Therapeutic Role of *Piper nigrum* L (Black Pepper) and Pharmacological Activities

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**Abstract**

Black pepper, the King of spices (*Piper nigrum* L.), is a widely used spice, known for its pungent odour. From time immemorial, plant sources were used in traditional systems of medicine and day-to-day common use, such as in meal preparation and cosmetic purposes. This is due to their vast pharmacological potential with beneficial effects. Among the various species of the Piperaceae family, black pepper is one of the most popular due to its principle pharmacological component, piperine. Which is an alkaloid that has diverse pharmacological activities like antioxidant, antiobesity, antitumor, antipyretic, anticonvulsant, antithyroid, antifungal, antibacterial, insecticidal, hepatoprotective, antiatherosclerotic, larvicidal, antihypertensive, antinflammatory, antidiabetic, antidiarrheal, bioavailability enhancer, immunomodulatory, antiepileptic, antifertility, GI stimulant, lipid metabolism accelerator, anticancer, CNS stimulant, diuretic, aphrodisiac, blood purifier and antiplatelet activities, etc. Due to some environmental factors and medicinal use, its being popular from ancient times, which is beneficial to modern generation. This review is aimed to provide a literature review on recent advancement of chemistry, pharmacogony, pharmacological activities, new Piperine based formulations and other general use of *Piper nigrum*.

**Key words:** Black Pepper, *piper nigrum*, Piperine, Antioxidant, Pharmacological applications.

**INTRODUCTION**

*Piper nigrum* is belong to the family (Piperaceae) is a valuable medicinal plant. It is one of the most commonly used spices and considered as the King of spices among various spices. Black pepper is grown in many tropical regions like Brazil, Indonesia, Malaysia, Thailand, Madagascar, West Africa and India [1]. *Piper nigrum* is commonly known as Kali Mirch in Urdu and Hindi, Pippali in Sanskrit, Milagu in Tamil and Peppercorn, White pepper, Green pepper, Black pepper, Madagascan pepper in English. Hot and pungent pepper corns are obtained from Black pepper which is the most famous and one of the commonly used spices throughout the world. Black pepper is used as medicinal agent, a preservative, and in perfumery. Whole Peppercorn of *Piper nigrum* or its active components are being used in different types of foods and as medicine [2].

Black pepper is a tropical vine that can grow to a height of 4-9 m, but with the support of other trees the leaves are simple, entire, elliptical, 10-15 cm long and 5-9 cm wide, thick, more or less leathery, and glabrous [3]. The fruit is a drupe up to 8 mm in diameter, better known as peppercorn [4]. The flowers are hermaphroditic, white, and usually 20 to 30 of them are grouped in pendulous spikes. The dried immature fruit of cultivated pepper plants is used as a drug. Black pepper fruit is ball-shaped, 8 mm in diameter, brown with a mesh-wrinkled surface. It has a spicy taste, a specific smell [5]. *Piper nigrum* has many pharmacological activities like antihypertensive and anti-platelets, antioxidant, antitumor, anti-asthmatics, antipyretic, analgesic, anti-inflammatory, anti-diarrheal, antispasmodic, axiolytic, antidepressant hepatoprotective, immuno-modulatory, antibacterial, antifungal, anti-thyroid, antiapoptotic, anti-metastatic, antimutagenic, antispermagenic, insecticidal and larvicidal activities etc [6-8].

*Piper nigrum* has been used for medicinal purposes in many parts of the world since ancient times.
Piperine has been found to enhance the therapeutic efficacy of many drugs, vaccines and nutrients by increasing oral bioavailability by inhibiting various metabolizing enzymes [8]. It is also known to enhance cognitive action and Fertility [9]. Piperine also found to stimulate the pancreatic and intestinal enzymes which aid to digestion. Many therapeutic activities of this spice are attributed to the presence of piperine apart from other chemical constituents. The fruits of *Piper nigrum* are used to produce white and green peppers. *Piper nigrum* is also used as a flavoring agent [10].

**Fig-01: Black paper seeds and pepper fruit [11, 17]**

**Chemical composition**

Piper was the first pharmacologically active compound isolated from different members of Piperaceae family. Many investigators isolated different types of compounds viz Phenolics, flavonoids, alkaloids, amides and steroids, lignans, neolignans, terpenes, chalcones etc and many other compounds [15]. Proximate, minerals, vitamins and bioactive metabolites Black pepper is rich in minerals, vitamins and nutrient. Some of the compounds are Brachyamide B, Dihydro-pipericde, (2E,4E)-N-Eicosadienoyl-pipereridine, N-trans-Feruloyltryamine, N-Formylpiperidine, Guineensine, pentadienoyl as piperidine, (2E,4E)- Nisobuty- ldecadienamid, isobutylicosadienamid, Tricholein, Trichostachine, isobutyl-eicosatrienamid, Isobutyl-octadienamid, Piperamide, Piperamine, Piperettine, Pipericde, Piperine, Piperolein B, Sarmentine, Sarmentosine, Retrofractamide [2]. These minerals are essential elements for day to-day activities of humans. Besides, black pepper also has a significant concentration of vitamins. The different pharmacological activities were reported due to the presence of these phytochemicals. Piperine reported to have four isomers Piperine, Isopiperine, Chavicine and Isochavicine. Among all isolated compounds isolated from *Piper nigrum*. Piperine, pipene, piperamide and piperamine were found to possess diverse pharmacological activities [16].

**Fig-02: Some of the important chemical constituents of piper nigrum [16]**
Taxonomical Classification of *Piper nigrum* [17, 18]

Nutritional composition of (*piper nigrum L*) [19, 20, 21]

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>5.40–6.86 (g)</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>31 (g)</td>
</tr>
<tr>
<td>Fat</td>
<td>4.3 (g)</td>
</tr>
<tr>
<td>Sodium</td>
<td>61.6 (mg)</td>
</tr>
<tr>
<td>Protein</td>
<td>9.3 (g)</td>
</tr>
<tr>
<td>Calcium</td>
<td>117.5 (mg)</td>
</tr>
<tr>
<td>Magnesium</td>
<td>196.8 (mg)</td>
</tr>
<tr>
<td>Potassium</td>
<td>111.6 (mg)</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>1.6 (mg)</td>
</tr>
<tr>
<td>Iron</td>
<td>8.5 (mg)</td>
</tr>
<tr>
<td>Zinc</td>
<td>1.4 (mg)</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>27.46–32.53 (mg)</td>
</tr>
<tr>
<td>Vitamin B1</td>
<td>0.74–0.91 (mg)</td>
</tr>
<tr>
<td>Vitamin B2</td>
<td>0.48–0.61 (mg)</td>
</tr>
<tr>
<td>Vitamin B3</td>
<td>0.63–0.78 (mg)</td>
</tr>
<tr>
<td>Tannin</td>
<td>2.11–2.80 (mg)</td>
</tr>
<tr>
<td>Flavonoids Catechin</td>
<td>410.0 (µg)</td>
</tr>
<tr>
<td>Myricetin</td>
<td>56.0 (µg)</td>
</tr>
<tr>
<td>Quercetin</td>
<td>13.0 (µg)</td>
</tr>
<tr>
<td>Carotenoids Lutein</td>
<td>260.0 (µg)</td>
</tr>
<tr>
<td>β-carotene</td>
<td>150.0 (µg)</td>
</tr>
</tbody>
</table>

Kingdom: Plantae  
Class: Equisetopsida  
Sub class: Magnoliidae  
Super order: Magnolianae  
Order: Piperales  
Family: Piperaceae  
Genus: Piper  
Species: *piper nigrum*

Fig-03: *Piper nigrum* (black paper) Piperine [45]

Fig-04: Black pepper (*Piper nigrum L*) uses and physiological effects [22]
Pharmacological activities of piper nigrum

Antimicrobial activity of Black pepper

An antimicrobial is an agent that kills microorganism or inhibits their further growth. These antimicrobial agents can be grouped into different categories according to their primary activity, like antibacterial, antifungal, antiviral, anti-parasitic, pesticide, etc [25]. Black pepper showed strongest antibacterial activity remains unclear till date. In a recent study, the silver nanoparticles from leaf and stem extract of Piper nigrum were synthesized and then antibacterial activity of the synthesized silver nanoparticles of Piper nigrum was evaluated against agricultural plant pathogens [25]. These silver nanoparticles showed the excellent antibacterial activity against plant pathogens. Authors concluded that the antibacterial activity of silver nano-particles is a beneficial application in crop improvement and protection in agricultural nanotechnology [26].

Anti-obesity Activity

Obesity is becoming a global problem, since it is a socially stigmatized health problem. Piper nigrum is used as an herbal medicine and other non-pharmacological way of management of obesity like exercise, yoga, meditation, diet control etc. There are so many plants that have anti-obesity potency among them [27].

Carminative Activity

Pepper has a high degree of the stimulating and carminative properties, causing a reflex flow of saliva, with increased secretion of gastric juice and improved appetite. Gastro-intestinal movements are augmented, with consequent eructation of gas and relief of colic. In sufficient doses, the peppers dilate the superficial vessels of the skin, causing a feeling of warmth, followed by diaphoresis and some reduction of temperature [25]. On account of these properties they are much employed as condiments, especially in hot countries. The pathological condition in which such painful masses occur, also called piles and black pepper is used as remedy for hemorrhoids. An oleoresin of pepper is prepared by extraction with acetone and separation from Piperine [7].

Cholesterol Lowering and Immune Enhancer Activity

Black pepper and Piperine reduce cholesterol uptake and enhance translocation of cholesterol transporter proteins [29]. It enhances digestion process by helping faster break down of larger fat molecules into easily digestible simple molecules and prevents the accumulation of fat in body. Black pepper exhibits immunomodulatory effect on human body [30]. Piper nigrum is one is used supplementing piperine with high fat diet (40 mg/kg) significantly reduced not only body weight, total cholesterol, triglyceride, LDL, VLDL and fat mass but also increased the level of HDL, with no change. The dietary intake of black pepper or piperine reduces the risk of atherosclerosis via hypolipidemic and antiatherogenic effects [31].

Anti-mutagenic, Antitumor and Anticancer Activity

Cancer is becoming global challenge in today’s health system. Although enormous efforts are done and going on to find new technology, drugs, research, surgery, it is still insufficient. So, we need to search such systems where negligible side effect with high therapeutic outcomes. (Piper Nigrum L) showed effective immunomodulatory and antitumor activity. Angiogenesis plays a key role in tumor progression and cancer. Research findings show that Piperine inhibits proliferation and G1/S transition of human umbilical vein endothelial cells [32].

Antioxidant activity

Black pepper contains an important source of natural antioxidant. The main role of antioxidant protects cells against free radicals, which may play a role in heart disease, cancer and other diseases. Free radicals are molecules produced when your body breaks down food or when you’re exposed to tobacco smoke or radiation [33]. The importance of antioxidants for maintaining the physiological functions of liver, kidney, digestive system, and prevention of cardiovascular diseases and cancer. They have beneficial influence on lipid metabolism efficacy as antidiabetic [34].

Digestive activity of black pepper

Dietary piper nigrum enhances digestion by stimulation of the pancreatic enzymes and considerably decreases the food transit time of gastrointestinal tract. To increases the saliva production and gastric secretions, and increases the production and activation of salivary amylase [35]. The orally administration of Piperine or Piper nigrum stimulate the liver to the secrete bile acids which in turn play key role in the absorption and digestion of fats [36].

Anti-pyretic activity

Ayurvedic, Yunani, Siddha and folklore medicines in India used pepper and pepper containing preparations for the treatment of intermittent fever, neuritis, cold, pains and diseases of throat are practiced in Pepper is also used as an anti-periodic in malarial fever and therefore it is claimed having analgesic and antipyretic properties [36]. Analgesic and antipyretic actions of piperine have been experimented and found strong antipyretic effect [37].

Antidiarrhoeal Effect

Along with above described antimicrobial activity of black pepper, against some bacteria which are also responsible for causing diarrhea. Other research signifies its great potency in controlling diarrhea [38]. As we know, diarrhea is a leading cause of morbidity and mortality globally, especially among the children in developing countries. Aqueous extract of black pepper
at a dose of 75, 150, 300 mg/kg, produces a significant dose dependent antimotility, anti-secretory and Antidiarrhoeal effects. This effect is due to the presence of alkaloids in black pepper [39].

**Immunomodulatory activity of black pepper**

Immunomodulatory and antitumor activity of *piper nigrum* was evaluated. Black pepper and cardamom exert immunomodulatory roles and antitumor activities, and hence they manifest themselves as natural agents that can promote the maintenance of a healthy immune system. Immunomodulation of Piperine for the use of cytokine production, macrophage activation and lymphocyte proliferation [40, 41].

**Other pharmacological activities**

*Piper nigrum* (Black Pepper) or pure compound “Piperine” exhibits many more Pharmacological activities like antihypertensive, antiplatelets, antipyretic, antispasmodic, antifungal, anti-apoptotic, anti-metastatic, antimutagenic, anti-spermatogenic, anti-Colon toxin, anti-asthmatics, anti-anxiety, antithyroids, antifungal, insecticidal and larvicidal activities etc [42-44].

**CONCLUSION**

Pepper has been used since ancient times as a spice, but it has also been used in various traditional medical preparations. Black pepper is a very rich source of a wide variety of chemical constituents, most of which are biologically active. *Piper nigrum* longum revealed that it has got a variety of pharmacologically and medicinally significant constituents, which are being utilized in the field of Ayurveda. It is a plant of high commercial and economical importance. The black pepper fruits (*Piper nigrum* L) are the king of spices and used all over the world. This spice has many health benefits and used traditionally to treat different ailments. The chemical composition of black pepper, which is including minerals, vitamins, Carotenoids and flavonoids, and various therapeutic and biological, and pharmacological activities. Piperine also has a broad spectrum of therapeutic potential and potential for improving health and beneficial use in liver joint pain, lung disease, and digestion, improves memory.

**REFERENCES**


