

Study of Essential Oil Profile to evaluate the medicinal importance of *Piper nigrum* L. and *Piper longum* L.

Santanu Dash¹, Amal Kumar Mondal²

^{1,2}Plant Taxonomy, Biosystematics and Molecular Taxonomy Laboratory UGC-DRS-SAP & DBT-BOOST-WB supported Department of Botany & Forestry, Vidyasagar University, Midnapore-721102, West Bengal

Email ID: santanudash1987@gmail.com

Genus- *Piper* L., belonging to the family-Piperaceae L., (after which the Family and Order are named), is best-known for their medicinal and commercial values. The present study has explored the peculiarities of two *Piper* sp. from the southern part of West Bengal, India. *Piper nigrum* L. (Black Pepper) and *Piper longum* L. (Long Pepper) are the two treasures with high content of terpenoids and phenols. Fruits of these species of *Piper* L. are used as spices and medicines. Black pepper has a worldwide demand but, long pepper is less known in this respect. To explore the variation in respect of their taste, flavour and medicinal utilities of these species the knowledge on essential oil profile is essential. GC-MS analysis has revealed the terpenoid and phenolic content along with their relative concentration of these species.

Keywords: *Piper* L., *Piper nigrum* L., *Piper longum* L., essential Oils, terpenoid, phenol, GC-MS analysis.

1. INTRODUCTION

Our predecessors have explored plants from different sources to treat human diseases. Ancient Indian civilizations were solely dependent on plant based drugs to treat their health issues. Plants possess certain metabolites which help them to fight against

herbivores and parasites. These are called secondary metabolites. These metabolites not only protect plants but also help us to make our internal systems and organs more efficient against parasites. Plant based drugs have curative properties, hence used directly or as a component of medication in different mode of treatment. Moreover, these drugs are less costly, easy to avail and lack potential side effects. In modern medication systems, isolated natural products from plants have been under use in treating ailments. Herbal drugs don't allow parasites to become drug resistant. Natural products obtained from plants play a significant role in novel drug development (Das et al, 2016). Out of a varied herbal resource, it is better to inspect some common but less explored plants like black pepper and long pepper. *Piper nigrum* L. (Black Pepper) and *Piper longum* L. (Long Pepper), belongs to the family Piperaceae L., which are the well-known plants in the southern districts of West Bengal, India.

Plants belong to the family *Piperaceae* L. is distributed from coastal area to the Sub-himalayan parts in India (Parthasarathy et al., 2006). Genus *Piper* contains climbing or creeping herbs or, shrubs with aromatic parts. Hooker (1886) had enlisted 45 species of the genus *Piper* from India and D. Prain (1903) had recorded eight species of *Piper* from undivided Bengal from pre-independence era. *Piper nigrum* L. (Black Pepper) and *Piper longum* L. (Long Pepper) are shade-loving climber with adventitious roots and pungently bitter fruits having characteristic aroma. They grow in wild. In spite of its alienness, these plants are very well known for their economic and medicinal uses in our state. Qualitative phytochemical screening for secondary metabolites of these plants has revealed the presence of alkaloids, flavonoids, phytosterols, phenols and terpenoids (Chakraborty and Shah, 2011). These natural products provide anti-microbial property and modify antibiotic resistance when used with conventional antibiotics. Fruit extract of these two plants are the rich source of phenol and terpenoid compounds (Shetty and Vijayalaxmi, 2012). Various solvents (methanol, acetone, petroleum ether etc.) can be used to isolate bioactive compounds and then GC-MS analysis should be carried out to identify nature, molecular weight and chemical structure of desired compound from a mixture of samples. This technique also helps to recognize an unknown organic

molecule by matching the spectra with reference spectra. Analysis of methanolic extract of dried *Piper nigrum* L. (Black Pepper) and *Piper longum* L. (Long Pepper) fruits reveal the presence of various secondary metabolites as key bioactive compounds with pharmacological activities (Shetty and Vijayalaxmi, 2012).

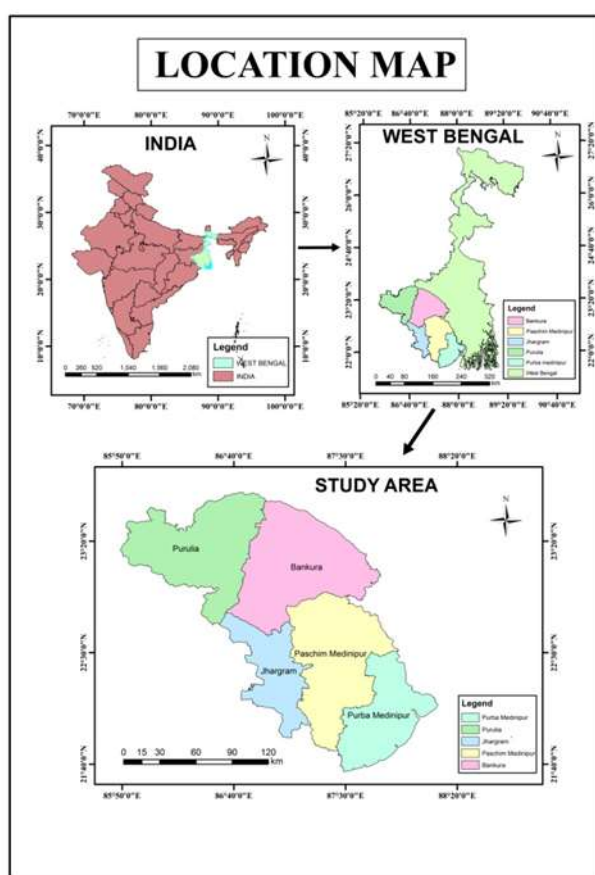


Fig. 1: Map of study area

2. MATERIAL AND METHODS

In search of these plants along with other herbal source, field visits were conducted to the south of West Bengal, India during 2022-2023. Purba Medinipur, Paschim Medinipur, Jhargram, Bankura and Purulia were the districts selected for this purpose. Plants were cumulated and identified on the basis of literature study and herbarium

sheets. Herbarium sheets of these plants were made and authenticated from Central National Herbarium (CNH), Botanical Survey of India (BSI). For detailed morphological study, hand lens and compound microscopes [Stereo Microscopy (SM) - (Leica M125 C)] were used. Field visits were conducted during four different seasons to observe morphological and phenological changes. For the screening of essential oil components along with their relative concentration, infructescences were collected, dried in dark rooms and grinded to dust for further study. 100 gm. of each sample were hydrodistilled to extract the essential oil and then under Gas-Chromatography (GC) coupled with Mass Spectrometry (MS) components of the essential oil of these two plants were recognized. The Chromatogram has revealed the essential oil components along with their relative concentration. The phenolic and terpenoid contents were identified from the essential oil profile of these two species taken under study.

3. RESULTS AND DISCUSSION

3.1. Plant description

3.1.1. *Piper nigrum* L.

Perennial, climber, monopodial, nodes with adventitious roots that enable climbing, internode of runner 9-12 cm long, 3 mm in diameter, glaucous, green, with crescentic leaf scar, aerial branches sympodial, horizontal along axis, leaves simple, alternate, distichous, ovate- lanceolate, 15-18 cm long, 8-10 cm wide, acute, entire, oblique, non-aromatic, petioles 2 cm long, 2.5 mm in diameter, stipular scar on petiole is less than half of the petiolar length, stipule adnate, deciduous, glabrous, 3cm long, plants polygamous, inflorescence spike, pendulous, 5-8 cm long, 1.5-2 mm in diameter, peduncle 1-1.5 cm long, bract leafy, stamens 2, dorsifixed, anthers bithecous, gynoecium monocarpellary, stigma 3-fid, petaloid, ovary superior, infructescence 9-16 cm long, 2-3 mm in diameter, contains 15-40 fruits, loosely distributed, fruits drupe, 2-4 mm in diameter, sessile, green in raw state but, becomes red later.



Fig. 2: *Piper nigrum* Linn. in its natural habit

3.1.2. *Piper longum* L.

Perennial, creeper, nodes with 0-4 roots, 1-3 cm long, internodes 12-15 cm long, 4 mm in diameter, puberulous, dark green, aerial branches semi-erect or, erect at reproductive season, with crescentic leaf scar, leaves simple, alternate, distichous, 9-11 cm long, 9-10 cm wide, cordate, acute, entire, non-aromatic, petioles 8-11 cm long, 2-3 mm in diameter, stipules adnate, 1-1.5 cm long, greenish white, plant dioecious, inflorescence spike, male spike 4-6 cm long, 3 mm in diameter, female spike 2-2.5 cm long, 3 mm in diameter, minute flowers densely crowded, bracteate, bract 1mm long, yellow, stamen 2, anthers bithecous, dorsifixed, extrose, gynoeceum monocarpellary, stigma 3-4-fid, ovary inferior, ovoid, peduncle 0.5-1.0 cm long, infructescence 3-6 cm long, 3-4 mm in

diameter, fruits berries, densely aromatic, pungently bitter, spicy, green in raw state but, becomes black later.



Fig. 3: *Piper longum* Linn. in its natural habit

3.2. Components of Essential Oil

Components of essential oil of these two plants can be broadly categorized into Phenols and Terpenoids. Essential Oil profile has revealed that Eugenol, Cedrol, Cubebol, Epicubebol, Terpinenol and Linalool are the major phenolic compounds recognized and Pinene, Copaene, Bisabolene, Caryophyllene, Sabinene, Himachalene, Elemene, Selinene, Cadinene, Farnesene and Cubebene were the main terpenoids obtained from the powder of Black Pepper and Long Pepper fruits. From this analysis, it can be said that the terpenoid contents of these two plants are more than the phenol contents. In following table the comparative data of essential oil profile of these two studied species was showed-

Table 1: Compounds identified from Essential Oil Profile of *Piper nigrum* and *Piper longum*

Nature of the Compound	Compound name	<i>Piper nigrum</i>	<i>Piper longum</i>
Phenols	Eugenol	-	+
	Cedrol	+	-
	Cubebol	+	-
	Epicubebol	+	-
	Terpinenol	+	+
	Linalool	-	+
Terpenoids	Pinene	+	+
	Copaene	+	+
	Caryophyllene	+	+
	Bisabolene	+	+
	Himachalene	-	+
	Elemene	+	-
	Selinene	+	-
	Cadinene	-	+
	Cubebene	+	-
	Sabinene	+	-
Farnesene	-	+	
+/-; Present/ Absent			

3.3. Medicinal properties

3.3.1. *Piper nigrum* L. as a herbal medicine

- ❖ Fruits have antibacterial, anti-fungal, anti-carcinogenic, anti-allergic, larvicidal, anti-diabetic properties.
- ❖ Decoction of fruits is used to treat mouth ulcer; to cure dental carries and to heal joint pain.
- ❖ Among villagers the use of fruit powder to treat skin diseases is common.
- ❖ Eugenol, present in fruits can be used as a stimulant and an antiseptic (Nayak et al, 2009).
- ❖ It also reduces the growth of benign tumours (Das et al, 2016).
- ❖ It also has immunosuppressive activity that can be useful in bringing down auto-immune diseases.
- ❖ It reduces indigestion, empowers respiratory system and boosts the growth of healthy microbes present in gut.

3.3.2. Usage of *piper nigrum* L. as a traditional medicine

- A mixture of black pepper and Ayapan [*Ayapana triplinervis* (Vahl) King et. Rob] leaves in equal amount cures leucorrhoea when ingested in empty stomach.
- Raw roots of *Piper nigrum* L. are used as contraceptive.
- Mixture made up of black pepper fruits and *Kalanchoe pinnata* (Lamk.) Pers. leaves are used to cure indigestion and bowel movement.
- Black pepper is often used to treat anxiety and nausea among tribal peoples.
- It is often ingested in empty stomach to treat nasal irritation and respiratory disorders.

3.3.3. *Piper longum* L. as a herbal medicine

- ❖ Fruits have antimicrobial, anti-allergic and anti-diabetic properties.
- ❖ Ripe fruits are used to cure internal inflammation and to reduce joint and muscle pain.
- ❖ Eugenol, present in fruits can be used as a stimulant and an antiseptic (Nayak et al, 2009).
- ❖ Powder of fruits is often used in post-gestational treatment of mothers.

- ❖ It reduces indigestion, empowers respiratory system and boosts the growth of healthy microbes present in gut.

3.3.4. Usage of *Piper longum* L. as a traditional medicine

- Half burned unripe fruits are consumed to heal joint and muscle pain among villagers.
- Unripe fruits and root are used to cure cough.
- Fruits are consumed to heal anxiety and suffocation among tribal villagers.

4. CONCLUSION

In this study, two plants from the aforesaid study area were explored for the first time. These two plants are well known among the villagers and tribal peoples of this area, but unfortunately their medicinal utilities and phyto-chemical configuration was not understood earlier. Terpenoids present in their fruits can enhance their medicinal and commercial demands. These compounds has made them valuable source for pharmaceutical industries. Essential oil profile of these two plant species has opened the gate for the interested ones and it will increase their demand as crop in recent future. Phenolic compounds present in fruits can easily be isolated and further used as flavouring agent in soap, tooth paste, cold drinks and beverages.

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6. REFERENCES

- Chakraborty, D. and Shah, B. (2011) Anti-microbial, Anti-oxidative and Anti-hemolytic activity of *Piper betle* leaf extracts. International Journal of Pharmacy and Pharmaceutical Sciences. Vol.3 (3):0975-1491
- Das, S., Parida, R., Sandeep, I.S., Nayak, S. and Mohanty, S. (2016) Biotechnological intervention in betelvine (*Piper betle* L.): A Review on recent advances and future



prospects. World Journal of Pharmacy and Pharmaceutical Sciences.Vol.5 (5):1405-1413

- Guha, P.(2006)Betel Leaf: The Neglected Green Gold of India. Journal of Human Ecology.Vol.19 (2):87-93
- Krishna, A., Reddy, R.,Nirmala, G.S. and Muruganandam, L. (2017) Optimization studies on extraction of phytocomponents from betel leaves. Resources Efficient Technologies.10.1016
- Madhumita,M., Guha,P. and Nag,A.(2020) Bio-activities of betel leaf (*Piper betle* L.): A comprehensive review on extraction, isolation, characterisation and biological activity.PhytotherapyResearch.Vol.10 (02):1-19
- Nayak,M., Nayak,R. and Ngulom,L.(2009) Comparative study of Betel leaf extract against Bacteria causing Dental carries. International journal of Recent Scientific Research.Vol.7 (11):200-205
- Parthasarathy, U., Saji, K.V., Jayarajan, K. and Parthasarathy, V.A. (2006) Biodiversity of Piper in South India- application of GIS and cluster analysis. Vol.91(5):652-658
- Shetty, S. and Vijayalaxmi, K.K. (2012) Phytochemical Investigation of Extract/Solvent Fraction of *Piper nigrum* Linn. Seeds and *Piper betle* Linn. Leaves. International Journal of Pharma and Bio Sciences. Vol.3(2):344-349