ABSTRACT

Several species of *Piper* are used in indigenous system of medicine in India. The root (Pippalimula) and fruit(Pippali) of *Piper longum* Linn. is possessing high therapeutic virtues. According to Ayurved system of medicine, the *Piper longum* Linn. roots are pungent and having heating, stomachic, laxative, anthelmintic and carminative properties. It improves the appetite and useful in bronchitis, abdominal pain, disease of the spleen and tumors. According to Unani system, root has a bitter, hot and sharp taste and used as carminative, hepato-protective, stomachic, abortificient, haematinic, diuretic, digestive and as a general tonic. It also cures inflammation of the liver, pains in the joint, lumbago, snakebite, scorpion-sting and night-blindness. Plant Pippali is cultivated and also imported from other countries as it is highly demanded in pharmaceutical industries. It is reported as endangered species in some states. The cultivation practice of *Piper longum* Linn. is necessary to overcome its requirement in Pharmaceutics as its highly used plant for classical formulations. On experimental level, Pippalimula is reported having analgesic, antifungal, antimicrobial and anti-oxidant activities. Also, the fruit and root extract of *Piper longum* along with ciprofloxacin showed good synergistic activity against MRSA. *P. longum* roots along with *E. ribes* seeds pregnancy showed antifertility activity in female albino rats. Further scientific validations and clinical trials may sustain the classical claims regarding the root of *Piper longum* Linn.

**Keywords:** *Piper longum* Linn., Pippalimula, Cultivation, activities, Pharmacology.

INTRODUCTION

India has got variety of climatic conditions and seasons favorable for growth of many species of plants. The family *Piperaceae* comprises 12 genera and about 1400 species mainly found in tropical region. The genus *Piper* (L.) contains more than 700 species...
they grow in tropical and subtropical rain forest. *Piper* species grown in South India are economically important and among the important medicinal plants used in various systems of medicine. Several species of *Piper* are used in indigenous system of medicine in India.\(^2\)

*Piper longum* Linn. is the native of Indo-Malaya region. It was very early introduced to Europe and was highly regarded as a flavour ingredient by the Romans. The Greek name "Peperi", the Latin "Piper" and the English "Pepper" were derived from the Sanskrit name "Pippali". Which means the drug which gives protection from diseases, also nourish and restore health.\(^3\) The synonym Vaidehi indicates that the plants were cultivated more in Videha Desha. It grows wild in the tropical rain forests of India, Nepal, Indonesia, Malaysia, Sri Lanka, Timor and the Philippines. In India, it is seen in Assam, West Bengal, Uttar Pradesh, Madhya Pradesh, Maharashtra, Kerala, Karnataka and Tamil Nadu. It is also cultivated in Bengal, Cherpunji area of Assam, Akola-Amravati region of Maharashtra, Anamalai hills of Tamil Nadu, Orissa, Udupi and Mangalore regions of Karnataka. Bulk of Indian long pepper comes from its wild growth in Assam, Shilong and West Bengal, supplemented by imports from Sri Lanka and Indonesia. (Viswanathan, 1995)\(^4\)

Ayurveda has valued its utilization by including it in various formulations i.e Panchakol churna, Dashmula-shatpal ghrita. Acharya charaka has included it in Agryaushadhi ascribed to adding it as Dipaniya-Pachaniya-Anaha prashamananam. He has enlisted the drug in Dipaniya and Shulaprasamana dashemani. It is used in approximate 30 formulations by Acharya charaka.\(^5\) Bhavprakash has reported its sedative effect if taken with jeggary.\(^6\) Fruit of *Piper longum* Linn. is also possessing high therapeutic virtues. It is amongst Trikatu group which is used frequently in Ayurvedic practice. Pippali is one of the maximum used plant (324 times) in classical formulations documented in Ayurved formulations of India.\(^7\) Though, Ayurveda classics cautioned about long usage of Pippali
fruit consumption and it appears that root is not restricted from regular usage. Both fruit and root of *Piper longum* Linn. require proper scientific validations.

In Ayurveda system of medicine, the *Piper longum* Linn. roots are pungent and having heating, stomachic, laxative, anthelmintic and carminative properties. It improves the appetite and useful in bronchitis, abdominal pain, disease of the spleen and tumors. According to Unani system, root has a bitter, hot and sharp taste and used as carminative, hepato-protactive, stomachic, abortificient, haematinic, diuretic, digestive and as a general tonic. It also cures inflammation of the liver, pains in the joint, lumbago, snakebite, scorpion-sting and night-blindness.

In Indian market Pippali and Pippalimula is possessing high demand due to its properties. As reported by NMPB it is one of the high trade sourced medicinal plants procured from cultivation. Approximate annual consumption of *Piper longum* Linn. (fruits and roots) is 1737 Metric Ton. But maximum amount of those consumptions are fulfilled through import. In the year 2004-2005; about 9,067,191 Kg Pippali was imported which includes its fruit and root.[8] The plant is reported as endangered for Tamilnadu and at lower risk for Kerala.[9] Moreover, the import of the plant is additionally expensive. Hence, cultivation of this plant should be encouraged.

Observing its importance in therapeutics as well as in pharmaceutical industries, the study was planned to analyze its cultivation and its reported pharmacological activities.

**MATERIALS AND METHODS**

The description about Pippalimula delineated in Ayurveda classics along with the observations made with various reported Pharmacological studies were compiled for analysis. The available published research articles related to its activities and various literature related to cultivation of medicinal plants were referred through internet and evaluated.

**RESULTS AND DISCUSSIONS**
After reviews of various books and articles related to cultivation practise and various pharmacological activities the result were presented in the study. This study may act as platform for the further research work as well as cultivation practise.

CULTIVATION [10]

Varieties
In different agro-climatic regions of the country a number of geographical races exist. The races found in Assam are called Asli (true) and Suvali (female in Assamese). Viswam- a selection from ‘Cheemathippalli’ which bears female type spikes possessing the highest spike weight and total yield released by Kerala Agriculture University for cultivation as a inter-crop in irrigated coconut plantations.[11]

Climate and soil:
The plant requires a hot moist climate and an elevation between 100 and 1000 m for its cultivation. It can be grown successfully even in areas which receive heavy rainfall with high relative humidity. In its natural habitat, the plant is found growing as under shrub. Hence, it is especially suited as a under crop in coconut and arecanut gardens with 20-25 percent shade intensity. It is also cultivated on a large scale in liomestone soil below Cherapunji region. Laterite soils rich in organic matter content with good moisture holding capacity are also suitable.

Propagation:
Long pepper can be propagated through seeds, suckers or cuttings or by layering of mature branches at the beginning of rainy seasons. However it can be easily propagated through the terminal stem cutting obtained from one year old growth and 3-5 internodes. Vine cuttings can be rooted in polythene bags filled with the common pot mixture. The nursery can be raised during March and April. The cutting planted in March-April will be ready for planting in the main field by the end of May.

Planting: Before planting, the land should be ploughed 2 to 3 times and levelled properly. Then the field is divided into convenient size of plots in which the pits are dug at a
spacing of 60 cm x 60 cm. These pits are filled with soil mixed with well decomposed FYM (Farm Yard Manure) or compost. In heavy rainfall areas, channels are made to drain access water. Afterwards, with the onset of monsoon the rooted cuttings are planted in the pits at the rate of 2 per pit. The pits are gap filled one month after planting. Long pepper is planted as an inter crop in Subabul, Eucalyptus (Eucalyptus globules Labill.) and Coconut (Cocos nucifera Linn.) in different parts of the country.

**Irrigation:**
The crop should be irrigated once in a week if it is grown as a pure crop. While as intercrop, the irrigation provided to the main crop is ample. Sprinkler system of irrigation may be adopted for economising the irrigation water.

**Weeding and Mulching**
During the first year of planting, weeding is done when weed growth is noticed in the beds. After the application of FYM to the beds; earthing up is done from the channels. During the summer, to prevent the moisture loss or losses from the soil surface, the beds may be mulched with dry leaves or straw.

**Disease and Management:**
Major insect: Mealy bugs, *Helopeltis theiveora*

Major diseases: Leaf and vine rotting, yellowing and crinkling of leaves.

1. To control mealy bugs, apply systemic insecticide like Roger @ 0.2%.
2. Application of Neem kernel extract at 2.5 per litre of water will control *Helopeltis*.
3. Spray 1% Bordeaux mixture during May and 2 or 3 sprays subsequently during the rainy season to control rotting of leaf and vine.

**HARVESTING AND YIELD**
The first harvest from vines is available after six months of planting. The spikes are ready for harvest 2 months after their formation on the plants. Spikes are picked when they are blackish green and most pungent. The harvested spikes are dried in the sun for 4
to 5 days until they are perfectly dry. The green to dry spike ratio is around 10:1.5. The dried spikes are then stored in the moisture proof containers. During the first year, the dry spike yield is around 400 kg per hectare. The yield increases thereafter up to 3 years and it will be about 1000 kg per hectare during the third year. In three years plantation, total yield of fruit and root may reach up to 2100 kg/ha and 500 kg/ha respectively. After three years, the productivity of the vines decreases and should be replanted. Besides the spike, the thick parts of stems and roots which have medicinal value may also be harvested from 18 months after planting. While harvesting the stems are cut close to ground, the roots are dug up, cleaned and heaped in shade for a day. The green to dry spike ratio is 10:1.5 by weight. The dried spikes have to be stored in moisture proof containers. Stem and roots are cleaned, cut into pieces of 2.5-5 cm length, dried in shade and marketed as Pippalimool. There are three grades of Pippalimool, based on the thickness. The grade I with thick roots and underground stem fetching higher price than grade II and or III which may comprises their roots, stem or broken fragments.

PHARMACOLOGICAL ACTIVITIES

Analgesic activities:
An aqueous suspension of P. longum root powder is given orally to mice and rat in dose of 200, 400 and 800 mg/kg. The delay in reaction time for thermal stimulus in rats and the number of writhings to chemical stimulus in mice are determined in each group. The results are analysed statistically. 400 and 800 mg/kg. Doses of P. longum show significant NSAID type of analgesia (P<0.001). Both Ibuprofen (40 mg/kg) and P. longum (800 mg/kg) showed 50% protection against writhing. The delay in reaction time to thermal stimulus was less than 6% for different doses of P. longum as against 100% for pentazocine.

Antimicrobial activity:
In vitro antibacterial and antifungal screening were performed with petroleum ether, ethyl acetate, chloroform and methanol extracts of root, stem and leaves of Piper longum.
against 13 pathogenic bacteria (5 gram-positive and 8 gram-negative) and 6 fungi by the standard disc diffusion method. Ethyl acetate, chloroform and methanol extracts obtained from *Piper longum* root showed mild to moderate activity against most of the tested bacteria. Ethyl acetate extracts of *Piper longum* root, stem and leaves showed relatively better anti-microbial effect against most of the tested organisms. Ethyl acetate, chloroform and methanol extracts obtained from *Piper longum* root showed mild to moderate activity against most of the tested bacteria. But inhibitory effect of petroleum ether was observed against only the bacteria. Of the four extracts, only ethyl acetate extract showed activity against gram-negative Klebsiella species. Ethyl acetate extract also displayed excellent activity against gram-positive Sarcina lutea (22 mm) and gram-negative Shigella sonnei (21 mm) whereas methanol extract showed strong activity against gram-negative Shigella flexneriae (17 mm). The organism Shigella boydii was resistant to all the extracts.\[15\]

The another study reveals that the antifungal potential of methanolic root extract of *Piper longum* against Keratinophilic species for which the problem of multidrug resistance may emerge thereby making them difficult to treat. The encouraging results indicate that this extract might be exploited as natural drug for the treatment of several diseases caused by these organisms and could be useful in understanding the relations between traditional cures and current medications. Further *in vitro* and *in vivo* studies are required in order to prove the bio-efficacy of the extract.\[16\]

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a bacterium responsible for difficult to treat infections in humans. These are strains of *Staphylococcus aureus* that are resistant to a large group of antibiotics called the beta-lactams, which include the penicillins and the cephalosporins. The fruit and root extract of *Piper longum* along with ciprofloxacin showed good synergistic activity against MRSA. The Piperine content of the plant is an P-Glycoprotien inhibitor (Multidrug efflux transporter) that inhibits ciprofloxacin efflux from bacterial cells.\[17\]
Anti-oxidant activity:
The extract of the root of *Piper longum* Linn. and its major compound, Piperine exert anti-oxidant activity and are protective in the myocardial ischemic condition. Piperine was isolated from the roots of the plant and by extracting with petroleum ether as solvent. Studies show that the petroleum ether extract and piperine shows significant DPPH scavenging activity. The extract and piperine were also found to exert protective effect in the myocardial necrotic rats. They have protected myocardium from the harmful effects of lipid peroxidation and even maintained the glutathione levels to normal. Hence it can be concluded that the pet.ether extract as well as piperine are useful in exerting protective activity in case of myocardial ischemia in treated animals. [18]

Antifertility activity:
*P. longum* roots and *E. ribes* seeds administered on days 4 to 7 and 6 to 9 of pregnancy showed 100% antifertility activity in female albino rat. [19]

Chronotropic and Inotropic effects:
Four major fractions namely F,G,H and I were isolated from root of *Piper longum* Linn and studied on isolated frog heart. Fraction F produces negative chronotropic effect on isolated frog heart. Fraction F blocks the actions of adrenaline completely at 200 mcg mL$^{-1}$. The heart rate and force of contraction decreases in a dose dependent manner. Fraction F acts as antagonist of beta adreno-receptors. It blocks the actions of adrenaline in a dose dependent manner. The hexane extract of root of *Piper longum* Linn. was comparatively found to be less active than fraction F. The isolated fraction was thus found to have more activity and the present work can serve as a platform for studying the beta antagonistic activity of the isolated fractions of the *Piper longum* Linn. The biochemical role of the fraction can be investigated in future in animals like mice and rat which may explore the role of the Fraction F as beta-blocking agent. [20]

CONCLUSIONS
The yield of the fruits maximum during 3 years of the plantation. (approx.2100 kg./ha). As the yield decreases after 3 years, plant is cut to collect the root which is divided in 3 grades according to quality. Aqueous preparations of the root of *P. Longum* Linn. has produced Analgesic activity which is similar to NSAID analgesic activity. Ethyl acetate extracts of *Piper longum* root, stem and leaves showed relatively better anti-microbial effect against most of the tested organisms. The fruit and root extract of *Piper longum* along with ciprofloxacin showed good synergistic activity against MRSA. Ayurvedic texts attributed Rasayana activity which can be interpreted as anti-oxidant activity. The patrolium ether extract and piperine were also found to exert protective effect in the myocardial necrotic rats. Here, it may be concluded that more scientific attention and validation is required to evaluate the other activities of Pipplimula described in Ayurved classics.

REFERENCES

1. Barroso G M; Sistematica de angiospermas do Brazil. Epu Usp. Sao Paulo. 1978; (1)45.
3. Dr.JLN Shastry, Ayurvedokta Aushadha Niruktamala, Chaukhambha orientaliya, Varanasi; 2001, p-69
7. Maximum used medicinal plants in the Ayurvedic Formulary of India- I & II and their availability and chance of cultivation in Orissa
8. Demand and supply of medicinal plants in India. NMPB-FRLHT, Published by Bishensingh Mahendrapal Singh.-2008
10. S.S. Purohit, S.P. Vyas, Medicinal Plants cultivations- A scientific approach, Agrobios (India) Jodhpur.-2007. p-501
11. Hand book of Medicinal and Aromatic plants. Published by NEDFI, India.
12. P.P. Joy et al, Medicinal Plants, Kerala Agriculture University, Kerala, India; 1998

For Correspondence:
Krutika J. Joshi
Email: vd.krutika@gmail.com