungicides may lead to toxic residues, development of fungicide resistance, environmental contaminations and carcinogenic, teratogenic and mutagenic effects in humans, animals and plants [43]. In this context, biocontrol approaches may help to develop an eco-friendly control stratagey for management of serious plant diseases.

Folk medicines of almost all civilizations of the world abound in herbal remedies. Majority of the traditional medicines used in healthcare are obtained from plants [44]. Some workers noticed that the neem seed oil has more effective than the powder formulation in reducing egg-laying and adult emergence of the bruchid [45].The excessive misuse of a wide range of fungicides has led to it being harmful to the environment and increases the resistant pathogen populations [46] .

As a matter of fact, it has been estimated that about 25% of all prescribed medicines today are substances derived from plants [47-48]. The used of traditional medicine and medicinal plants in most developing countries, as a normative basis for the maintenance of good health, has been widely observed. Furthermore, increasing reliance of the medicinal plants in the industrialized countries has been traced to the extraction and development of several drugs and chemotherapeutic from these plants as well as from traditionally used rural herbal remedies.

Various organic substances such as cow dung, neem oil cake, mustard oil cake, coconut oil cake etc. are used by farmers as organic manure.

Antimicrobial Activity: Use of plants as a source of medicine is as old as humanity. As the focus of the world is shifting towards natural products and analogues, the demand of herbal medicine is also increasing and several plants have been screened for activity. Antifungal activity of plant or their extracts as well as essential oil have been studied by several workers [49-60].

Antimicrobial screening of plant extracts is usually done with crude alcohol or aqueous extracts prepared either by cold or hot extraction methods. Crude or alcohol extract of several plants have been screened for their possible antimicrobial activities against pathogenic virus, bacteria, fungi and protozoa [61-75].

Initial antimicrobial screening with crude extract is followed by screening of extracts prepared in various organic solvents. These extracts are studied to search for various phytochemicals, responsible for antimicrobial activity [76] reported antibacterial potential of methanolic extract of *Turkish Verbascum* spp against *Candida albicans, Cryptococcus neoformans, Staphylococcus aureus, S. aureus, Pseudomonas aeruginosa, Aspergillus fumigatus* and *Mycobacterium intracellulare*.

The antimicrobial activity of plants is due to the presence of aromatic secondary metabolites such as alkaloids, flavonoids, sterols and tannins etc. which may act as phytoalexins, toxins, inhibitors etc.[77].

Several workers have reported the antimicrobial activity of various plant extracts, plant derived products and essential oils and other natural products against a wide range of food spoiling microorganisms, depending upon their concentration, testing methods and active constituents present [78-82].

A study reported that extraction of tannins and other phenolics was better in aqueous acetone than in aqueous methanol. Similar findings have been

reported by several workers [83]. Some authors use a combination of these solvents for complete extraction of secondary metabolites from plants [84-87]. In recent years the interest in the possible use of natural alternatives to food additives to prevent fungal growth has notably increased. Plants and plant parts represent a source of natural alternatives to improve the shelf life and safety of foods. Plant extracts of many higher plants have been reported to exhibit *in vitro* antibacterial, antifungal and insecticidal properties [88], due to presence of antimicrobial metabolites like flavonoids, coumarins and phenols. Essential oils from *Azadirachta indica* and *Morinda lucida* were found to inhibit the growth of toxigenic.

To find out which group of compounds is responsible for antimicrobial activity, initial screening of plants typically begins by using the crude aqueous or alcohol extracts prepared either by cold or hot extraction methods. Water and alcohol are universal solvent used to extract plant products with antimicrobial activity as most of the antimicrobial compounds are soluble in these solvents. Since nearly all of the identified antimicrobial compounds from plants are aromatic or saturated organic compounds, they are most often obtained through initial alcoholic extraction[89]. Crude extract contains different type of secondary metabolites with different polarity. Thus the most commonly used solvents for preliminary investigations of antimicrobial activity in plants are water and alcohol (usually methanol and ethanol) [90] have demonstrated the antifungal effect of methanol extracts of nine medicinal plants against *Candida albicans, C. glabrata, C. tropicalis, Cryptococcus luteolus, C. neoformans, Trichosporan beigelli, A.flavus, A. parasiticus and A. niger*. Hexane, ethyl acetae and methanolic extracts of dried powdered leaves of *Eucalyptus globulus* were screened for basic secondary metabolite and antibacterial activity [91]. Antifungal and antibacterial activity of plant base gums & resins have been reported by some workers [92]. Plant based bioformulations also have preventive effect against plant pathogenic microbes. Scientists all overview the world is involved in screening plant extracts for antimicrobial activity in search of novel compounds which can be used to control bacterial and fungal diseases of humans and plants

Methodology:

Isolation of *Alternaria solani:*

The test fungus will be isolated from infected leaf and fruit of tomato by Potato dextrose Agar plate method [93] and single spore technique [94]. Identification of fungus will be done by standard keys. V8 medium is also used by some worker for isolation of *Alternaria solani* [95]. Isolation of pathogen associated with leaf of tomato showing leaf blight symptoms shows the presence of *Alternaria* conidia under microscopic detection. These will be subjected to isolation of the associated pathogen on Potato-Dextrose-Agar medium by using single spore technique.

Extract Preparation: There are several methods for the extraction, purification and screening of the antifungal compound of plant origin. In this view, the use of efficient system of materials and methods is essential for evaluating the efficacy of medicinal plants as antimicrobial agents. Selection of plants is the first step. In the present study both plants were selected according to the literature available on their medicinal properties.

The next step after selection of plant material is the extraction. Extraction is the separation of medicinally active portion of plant tissue using selective solvents through standard procedures. Such extraction technique separates the soluble secondary metabolite from plant and leave behind the insoluble cellular marc. The basic parameters influencing the quality of extract are the plant parts used as starting material, the solvent used for extraction and the extraction method. The use of appropriate extraction technology, plant material and solvent is necessary during the screening of plant material for their antimicrobial activity.

The extraction is usually done from the fresh as well as dry plant material. Some workers used the fresh plant material for the extraction during antimicrobial screening but use of dry plant material is preferred due to three reasons. The first reason is there are fewer problems associated with the large scale extraction of dried plant material than with the fresh material. Secondly, the time delay between collecting plant material and processing makes it difficult to work with the fresh material.

The differences in water content during the collection and processing period may affect solubility of the material and also affect subsequent separation by liquid-liquid extraction. The third reason for using dried plant material during antimicrobial screening is the secondary metabolic plant component should be relatively stable especially if it should be used as antimicrobial agent. Hence in most of the studies of antifungal screening extract was prepared with dried plant material although some examples of using fresh plant material is also available. Essential oil is generally extracted from fresh plant material for obtaining high percentive value, as these are aromatic substances, thus major part can be lost during the drying of the material. In some cases dried plant material was also used for the extraction of essential oil [96].

Several authors have used water and alcohol extract for screening against various pathogens [97-100]. Initial screening with crude extract is followed by screening of extracts prepared in various organic solvents. Crude or partially purified extracts is the mixture of all secondary metabolites present in plant part. The purpose of using organic solvents is the separation of these metabolites according to their polarity and solubility. Different workers have used a variation of solvents for the purpose. Dichloromethane [101], acetone [102], hexane [103], DMSO, chloroform [104] are generally used solvents. Some authors use a combination of these solvents to obtain the best solvent system for the extraction [105]. Though there is a wide diversification in the usage of solvents, it is necessary to focus on a standardized solvent system for efficacy of antimicrobial screening; hence in the present study various organic solvents were studied and standardized prior to antifungal screening.

Cold Extraction: This extraction was done in two universal solvents i.e. water and alcohol. Cold extract was prepared according to modified method of [106]. 100% alcoholic, 50% alcoholic as well as 100% aqueous extract of leaf of *Eucalyptus globulus* was prepared by dissolving 20 g dried and powdered plant material in 100 ml of solvent (alcohol/ water) for 24 h. The mixture was then filtered and supernatant was evaporated under reduced pressure using a rotary evaporator. The dried residue was used as extract, which was stored in an airtight jar in refrigerator. Several workers have been screened the antimicrobial activity of crude extracts prepared by this method [107].

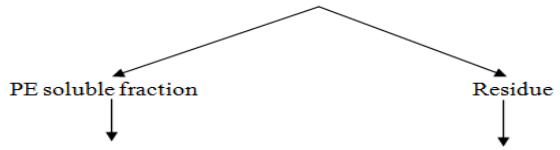
Decoction requires boiling the plant material with water and/or organic solvent for a specific time period. Dried plant parts can also be used externally in form of mixed with oils and petroleum jelly.

(a)Hot Extraction: Hot extraction method is serial exhaustive method which involves successive extraction with solvents for the separation of different phytochemical constituents from plant parts [108-109]. Leaves were used for hot extraction as these parts showed best antifungal activity against test fungi. Solvent series used for successive separation was non-polar to polar i.e.

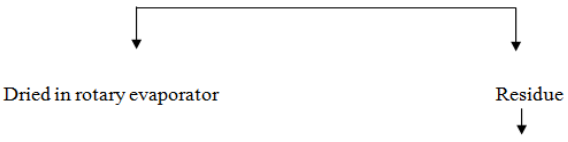
Pet. ether → Benzene → Chloroform → Acetone → Alcohol→ Methanol → Water

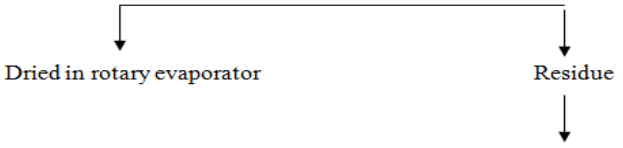
This method involves continuous extraction of powdered dried plant material in soxhlet apparatus with the above series of organic solvents. Extraction with next solvent was done each time after the plant material was dried in an oven below 50°C. 40 gm dry plant powder was kept in soxhlet extraction unit and extracted with 280ml petroleum ether till all petrol soluble fractions was extracted. Residue was dried and used for extraction with next solvent. Same procedure was repeated with each solvent and finally residue was macerated with water to obtain aqueous fraction. The outline of successive extraction process used was as follows:

40 gm dry plant powder was extracted with 280 ml petroleum ether (40^0 -60^0 C) till all PE extract was obtained.



Dried at room temperature. Extracted with 280ml Benzene till all benzene soluble fractions were obtained.





Dried at room temperature. Extracted with 280ml acetone till all acetone soluble fractions were obtained.

Dried at room temperature. Extracted with 280ml methanol till all alcohol-soluble fraction were obtained

Dried at room temperature. Extracted with 280ml water till all water-soluble fraction were obtained Crude extract and fractions obtained at every step including aqueous fraction were vacuum dried in a rotary evaporator. The dried extract and fractions were weighed and their percentage in terms of the dry weight of the plant material was estimated by the following formula given below.

$$\text{Percent extractive} = \frac{\text{Weight of dried extract}}{\text{Weight of dried plant material}} \times 100$$

Use of different solvents ensures complete extraction of all kinds of primary as well as secondary metabolites present in the plant or its parts. Petroleum ether, benzene, chloroform, hexane, methanol, ethanol and alcohol have been used by several workers for successive extraction of active compounds in plant extracts [110-111]. Each fraction prepared by successive extraction carries a specific set of secondary metabolites as the solubility of secondary metabolites differs in different organic solvents depending on polarity of solvent as well as compound used for extraction. Phytochemical tests are performed for the detection of phyto -constituents present in individual fractions.

In vitro and In vivo assay of antifungal activity of plant extracts, various elicitors and binders like oil cakes, cow dung, guar gum individually and in combination etc., against *Alternaria solani*.

Antifungal susceptibility of the extract is done by various methods. Broadly these methods are classified into diffusion and dilution. The diffusions tests include agar well diffusion, disk diffusion and bio-autography whereas dilution methods include poison food technique (agar dilution) and macro or micro broth dilution [112]. Diffusion methods against *Aspergillus* spp. were previously used by [113-115]. Dilution methods are generally used for antimicrobial screening as well as MIC and MFC determination. MIC is the minimum inhibitory concentration which is the lowest concentration that will inhibit the visible growth of micro organisms after optimum incubation period for the growth. MFC is the minimum fungicidal concentration on which fungal strain is completely killed.

Although diffusion methods are commonly used for the susceptibility testing but the dilution methods are more appropriate [116], as in the diffusion methods there is limited diffusion of less polar active compounds in solid media whereas in broth dilution method the compounds in solution easily in contact with the organism [117-118] used poison food and macro broth dilution method for the determination of antifungal activity, Some workers also reported the significant antifungal properties of the organic substances.

The present work proposes to develop a formulation by combining plant extracts/ plant powder with these traditionally used organic substances for control of early blight of tomato caused by *Alternaria solani*. This type of formulation will provide a cheap and environmentally safe herbal fungicide that can be further used as a commercial herbal bio-control agent. Several plant extracts have shown the antimicrobial activity against fungal pathogens under *in vitro* and *in vivo* conditions[119]. The effect of neem kernel cake powder in controlling the plant pathogenic fungi has been reported. Use of various oilcakes and fertilizers were also evaluated and the effectiveness of various groups of fungicides for controlling early blight (*Alternaria solani*) as well as their effect on tomato fruit yield, following early blight severity in leaf lets and stems; percentage of leaf drop; incidence of healthy, infected and sun-damaged fruits; yield and the percentages of large, medium and small sized fruits were observed.

Description of Pathogen (*Alternaria solani*):
Blight disease is caused by *Alternaria solani* belongs to the sub-division Deuteromycotina, class Hyphomycetes, family Dematiaceae. Species of the genus are cosmopolitan, surviving both as saprophytes as well as weak parasites. The characterisics feature of the genus is the production of obclavate or beaked, pigmented conidia with relatively thin transverse and longitudinal septa (Muriform). The conidia are porospores produced from simple, dark, septate conidiophores in simple and borne singly[120].

The pathogen produces distinctive leaf spots and can also cause stem lesions and fruit rot on tomato and tuber blight on potato. Foliar symptoms usually occur on older leaves. If uncontrolled, early blight can cause significant yield reductions. Primary methods of controlling this disease include preventing long periods of wetness on leaf surfaces and applying fungicides.

Geographically, *Alternaria solani* is problematic in tomato production areas east of the Rocky Mountains and is generally not an issue in the less humid Pacific or inter-mountain regions [121].

Disease symptoms caused by *Alternaria:* Among the different diseases caused by the genus *Alternaria*, blight disease is one of the most dominant one that causes average yield loss in the range of 32-57%. Symptoms of this disease include presence of irregular, often circular brown to dark brown colour leaf spots on the leaves with concentric lines inside the spots. Often the circular spots coalesce to form large patches resulting in the leaf blight. In several cases, small dark coloured spots are also formed on pods and tender twigs [122].

Disease cycle: Under free moisture or near-saturated humidity at a wide range of temperatures (8°–32°C), conidia germinate to produce one or more germ tubes. These subsequently penetrate the host epidermal cells directly by means of appressoria or they enter through stomata or wounds by hyphal growth [123]. Penetration can occur at temperatures between 10°C and 25°C. Host colonization is facilitated by enzymes (cellulases, pectin methyl galacturonase) that degrade the host cell wall and by a number of toxins that kill host cells and enable the pathogen to derive nutrients from the dead cells [124]. Lesions become visible 2–3 days after infection, and spore production occurs 3–5 days later. This relatively short disease cycle allows for polycyclic infection. The fungus survives between crops as mycelia or conidia in soil, plant debris, and seed. Therefore, the life cycle of *A. solani* includes soil- and seed- as well as air-borne stages, making the pathogen difficult to control by means of rotation and sanitation. The main hosts of *A. solani* are solanaceous crops including tomato, potato, eggplant, and pepper [125-126]. *Alternaria solani* reproduces asexually by means of conidia with polycyclic life cycle. The life cycle starts with the fungus over wintering in crop residues or wild members of the Solanaceae family. Every part of the plant can be infected and form lesions.

This is especially important when fruits are infected as they can be used to spread the disease. In general, development of the pathogen can be aggravated by an increase in inoculum from alternative hosts such as weeds or other solanaceous species. Disease severity and prevalence are highest when plants are mature [127]*Alternaria solani* spores are universally present in fields where host plants have been grown.

On tomatoes: On tomato, foliar symptoms of *A. solani* generally occur on the oldest leaves and start as small lesions that are brown to black in color. These leaf spots resemble concentric rings - a distinguishing characteristic of the pathogen - and measure up to 1.3 cm (0.51 inches) in diameter. Both the area around the leaf spot and the entire leaf may become yellow or chlorotic. Under favorable conditions (e.g., warm weather with short or abundant dews), significant defoliation of lower leaves may occur, leading to sunscald of the fruit. As the disease progresses, symptoms may migrate to the plant stem and fruit. Stem lesions are dark, slightly sunken and concentric in shape. Basal girdling and death of seedlings may occur, a symptom known as collar rot. In fruit, *A. solani* invades at the point of attachment to the stem as well as through growth cracks and wounds made by insects, infecting large areas of the fruit. Fruit spots are similar in appearance to those on leaves – brown with dark concentric circles.

Mature lesions are typically covered by a black, velvety mass of fungal spores that may be visible under proper light conditions [128].

Description of Plant (*Eucalyptus globulus*):
Eucalyptus globulus Hook, the economically important genera belongs to family Myrtaceae order Myrtales. It is commonly known as lemon scented tree due to lemon type smell of aromatic substances in leaves and gum. *Eucalyptus* oil has great medicinal values due to its anti-inflammatory, antispasmodic, decongestant and antiseptic prop- In addition, it is also has anti-diabetic activity [129]. Antibacterial and antifungal properties of *Eucalyptus* extract and oil are also reported by some authors [130-133].

Geographical Distribution: *Eucalyptus globulus* Labill belonging to the family Myrtaceae is a fast-growing species native to Australia and widely distributed in southern China, such as Guangdong, Guangxi, Sichuan and Yunnan. The genus name *Eucalyptus* comes from the Greek word *Eucalyptus*, meaning "well-covered," and refers to its flowers that, in bud, are covered with a cup-like membrane [134]. *Eucalyptus globulus* (Labill) also called Tasmanian bluegum, is one of the world's best known eucalyptus trees. It is the "type" species for the genus in California, Spain, Portugal, Chile, and many other locations. One of the first tree species introduced to other countries from Australia, it is now the most extensively planted eucalyptus in the world.

Morphology: *Eucalyptus* is an evergreen tree of 24-40 m in height with tall straight, solid cylindrical woody and white shining stem. Leaf is petiolated expstipulate simple, lanceolated ovate smooth aromatic with oil glands. Inflorescence is umbellate in clusterof three. The flower of eucalyptus is pedicillate, complete actinomorphic and epigynous. Placentation is axile. Seasonality of rainfall is not of critical importance to the species. Bluegum *eucalyptus* is much used for pulpwood, particularly so because its bark, acceptable in most pulping processes, adds greatly to the yield. It is used mostly for bleached products made by sulfate, sulfite, or bisulfate processes. Other uses include the extraction of essential oils from the leaves, honey production from the flowers (that are also good pollen sources), plantings for erosion control, and roadside plantings to provide a noise and headlight buffer [135]. The wood is heavy and shrinks greatly in drying so that it is unsuitable for lumber.

Traditional Medicinal Uses: The essential oil extracted from the leaves of *Eucalyptus globulus* Labill is known to be a rich source of traditional medicines with a variety of biological activities. It is widely used to treat pulmonary tuberculosis[136] diabetes [137-138], asthma and also used as disinfectant [139-140], antioxidant agent and antiseptic agent especially in the treatment of upper respiratory tract infections and certain skin diseases. Ointments containing eucalyptus oil have been used in traditional aboriginal medicins to heal wounds and fungal infections. The essential oil extracted from the leaves of *Eucalyptus globulus* Labill is known to be a rich source of traditional medicines with a variety of biological activities. It is widely used to treat pulmonary tuberculosis diabetes, asthma and also used as disinfectant antioxidant agent[141] and antiseptic agent especially in the treatment of upper respiratory tract infections and certain skin diseases.

Eucalyptus leaves and inflorescence have anti-inflammatory, antispasmodic, decongestant and antiseptic properties [142]. Due to its medicinal properties, it is often used in preparation of medicinal drugs for rashes, inhalers, liniments, creams and mouthwashes. *Eucalyptus* oil is generally used as a stimulant and as an antiseptic gargle. It helps in treating a number of respiratory problems like cold, cough**,** running nose, asthma and bronchitis. In addition, it is also has anti-diabetic activity [143]. Antibacterial and antifungal properties of *Eucalyptus* extract and oil are also reported by some authors [144-147].

Antimicrobial activities of *Eucalyptus globules:*
Eucalyptus leaves contain the essential oil which are used for medicinal purpose. Due to isoprenoid accumulation eucalyptus plant has great antifungal, antibacterial, antitumor, antiviral, antmalarial and antioxidant properties (Kumar and Laxmidhar, 2011). *Eucalyptus* essential oil is also used as natural pesticide. [148] The chemical compositions of the leaf oils of various *Eucalyptus* species had been reported[149]. Few studies have been reported on the chemical constituents of the essential oil obtained from the leaves of *Eucalyptus globulus* Labill [150].

Description of Crop Plant (Tomato): Vegetables belonging to family solanaceae are important due to their nutritional as well as economical values. However, farmers face heavy losses both in the quality and quantity of these crops due to various diseases. Early blight disease caused by fungal pathogen *Alternaria spp*. Inflict serious damage to these crops [151].Tomato is very important solanaceous crops in India either for local consumption and export. Tomato is considered as one of the highest nutritional crops because of its high contents of Vitamin A, C, potassium, minerals and fibers. [152].

It is susceptible to infection by the blight disease caused by *Alternaria solani* during fruiting period [153-154] which causes great reduction in the quantity and quality of fruit yield. It is well known that tomato fruits are mostly consumed freshly, thereby spraying fungicides just before harvesting resulted in high fungicide residue in the fruits, which cause great hazard to the human health [155]. Therefore, the object of this study is to test the efficiency of herbal formulations in reducing the infection of early blight caused by *Alternaria solani* in tomato.

Physiology of tomato: Tomato (*Lycopersicon esculentum*) belongs to the genus Lycopersicon under Solanaceae family. Tomato is a herbaceous sprawling plant growing to 1-3 m in height with weak woody stem. The flowers are yellow in colour and the fruits of cultivated varieties vary in size from cherry tomatoes, about 1–2 cm in size to beefsteak tomatoes, about 10 cm or more in diameter. Most cultivars produce red fruits when ripe. Tomato is a native to Peruvian and Mexican region. It is one of the most versatile vegetable with wide usage in Indian culinary tradition. Tomatoes are used for soup, salad, pickles, ketchup, puree, sauces and in many other ways it is also used as a salad vegetable. Tomato has very few competitors in the value addition chain of processing.

They contain the carotene lycopene, one of the most powerful natural antioxidants. In some studies, lycopene, especially in cooked tomatoes, has been found to help prevent prostate cancer, but other research contradicts this claim. Lycopene has also been shown to improve the skin's ability to protect against harmful UV rays. The tomato crop is cultivated during winter and summer seasons. The crop cannot withstand severe frost.

It grows well under an average monthly temperature range of 21 -23 ºC but commercially it may be grown at temperatures ranging from 18 ºC to 27 ºC. Temperature and light intensity affect the fruit-set, pigmentation and nutritive value of the fruits

The crop will be ready for harvest in about 2- 3 months after planting. The harvesting of the tomatoes is done as per the requirement of the market and in a typical season 8 to 10 harvesting is done to feed the market as per its requirement.

Tomato is mainly grown as Rabi crop in the plains of India. However in the hilly region it can also be grown as a summer and rainy season crop.

CONCLUSION: Review of literature reports that plant extracts have been mostly screened for activity against human pathogenic bacteria and fungi. Compared to this, there are very few reports regarding inhibitory activity against plant pathogenic fungi. Although there are several reports of antifungal activity of plant products yet not much work has done to develop herbal bio-control agents or formulations using plant products or extracts. Especially, plant extracts have not been used to significant extent in development of fungicides to protect the economically important crop like tomato. *Eucalyptus globulus* extract has been screened for antifungal activity against human pathogenic fungi and bacteria but very few reports are available regarding plant pathogenic fungi especially early blight caused by *Alternaria solani*. Antifungal activity of organic substances has been reported by some workers but no study till date has been reported on preparation of herbal formulation by combining plant powder, extracts and organic substances.

Therefore, present study will investigate the protective action of herbal formulation prepared by combining *Eucalyptus globulus* leaf extract/ dry powder suitable binders such as cow dung, guar gum, gum acacia etc. and elicitors (organic substances such as neem oil cake, mustard oil cake, coconut oil cake, pongamia oil cake etc.) to control early blight disease in tomato.

REFERENCES:

1. Cameron HJ and Julian GR: The effects of four commonly used fungicides on the growth of Cyanobacteria. Journal of Plant Soil 1984; 78:409-415.
2. Al-Rehiayam Osman KA and Al-Rehiayam S: Risk assessment of pesticide to human and the environment. Saudi Journal of Biological Science 2003; 10: 81-106.
3. Masuduzzaman S, Meah MB and Rashid MM: Determination of inhibitory action of Allamanda leaf extracts against some important plant pathogens. Journal of Rural 2008; 107-112.
4. Siva N, Ganesan S, Banumathy N and Muthuchelian: Antifungal effect of leaf extract of some medicinal plants against Fusariumoxysporum causing wilt disease of Solanum melogenaL. Ethnobot. Leaf 2008; 12:156-163.
5. Zhonghua MA and Michailides TJ: Advances in understanding molecular mechanisms of fungicide resistance and molecular detection of resistant genotypes in phytopathogenic fungi. Crop Protection 2005; 24: 853-863
6. Cragg GM, Newman DJ, Skarlatos SI, Velletri P and Morris M: In New Vistas in Therapeutics. From Drug Discovery to Gene Therapy. New York Academy of Sciences: New York, 2001: 3-25
7. Munoz-Mingaro D, Acero N, Llinares F, Fozuelo JM , Galan de Mera A, and Vicenten JA: Biological activity of extracts from Catalpa bignonioideswalt (Bignoniaceae). Journal of Ethnopharmacology 2003; 87: 163-167.
8. Coelho de Souza G, Has AP.S, Von Poser G L, Schapoval E.E.S and Elisabetski E: Ethno pharmacological studies of antimicrobial remidies in the South of Brazil. Journaql of Ethnopharmacology 2004; 90: 135-148.
9. Cao KQ and Forrer H R: Current status and prosperity on biological control of potato late blight (Phytophthora infestans). Journal of Agricultural University of Hebei 2001; 24: 51–58.
10. Yelmame MG, Mehat BP, Deshmukh AJ and Patil VA: Evaluation of some organic extracts in In vitro to control Fusarium solani causin Chilli Wilt. International Journal of Pharm and Bio Science 2010; 1.
11. Nene YL: Crop diseases management practices in ancient, medieval, and premodern india. Asian Agrihist journal 2003; 7: 185-201.
12. Sadhale N and Parashara K: Agri-History Bulletin no.2. Asian Agri- History Foundation, Secunderabad, 1999.
13. Krupinsky JM, Bailey KL, McMullen MP, Gossen BD, and Turkington TK: Managing Plant Disease Risk in Diversified Cropping Systems. Agronomy Journal 2002; 94: 198 – 209.
14. Cook E F and Martin E W: Remington's Practice of Pharmacy. Easton, PA The Mack Publishing Company, 1951.
15. Wootton AC: Chronicles of Pharmacy Tuckahoe. NY USV Pharmaceutical Corp. 1972
16. Schmidt B, Ribnicky DM, Poulev A, Logendra S, Cefalu WT and Raskin I. A natural history of botanical therapeutics. Metabolism Clinical and Experimental, 2008; 57: S3-S9.
17. Deshpandy and Kulkarni: Traditional method of tuber cultivation in Raj Gond tribe of Vidarbha, Maharashtra state, India Suwarna Deshpande and D. K. Kulkarni Scholars Research Library Annals of Biological Research, 2013: 4 : 22-26
18. Fakim A G: Medicinal plants: Traditions of yesterday and drugs of tomorrow. Molecular Aspects of Medicine 2006; 27:1-9.
19. Vyas GD: Soil Fertility Deterioration in Crop Land Due to Pesticide. Journal of Indian Botanical Society 1999 ; 78: 177-178.
20. Kaushik JC, Arya Sanjay, Tripathi NN, Arya S: Antifungal properties of some plant extracts against the damping off fungi of forest nurseries. Indian Journal of Forestry 2002; 25: 359-361.
21. Lal C and Verma LR: Use of certain bio-products for insect-pest control. Indian Journal of Traditional Knowledge 2006; 5: 79- 82.
22. Lange L, Breinholt J, Rasmussen FW and Nielsen RI: Microbial fungicides-the natural choice. Pesticide Science 1993; 39: 155-160.
23. Jat J R, Singh S, Lal H and Choudhary LR. Knowledge level of farmers about improved tomato production technology Raj J Extn Edu 19 : 139-143, 2011)
24. Cerkauskas RF: Tomato Diseases - Early Blight. Asian Vegetable Research and Development Center Report 2005; 05: 635.
25. Momel TM and Pemezny KL: Florida plant disease management guide: Tomato. Florida Cooperation Extensive Service. Institute of Food and Agriculture Sciences, 2006.
26. Paranagama PA, Abeysekera KHT, Abeywickrama K and Nugaliyadde L: Fungicidal and anti-aflatoxigenic effects of the essential oil of Cymbopogon citrus (DC.) Stapf.(lemongrass) against Aspergillus flavus Link. Isolated from stored rice. Journal of Applied Microbiology 2003; 37: 86-90.
27. Folsom and Bonde. Alternaria solani as a cause of tuber rot in potatoes. Phytopathology 15:282-286, 1925.
28. Wharton P and Kirk W: Fusarium Dry Rot http://wwwPotatodiseases, Orgcontact. Html, 2007.
29. Pscheidt J.W. and W.R. Stevenson. The critical period for control of early blight (Alternaria solani) of potato. American Potato Journal, 1988; 65:425–438.
30. Shtienberg D, SN Bergeron, AG Nicholson, WE Fry and EE Ewing. Development and evaluation of a general model for yield loss assessment in potatoes. Phytopathology 1990; 80: 466–472.
31. Jain P, Nimbrana S and Kalia G. ntimicrobial activity and phytochemical analysis of eucalyptus tereticornis bark and leaf methanolic extracts. 4; Article 021: September – October 2010.
32. Areej Ali Baeshen: Assessment of the Effect of Some Medicinal Plants Extracts on Germination and Growth of Lentil (Lens culinaris). Research Journal of Pharmaceutical, Biological and Chemical Sciences, 2014; 5:1846-1856.
33. Singh R, Chandra R, Bose M, Luthra PM: Antibacterial activity of Curcuma longa rhizome extract on pathogenic bacteria. Current Science 2000; 83: 737-740.
34. Kimaru SK, Waudo SW, Monda E, Seif AA and Birgen JK: Effect of Neem Kernel Cake Powder (NKCP) on Fusarium Wilt of Tomato when Used as Soil Amendment. Journal of Agriculture and Rural Development in the tropics and subtropics 2004; 105: 63–69.
35. Deepak and Lal G: Integrated strategy to control wilt disease of cumin (Cuminum cyminum L.) caused by Fusarium oxysporum f. sp. cumini (Schlecht).Journal of spice and aromatic crops 2009; 18.
36. Cowan M M: Plant product as antimicrobial agents. Clinical Microbiology Reviews 1999; 12:564-582.
37. Wanchaitanawong P, Chaungwanit P, Poovarodom N and Nitisinprasert S: In vitro antifungal activity of Thai herb and spice extracts against food spoilage fungi. Kasetsart Journal of Natural Science 2005; 39: 400 – 405.

38. Parekh J, Nair, R Chanda S: Preliminary screening of some folklore medicinal plants from western India for potential antimicrobial activity. Indian Journal of .Pharmacology 2005; 37: 408- 409.
39. Helmy WA, H Amer and NMA El-Shayeb: Biological and anti-microbial activities of aqueous extracts from neem tree (Azadirachta indica A. Juss., Meliaceae). Journal of Applied Science Research 2007; 3: 1050-1055.
40. Somda I, Leth V and Sereme P: Evaluation of lemon grass, Eucalyptus and neem aqueous extracts for controlling seed borne fungi of Sorghum grown in Burkina Faso. World Journal of Agricultural Sciences 2007; 3: 218-223.
41. Fawcett CH and DM Spencer: Plant chemotherapy with natural products. Anuls of research and Review of phytopathology, 1970; 8t403-418.
42. Dilika F, Afolayan AJ and Meyer JJ M: Comparative antibacterial activity of two Helichrysum species used in male circumcision in South Africa. South. African Journal of Botany 1996; 63: 158-159.
43. Baris O, Gulluce M, Sahin F, Ozer H, Kilic H, Ozkan H, Sokmen M and Ozbek T: Biological activities of the essential oil and methanol extract of Achillea Biebersteinii Afan. (Asteraceae). Turkish Journal *of* Biology 2006; 30: 65-73.
44. Rajavel RL: Seed borne colletotrichum capsici (syd). Buter and Bisby and its management M.Sc. Thesis, Tamilnadu agricultural University, Comimtoor. 2000.
45. Kala CP, Farooquee NA and Dhar U: Prioritization of medicinal plants on the basis of available knowledge, existing practices and use value status in Uttaranchal, India. Biodivers Conserv 2004; 13: 453-469.
46. Lale NES & Abdulrahman HT: Evaluation of neem (Azadirachta indica A. juss) seed oil obtained by different methods and neem powder for the management of Callosobruchus maculatus (F.) (Coleoptera: Bruchidae) in stored cowpea. Journal of stored Product and research, 1999; 35: 135-143.
47. Özgönen H, Biçici M, Erkiliç A: The effect of salicyclic acid and endomycorrhizal fungus Glomus etunicatum on plant development of tomatoes and Fusarium wilt caused by Fusarium oxysporum f. sp. lycopersici. Turkish J. of Agriculture and Forestry, 2001; 25: 25-29.
48. Egwaikhide P.A and Gimba C.E : Analysis of the phytochemical content and Antimicrobial activity of Plectranthus glandulosis whole plant middle – east Journal of Scientific Research,2007;
49. Zheng, W. and Wang, S.Y., (2001). Antioxidant activity and Phenolic compounds in selected herbs. Agric food chem. 49: 5165-5170
50. Ballal M, Srujan D, Bhatt KK, Shirverkar A, and Shivanand PG: Antibacterial activity of Holarrhena antidysentrica (Kurchi) against the enteric pathogens. Indian Journal Pharmacology 2001; 37: 392-393.
51. Satya VK, Radhajayalakshmi R, Kavitha K, Paranidharan V, Bhaskaran R, and Velazhahan R: In vitro antimicrobial activity of Zimmu (Allium sativum, Allium cepa L.) leaf extract. Arch Phytopathology plant protect.2005; 38: 185-192.
52. Akinpelu DA and Onakoya TM: Antimicrobial activity of medicinal plants used in folk lore remedies in South-Western. African Journal of Biotechnology 2006; 5: 1078-1081.
53. Buwa LV and Staden JV: Antibacterial and Antifungal activity of traditional medicinal plants used against veneral diseases in South Africa. Journal of Ethenopharmacology 2006; 103: 1333-1338.
54. Guleria S and Kumar A: Antifungal activity of some Himalayan medicinal plants using direct bioautography. *Journal* of *Cell* and *Molecular Biology 2006;* 5: 95-98, 2006.
55. Tegegne G and Pretorius JC: In vitro and In vivo antifungal activity of crude extract and powdered dry material from Ethiopia wild plants against economically important plants pathogens. Biocontrol 52: 877-888, 2007.
56. Liasu MO and Ayandele AA. Antimicrobial activity of aqueous and ethanolic extracts from Tithonia diversifolia and Bryum coronatum collected from Ogbomoso, Oyostate. Nigeria. Advances in natural and applied sciences 2008; 2: 31-34.
57. Bobbarala V, Katikala P, Chandrasekhar K, and Penumajji S. Antifungal activity of selected plant extracts against phytopathogenic fungi Aspergillus niger F2723. Indian Journal of Science and technology 2009; 2: 81-90.
58. Audipudi AV and Chakicherla BVS. Antioxidative and antimicrobial activity of methanol and chloroform extracts of Gmelina arborea Roxb. International Journal of Biotechnology and Biochemistry 2010; 6: 139-144.
59. Ashraf Z, Muhammad A, Imran M and Tareq A H. In Vitro Antibacterial and Antifungal Activity of Methanol, Chloroform and Aqueous Extracts of Origanum vulgare and Their Comparative Analysis. International Journal of Organic Chemistry 2011; *257 – 261*.
60. Sheikh M, Malik AR, Meghavanshi MK, and Mahmood I. Studies on Some Plant Extracts for Their Antimicrobial Potential against Certain Pathogenic Microorganisms. American Journal of Plant Sciences 2012; 3: 209 – 213.
61. Rajamanickam K and Sudha SS: In-vitro antimicrobial activity and in-vivo toxicity of Moringa oleifera and Allamanda cathartica against multiple drug resistant clinical pathogens. International Journal of Pharma and Bio Sciences 2013; 4: 768–775.
62. Digrak M, Alma MH and Ilcim A: Antibacterial and antifungal effects of various commercial plants extract. International Journal *of* pharma and bio sciences 2010; 37: 216-220.
63. Bowers JH and Locke JC. Effect of botanical extracts on the population density of Fusarium oxysporum in soil and control of Fusarium wilt in the green house. Plant disease 2000; 84: 300-305.
64. Eksteen D, Pretorius JC, Nieuwoudt TD, and Zietsman PC. Mycelial growth inhibition of plant pathogenic fungi by extracts of South African plant species. Annals of Applied Biology 2001; 139: 243-249.
65. Hol WHG and Van-veen JA. Mycelial growth inhibition of plant pathogenic fungi by extracts of South African Plant species. Annals Applied Biology 2002; 139: 243-249.
66. Magama S, Pretorius JC and Zietsman PC. Antimicrobial properties of extracts from Euclea crispa subsp crispa (Ebenaceae) towards human pathogens. South African Journal of Botany 2003; 69:193-198.
67. Shamin S, Ahmed SW and Azhar I. Antifungal activity of Allium, Aloe and Solanum species. Pharmaceutcal Biology 2004; 42: 491-498.
68. Rahman MM, Polfreman D, macgeachan J, Gray AI. Antimicrobial Activities of Barringtonia Acutangula. *Phytotherapy Research 2005;* 19:543-5.
69. Pujol CA, Scolaro LA, Ciancia M, Malulemicz MC and Damonte EB. Antiviral activity of carageenan from Gigartina skottsbergii against interaperitonia murine herpes simplex virus infection. *Planta Medica* 2006; 72: 121-125.

70. Ayandele A and Adebiyi AO. Antimimcrobial screening of extracts of Olax Subscorpiodes African Journal of Biotechnology 2007; 6: 868-870
71. Raghavendra MP, Satish S, and Raveesha KA. Alkaloid extracts of Prosopis juliflora (Sw.) DC. (Mimosaceae) against Alternaria alternata. Journal of Biopest 2009; 2: 56-59.
72. Shanmugavalli N, Umashankar V and Raheem. Antimicrobial activity of Vanilla planifolia. Indian Journal of Science and Technololgy 2009; 2:37-40.
73. Audipudi AV and Chakicherla BVS. Antioxidative and antimicrobial activity of methanol and chloroform extracts of Gmelina arborea Roxb. International Journal of Biotechnol Biochemistry 2010; 6: 139-144.
74. Shabir G, Anwar F, Sultana B, Khalid ZM, Muhammad A, Khan QM, and Ashrafuzzaman M. Antioxidant and Antimicrobial Attributes and Phenolics of Different Solvent Extracts from Leaves, Flowers and Bark of Gold Mohar [Delonix regia (Bojer ex Hook.) Molecules 2011; 16: 7302-7319.
75. Ayman Al-Mariri and Mazen Safi. In Vitro Antibacterial Activity of Several Plant Extracts and Oils against Some Gram-Negative Bacteria. Iranian Journal of Medicine Science 2014; 39
76. Mazen safi and Ayman al-marir: In vitro antibacterial activity of several plant extracts and essential oils against Brucella melitensis 2014;60
77. Tatli II, Akdemir ZS. Antimicrobial and antimalarial activities of secondary metabolites of some Turkish Verbascum species. *FABAD Journal* of *Pharmaceutical Sciences* 2005; 30:84-92.
78. Bourgaud F, Gravot A, Milesi S and Gontie E. Production of plant secondary metabolites: a historical perspective. Plant Science 2001; 161:839-851.
79. Paster N, Menasherov M, Ravid U and Juven B. Antifungal activity of oregano and thyme essential oils applied as fumigants against fungi attacking stored grain. Journal of Food Protection 1995; 58:81–85.
80. Lis-Balchin, M. Ochoka, R J Deans, SG Asztemborska, M and Hart S. Difference in bioactivity between the enantiomers of a-pipene. Journal of Essential Oil Research 1999; 11:393–397.
81. Smith-Palmer, A Stewart J and Fyfe L. The potential application of plant essential oils as natural food preservatives in soft cheeses. Food Microbiology 2001; 18:463–470.
82. Thanaboripat D, Chareonsettasilp S, Pandee K and Udomwongsup K. Inhibitory effect of Kaffir lime, bitter cucmber and tobacco extract on the growth of Aspergillus flavus. KMITL Science. Tech. journal 2006; 6:18-24.
83. Murugan S, Anand R, Uma Devi, P Vidhya N and Rajesh K A. Efficacy of Euphorbia milli and E. pulcherima on aflatoxin producing fungi (Aspergillus flavus and Aspergillus parasiticus). African Journal of Biotechnology 2007; 6: 718-719.
84. Sanchez A C, C Lopes, G C Nakamura, C V Filho BPD and de Mello J C P. Antioxidant and antifungal activities of extracts and condensed tannins from Stryphnodendron obovatum Benth. Brazilian Journal of Pharmaceutical Science, 2005; 41: 101-107.
85. Mishra AK and Dubey NK. Evaluation of some essential oils for their toxicity against fungi causing deterioration of stored food commodities. Applied and Environmental Microbiology 1994; 60:1101-1105.
86. Tripathi YB and Upadhyay A K. Effect of the alcohol extract of the seeds of Mucuna pruriens on free radicals and oxidative stress in albino rats. Phytotherapy Research 2003; 16:534–538.
87. Gonçalez E, Felicio J D, Pinto M M, Rossi MH, Medina, C Fernandes, M J B and Simoni IC. Inhibition of aflatoxin production by Polymnia sonchifolia and its in vitro cytotoxicity. Arquivos do Instituto Biologic 2003; 70:139–143.
88. Tripathi P and Dubey NK. Exploitation of natural products as an alternative strategy to control postharvest fungal rotting of fruit and vegetables. Postharvest. BioTechnology 2004; 32:235-245.
89. Ergene A, Guler P, Tan S, Mirici S, Hamzaoglu E and Duran A. Antibacterial and antifungal activity of Heracleum sphondylium subsp. artvinense. African Journal of Biotechnology 2006; 5:1087-1089.
90. Ramezani S, Ramezani F, Rasouli F, Ghasemi M, Fotokian MH. Diurnal variation of the essential oil of four medicinal plants species in Central Region of Iran. Research Journal of Biological Sciences 2009; 4: 103–106.
91. Parajuli DP, AR Gyawali and BM Shrestha. A Manual of the Important Non-Timber Forest Products in Nepal. Training and manpower development in C.F.M. Pokhara, Nepal, 1998.
92. Egwaikhide PA, Okeniyi S O and Gimba C E. Screening for antimicrobial activity and phytochemical constitiuents of some Nigerian medicinal plants. Advances in Biological Research 2007; 1: 155-158.
93. Sravani P Y , Kiranmayee S, Narasimha M, VS Reddy, S Asha and R Bharath Kumar. In-vitro Experimental Studies on Selected Natural Gums and Resins for Their Antimicrobial Activity. Research Journal of Pharmaceutical Biological and Chemical Sciences 2014; 5.
94. Padhi NN, Rath GC. Sporulation of Alternaria solani in pure culture. Indian Phytopathology 1973; 26:495-501.
95. Shahin EA and JF Shepard. An efficient technique for inducing profuse sporolation of Alternaria species. Phytopathology 1979; 69:618-620.
96. Tatiana TMS, Luiz R, Maffia A, Onkar D. Dhingra and Eduardo SG, Mizubuti In vitro production of conidia of Alternaria solani Tropical Plant Pathology 2010; 35: July - August .
97. Bluma VR and Etcheverry M G. Application of essential oils in maize grain: impact on Aspergillus section Flavi growth parameters and aflatoxin accumulation. Food Microbiology 2008; 25:324-334.
98. Freixa B, Vila R, Vargas L, Lozano N, Adzet T and Caniguera S. Screening for antifungal activity of nineteen Latin American plants. Phytotherapy Research 1996; 12: 427-430.
99. Kumar R, Mishra AK, Dubey N K and Tripathi Y B. Evaluation of Chenopodium ambrosioides oil as a potential source of antifungal, antiaflatoxigenic and antioxidant activity. International Journal of Food Microbiology 2007; 115:159-164.
100. Masoko P and Eloff J N: Bioautography indicates the multiplicity of antifungal compounds from twenty-four southern African Combretum species (Combretacea). African Journal of Biotechnology 2006; 5:1625-1647.
101. Satish S, Mohana DC, Raghavendra MP and Raveesha KA. Antifungal activity of some plant extracts against important seed borne pathogens of Aspergillus sp. Journal of Agricultural Technology, 3: 109-119, 2007.
102. Nostro A, Germano M P, D Angelo V, Marino A and Cannatelli M A. Extraction methods and bioautography for evaluation of medicinal plant antimicrobial activity. Lett. Microbiol 2000; 30:379-384.

103. Shadomy and Ingroff. A Manual of Clinical Microbiology (Lennet E.H., Spauling E.H., Truant, J.P. eds), American Society of Microbiology, Washington, p. 569,1974.
104. Ballal M, Srujan D, Bhatt KK, Shirverkar A, and Shivanand PG. Antibacterial activity of Holarrhena antidysentrica (Kurchi) against the enteric pathogens. Indian Journal of Pharmacology2001; 37: 392-393.
105. Harborne JB. Methods of plant analysis. In phytochemical methods. London, NewYork: Chapman and hill, 1984, p. 05-06.
106. Kokate CK, Purohit AP and Gokhale SB. Pharmacognogy. In: Analytic pharmacognosy (7th ed.). Nirali Prakashan, Pune, 122-124, 1990.
107. Pathania, J. J., Kumar, B., Gupta, S. and Sharma, N. C. 2002. Antimicrobial activity of commonly occurring weed Ipomea carnea Jacq. Journal of Indian Botanical Society 81: 317-321.
108. Balakrishnan, B. R., Sangameswaran, B., Arul, B. and Bhaskar, V. H. 2003. Antibacterial activity of aerial parts extracts of Achyranthes bidentata Blume. Indian Journal of Pharmaceutical Science 2003; 186-188.
109. Das K, Tiwari R K S and Shrivastava D K. Techniques for evaluation of medicinal plant products as antimicrobial agent: current methods and future trends. Journal of Medicinal Plants Research 2010; 4:104-111.
110. Sanches A C, C Lopes, G C Nakamura, C V Filho BPD and de Mello J C P. Antioxidant and antifungal activities of extracts and condensed tannins from Stryphnodendron obovatum Benth. Brazilian Journal of Pharmaceutical Science 2005; 41: 101-107.
111. Bobbarala V, Katikala PK, Naidu KC and Penumajji. Antifungal activity of selected plants extracts against phytopathogenic fungi Aspergillus niger. Indian Journal of Science and Technology, 2009; 87-90.
112. Reddy K R.N, Reddy C S and Muralidharan K. Potential of botanicals and biocontrol agents on growth and aflatoxin production by Aspergillus flavus infecting rice grains. Food Control 2009; 20: 173-178.
113. Collee FG, Miles RS, and Watt B. Test for identification of bacteria. In: Mackie and McCartney Practical Medical Microbiology. Singapore: Longman Singapore publishers Ltd. p. 131-150, 1996
114. Silva JC, Bettiol W. Potential of non-pathogenic Fusarium oxysporum Isolates for control of Fusarium wilt of tomato. Fitopatologia Brasileira 2005; 30: 409-412.
115. Kumar R, Mishra A k, Dubey N K and Tripathi Y B. Evaluation of Chenopodium ambrosioides oil as a potential source of antifungal, antiaflatoxigenic and antioxidant activity. International Journal of Food Microbiology 2007; 115:159-164.
116. Kagale S, Marimuthu T, Thayumanavan B, Nandakumar R, and Samiyappan R. Antimicrobial activity and induction of systemic resistance in rice by leaf extract of Datura metel against Rhizoctonia solani and Xanthomonas oryzae pv. oryzae. Physiological Moleculerl Plant Pathology 2004; 65: 91–100.
117. RS Mehrotra and KR Aneja. Book an to mycology R.S Mehrotra and K.R Aneja). introduction Book an introduction to mycology
118. Pandey KK. Resistance to early blight of tomato with respect to various parameters of disease epidemics. Journal of General Plant Pathology 2003; 69: 364-371.
119. Valkonen JPT and Koponen H. The seed borne fungi of Chinese cabbage (Brassica pekinensis), their pathogenicity and control. Plant Pathology 1990; 391: 510-516.
120. Sherf A F and Macnab A A. Vegetable diseases and their control. John Wiley and Sons, New York. pp. 634-640, 1986.
121. Rotem, J. The genus Alternaria biology, epidemiology, and pathogenicity, 1 st Ed. The American Phtyopathological Society, St. Paul, Minnesota 48: 203.1994.
122. Neergaard P. Danish Species of Alternaria and Stemphylum. Translated by H. Anderson Oxford University press, London 560 P, 1945.
123. Ellis MB and Gibson IAS. Alternaria solani no. 45 set 48 Common wealth Mycological Institute Kew, Surrey, UK.1975.
124. Wharton P and Kirk W. Fusarium Dry Rot http://wwwPotatodiseases, Orgcontact. Html, 2007.
125. Chaerani and Voorrips. Tomato early blight (Alternaria solani): the pathogen, genetics, and breeding for resistance. Journal of Gen Plant Pathology 2006; 72:335–347
126. Martin, GJ. Ethanobotany: a method manual. Chapman and Hall, New York.), 1995.
127. Mishra AK and Dubey NK. Evaluation of some essential oils for their toxicity against fungi causing deterioration of stored food commodities. Applied and Environmental Microbiology 1994; 60:1101-1105.
128. Tripathi YB and Upadhyay A K: Effect of the alcohol extract of the seeds of Mucuna pruriens on free radicals and oxidative stress in albino rats. Phototherapy Research 2002; 16:534–538.
129. Gonçalez E, Felicio J D, Pinto M M, Rossi MH, Medina, C Fernandes, M J B and Simoni IC. Inhibition of aflatoxin production by Polymnia sonchifolia and its in vitro cytotoxicity. Arquivos do Instituto Biologic 2003; 70:139–143.
130. Tripathi P, Dubey NK, Banerjii R and Chansouria J PN: Evaluation of some essential oils as botanical fungitoxicants in management of post harvest rotting of citrus fruits. World Journal of Microbiology and Biotechnology 2004; 20:317-321.
131. Grieve M. A Modern Herbal. New York: Dover Publications, Inc. Indian Pharmacopoeia (1996). Delhi: Government of India, Ministry of Health and Family Welfare—Controller of Publications, Vol. 1: 310, 1979.
132. Singh R, Chandra R, Bose M, Luthra PM: Antibacterial activity of Curcuma longa rhizome extract on pathogenic bacteria. Current. Science 2000; 83: 737-740.
133. Liu YM, Li SF and Wu YT. Advances in the study of Eucalyptus globulus Labill. Journal of Chinies Medecinal Materials 2003; 26: 461-3.
134. Swanston-Flatt SK, Day C, Bailey CJ and Flatt PR. Traditional plant treatments for diabetes. Studies in normal and streptozotocin diabetic mice. Diabetologia. 33:462-4, 1990.
135. Gray AM, Abdel-Wahab YHA and Flatt PR: The traditional plant treatment, sambucus nigra (elder), exhibits insulinlike and insulin-releasing actions in vitro. Journal of Nutrition 2000; 130: 15-20.
136. Cimanga K, Kambu K, Tona L, Apers S, De Bruyne T, Hermans N, Totté J, Pieters L and Vlietinck AJ: Correlation between chemical composition and antibacterial activity of essential oils of some aromatic medicinal plants growing in the democratic republic of Congo. Journal of Ethnophamacology 2002; 79: 213-20.
137. Osawa K, Yasuda H. Macrocarpals H, I and J from the leaves of Eucalyptus globulus. Journal of natural Product 1996; 59:
138. Dessi MA, Deiana M, Rosa A, Piredda M, Cottiglia F, Bonsignore L, Deidda D, Pompei R and Corongiu FP:

Antioxidant activity of extracts from plants growing in isolated from the stem bark of Eucalyptus globulus. Pharm Res 2000; 23: 147-50.
139. Ramezani S, Ramezani F, Rasouli F, Ghasemi M, Fotokian MH: Diurnal variation of the essential oil of four medicinal plants species in Central Region of Iran. Research Journal of Biological Science 2009;4: 103–106.
140. Bhosle S,Bapat R, Gauri, V Jitendra, G Sandhya and S Hiralal. Antimicrobial activity of terpenoid extracts from Ganoderma samples. International journal of pharmacy & life sciences 2010; 1:234-240.
141. PA Egwaikhide1, S O Okeniyi and CE Gimba. Screening for anti-microbial activity and phytochemical constituents of some Nigerian medicinal plants. Journal of Medicinal Plants Research 2009; 3: 1088-1091.
142. Sartorelli P, Marquioreto AD, Amaral-Baroli A, Lima MEL, Moreno P RH. Chemical composition and antimicrobial activity of the essential oils from two species of *Eucalyptus*. Phytotherapy 2006; 21: 231-233.
143. Patra A, Jha S and Sahu AN. Antidiabetic activity of aqueous extract of *Eucalyptus citriodora* Hook. in alloxan induced diabetic rats. Pharmacognosy Magazine – Supplement 2009; 5: 51-54.
144. Babayi H, Kolo I, Okogun JI and Lijah U J J: The antimicrobial activities of methanolic extracts of *Eucalyptus camaldulen* and *Terminalia catappa* against some pathogenic microorganisms. Biochemistry 2004; 16: 106-111.
145. Nair R and Chanda S: Anticandidal activity of Punica granatum exhibited in different solvents. Pharmaceutical Biology 2005; 43: 21-25.
146. Vaghyasiya Y, Dave R and Chanda S: Phytochemical analysis of some medicinal plants from western region of India. Research Journal of medicinal plant 2011, 1-10.
147. Pathmanathan M K, Uthayarasa K, Jeyadevan JP and Jeyaseelan E C: In vitro antibacterial activity and phytochemical analysis of some selected medicinal plants. International Journal of Pharmaceutical and Biological Archeives 2010; 1: 291-299.
148. Kumar Danendra Hardel and Sahoo Laxmidhar: A review on phytochemical and Pharmacological of *Eucalyptus globulus*: A Multipurpose Tree. International Journal of Research in Ayurveda 2011; 1527-1530.
149. Daizy R Batish, Harminder Pal Singh, Ravinder, Kumar Kohil and Shaliender Kaur.: (Elesvier) Science direct Journal For Ecol Manage 2008; 256:2166-2174.
150. Singh R, Chandra R, Bose M, Luthra PM: Antibacterial activity of *Curcuma longa* rhizome extract on pathogenic bacteria. Current. Science 2000; 83: 737-740.
151. Luo JL, Song YF: Chemical constituents of the essential oil from the leaves of three species of Eucalyptus. Natural Product Research Development 1991; 3: 79-83.
152. Neeraj and Verma S: Alternaria diseases of Vegetable Crops and New Approaches for its Control. Asian Journal of Experimental Biology and Science 2010; 1: 681-692.
153. AMA Ashour: A Protocol Suggested for Managing Tomato Early Blight. Egyptian Journal of Phytopathology 2009; 37: 9-20.
154. Cerkauskas RF: Tomato Diseases - Early Blight. Asian Vegetable Research and Development Center Report, AVRDC 2005; 05: 635.
155. Momel TM and Pemezny KL: Florida plant disease management guide: Tomato. Florida Cooperation Extensive Service. Institute of Food and Agriculture Sciences 2006.

How to cite this article:
Mehta S and Sharma K: Natural resources: an ecofriendly and safer alternate to control plant diseases. Int J Pharm Sci Res 2016; 7(11): 4327-40.doi: 10.13040/IJPSR.0975-8232.7(11).4327-40.