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A Review on Pepper and Their Common Phytochemicals

Thiyagarajan Gnanasundaram[1*] and Thirumal Sivakumar[2]

[1]Dept. of Botany, Annamalai University, Annamalai Nagar, Tamil Nadu (608 002), India
[2]Dept. of Botany, Thiru A. Govindasamy Govt. Arts College, Tindivanam, Tamil Nadu (604 307), India

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Corresponding Author
Thiyagarajan Gnanasundaram
e-mail: drgtbotany@gmail.com

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Abstract

In the present article reviews novel discoveries associated within the phytochemical analysis and antioxidant activity of piper species. Black pepper (*Piper nigrum* L.) regard as the "King of spices" is a broadly utilized spice that convenes its own flavor to foods and augmented the flavor of other ingredients. *Piper nigram* has been extensively investigated for its bioactive phytochemicals. Piper species are essential herbal plants utilized in the traditional medicinal plants. They are traditionally used to treat abdominal pain, rheumatism, diarrhea and other common infections, the effectiveness of which is stated by their bioactive compounds. Current scientific research has established that many of these spices, which are known to have specific pharmacological properties, contain active compounds. The result has been an increase in the requirement for herbal medicines globally, which has led to the realization of advanced new medicines. Most communities in growing countries are deeply involved in the use of medicinal plants owing to the alarming rates of poverty, so this requires scientific support, particularly in reducing their effectiveness in treating such diseases. In their pure compounds or standardized plant extracts, they offer unlimited opportunities for new pharmaceuticals as they are unparalleled in compensating for their chemical diversity. The vitality of natural products is related to the effects of various phytochemicals such as tannins, terpenoids, cardiac glycosides, flavonoids, saponins.

1. Introduction

Piper nigram (Family: Piperaceae) is a more than 1000 species, and also available all over the tropical and subtropical area. Piper distribution extends from sea level to the upper ranges of the Andes and sub-Himalayas (Royle, 1990). The pharmacological resources of herbal used for food, medicine or spiritual purposes over the centuries have been confirmed by new approaches to their analysis (Mishra *et al.,* 2018; Sharifi-Rad *et al.,* 2018; Abdolshahi *et al.,* 2018; Jothi *et al.,* 2019). The traditional use of certain plants in traditional medicine has been consistently confirmed by scientific research based on their effects (Mishra *et al.,* 2018; Salehi *et al.,* 2018; Sivakumar and Gajalakshmi, 2019). In these modern times, the idea of going back to the "roots" of medicine is starting to enhance more and more popular. Scientific advances have provided new approaches to analyzing various traditional herbs used in different cultures (Salehi *et al.,* 2018; Sharifi-Rad *et al.,* 2018). Piper is one of the most broadly distributed plant species in the pan tropical regions. Piper plants are also commonly known as "pepper". The existence of oil cells in the structures of almost all piper species puts them in the group of aromatic plants (Dyer *et al.,* 2012; Angelin *et al.,* 2019; Angelin *et al.,* 2020, Deepa and Sivakumar, 2020). Moreover, their well-known uses as culinary spices, bioactive ingredients separated from piper plants exhibit worldwide human health effects.

2. Habitat and Cultivation of Piper Plants

The *Piper nigram* belongs to the (family: Piperaceae) native to India. This plant is well known for its medicinal properties. It is commonly used as spices, hence it is known as the "spice king" and also various types of black pepper have different colors. Moreover, all are commonly known pepper white and black peppers (Ahmad *et al.,* 2012; Acharya *et al.,* 2012). Black pepper is commonly in English called as kali Mirchits, white pepper, green pepper, and Madagascar pepper. Furthermore, black pepper has a wide range of uses. It is used medicinally and safely and also used in perfumes (Damanhouri and Ahmad, 2014). The active ingredients of *P. nigram* are used in food and medicine. Pepper is used in sauces and meat dishes all over the world.

It consist of alkaloid is known as piperine its well-known for remarkable pharmacological actions, contain antioxidant,

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antibacterial, anticancer, antipyretic, antiplatelet, antidiarrheal, anti-mutagenic, anti-inflammatory, immunmodulatory, hepato-protective, antifungal, larvicidal, insecticidal and also many other activities (Srinivasan, 2009; Sivakumar *et al.,* 2015; Senthil Kumar *et al.,* 2016; Senthil Kumar *et al.,* 2017; Jothi *et al.,* 2019; Sivakumar, 2019; Angelin *et al.,* 2019). Piper inhibits many metabolic enzymes and enhances the oral bioavailability of many vaccines, drugs and nutrients, eventually improving their therapeutic effects. Piper aids digestion by stimulating intestinal and pancreatic enzymes. Piper is the only major ingredient in most of the therapeutic actions of these spices. The fruits of *P. nigram* are used to make green and white peppers (Zhu *et al.,* 2018).

The forests of the Western Ghats are regard as to be the vital center for black pepper cultivation. It is believed that black pepper was first grown in this area many centuries ago. Pepper cultivation was introduced to other countries such as Asia, Sri Lanka, Malaysia, Madagascar, Latin America, Brazil, some African countries and many Southeast Asian countries. *Piper nigrum* prefers warm and moist places for growth. This plant is available in a variety of conditions ranging from high altitude to different soil and climatic conditions. It is found in all tropical and subtropical regions of the world. The geographical distribution of black pepper is affected by the minimum temperature of the cold month and the rainfall of the wet month. Physiological activities are at their highest during wet periods. In the wet season, flowering, filling grains and ripening. This period requires a lot of water (Li *et al.,* 2010).

3. Phytochemicals

Phytochemicals include antioxidant effects, modulation of enzyme activity, stimulation of the immune system, antibacterial, hormonal metabolism and antiviral effects, DNA replication and/or interaction with the body. It can physically tie to certain cell walls, hereby preventing diseases from attaching to human cell walls (Ngoci *et al.,* 2011). The phytochemicals are elucidated in the following sections.

3.1 Saponins

These are work active agents with soap-like properties, and they can be detected by their ability to foam and bleed blood cells (Harborne, 1973). Raising the respiratory in anticipations, and also it contains biological role, including anti-cough activity. They act as vaccine boosters by acting as adjuncts. They have anti-inflammatory, emetics, antiviral, antifungal, molluscicidal, piscidal and antibacterial activity (Ngoci *et al.,* 2011). The mechanism of action for antibacterial effects includes the membrane properties of saponin and the reduction of the surface tension of the extracellular medium (Al-Bioti and Al-Mola, 2008).

3.2 Alkaloids

Alkaloid is a plant-acquired compound that is toxic or physiologically active. Some alkaloids, such as isopteropodine and strophobine, have antimicrobial activity, thereby activating white blood cells by promoting the elimination of harmful microorganisms and cell debris (Okunvenmo *et al.,* 2007; Sivakumar and Panneerselvam, 2011; Sivakumar, 2019; Angelin *et al.,* 2019). Extremely aromatic planar quaternary alkaloids such as berberine, piperine and harmon work by combining DNA and cell wall (Cowan, 1999). They act as narcotics, antimalaria, and topical anesthetics Ophthalmology; in the treatment of hypertension, rheumatism, neurology, motion sickness and prolonging the life of hormones (Ngoci *et al.,* 2011). They have analgesic action and are therefore used to alleviate complaints such as septic injuries, boilsand headaches, abdominal pain and eye conditions. They also have antineoplastic functions, for instant indole alkaloids are used in leukemia and Hodgkin's disease chemotherapy. They act by depolymerizing protein microtubules that form the mitotic cycle in the cell division. This process allows the tumor cells to divide or divide and no longer stop as a result of reducing cancer. However, few types of alkaloids are hallucinative, addictive, and toxic, so arrow poisons are used to hunt wild game (Okunvenmo *et al.,* 2007; Ngoci *et al.,* 2011; Sivakumar and Gajalakshmi, 2104).

3.3 Tannins

Tannins are astringent, bitter plant polyphenols that bind, accelerate or contract proteins. They play a physiological role by acting as antioxidants through free radical scavenging activity, transformation of metals, and fraud by proximate oxidative enzymes and lipid peroxidation (Navarro *et al.,* 2003; Vit *et al.,* 2008; Ngoci *et al.,* 2011). Modifying antioxidant pressure and preventing degenerative diseases. They inhibit tumor growth by inducing apoptosis (Scalbert *et al.,* 2005) and by preventing the mutagenecity of cancers (Okuda, 2005; Ngoci *et al.,* 2011). They indicate antimicrobial activity by complicating nucleophilic proteins by hydrogen binding, covalent binding, and unspecified interactions. The chief targets of the complex are cell wall and cell membrane adhesive proteins, thus inactivating microbial adhesions, which is the first step in establishing infection. They also cause cell wall/ membrane disorders (Cowan, 1999; Okuda, 2005; Biradar *et al.,* 2007; Ngoci *et al.,* 2011). It also inactivates microenzymes and cell envelope transport proteins by processes involving reactions with sulfide groups of proteins (Samy and Gopalakrishnakone, 2008; Kaurand Aurora, 2009; Ngoci *et al.,* 2011).

They accumulate/ complexes metal ions (*e.g.* manganese, cobalt, copper, iron, *etc*.) required for microbial growth as co-agents and enzyme activators. They also inhibit viral reverse transcriptase (Okuda, 2005; Biradar *et al.,* 2007; Okunvenmo *et al.,* 2007; Ngoci *et al.,* 2011). Toxicity to microorganisms in phenolic compounds depends on the site and number of hydroxyl groups, with evidence that hydroxylation leads to increased toxicity (Przybylski *et al.,* 1998; Cowan, 1999; Biradar *et al.,* 2007; Samy and Gopalakrishnakone, 2008; Sivakumar and Panneerselvam, 2011). They play an endocrine role by

interacting with estrogen receptors. They are important in the control of anti-inflammatory, molluscicidal and schistosomiasis.

3.4 Flavonoids

They are fundamental derivatives of flavonoids, have integrated aromatic systems, are often bound to glycosides with sugar(s), and are naturally phenolic and water-soluble (Harborne, 1973). They play their roles as antioxidants, thus protecting against degenerative pathogens. Flavonoids such as quercetin act as chain-breaking antioxidants and inhibit the oxidation of low-density lipoprotein by metal ions such as macrophages and copper. It reduces antioxidant stress (Ngoci *et al.,* 2011). They act as antibiotics by complicating extracellular and soluble proteins and complicating the bacterial cell wall. Lipophilic flavonoids can also disrupt microbial membranes (Navarro *et al.,* 2003; Al-Bioti and Al-Mola, 2008; Samy and Gopalakrishnakone, 2008; Kaur and Aurora, 2009; Ngoci *et al.,* 2011). Potential targets of the microbial cell are surface-exposed adhesins, cell wall polypeptides, and membrane-bound enzymes. The catechins found in oolong green tea inactivate bacterial toxins (*e.g*. cholera toxins) and inhibit bacterial glucosyltransferase. They function; 'Nature's biological modifiers' trigger two enzymes that are anti-allergic, anti-inflammatory, and eliminate mutations and cancers (Okunvenmo *et al.,* 2007). They are also known to simplify capillary weakness (Harborne, 1973), antiallergic and antispasmodic and therefore used for reliefasthma and nasal bleeding (Ngoci *et al.,* 2011). Flavonoids that do not have hydroxyl groups (-OH) in their composition are more active against microorganisms than -OH, and this supports the notion of their microbial target membrane (Cowan, 1999; Samy and Gopalakrishnakone, 2008; Ngoci *et al.,* 2011).

3.5 Phytosteroids

Phytosteroids are plant steroids that may or may not act as weak hormones in the body. They share a common basic ring structure with animal stimulants, but they are not identical due to the various chemical groups attached to the main ring at different stages (Ngoci *et al.,* 2011). They are mainly used to treat reproductive problems, which are used to ensure easy delivery during pregnancy, as well as improve fertility in women and libido in men. They also act as sex hormone derivatives (for example, they can be metabolized to substances such as androgen or estrogen) so they are potential sources of contraception (Edeoga *et al.,* 2005; Ngoci *et al.,* 2011). They are utilized in antimicrobial, analgesic, anti-inflammatory and therapeutic purposes and in reducing serum cholesterol levels (Ngoci *et al.,* 2011). They have also been revealed to be potent inhibitors of macrophage activity, inhibiting the production of anti-inflammatory cytokines and LPS-induced death, so they are particularly effective as prophylaxis agents especially the physalins (Soares *et al.,* 2005; Ngoci *et al.,* 2011).

3.6 Terpenoids

These are the derivatives of the isoprene molecule with a carbon skeleton constructed from one or more C15 units (Harborne, 1973). They play their roles as antiviral, antibacterial, antifungal, protozoan, immune boosters, anti-allergic and antinoplastic (Roberts, 2007; Ngoci *et al.,* 2011). The mechanisms of action by which these lipophilic compounds cause membrane degeneration are speculated (Cowan, 1999; Okunvenmo *et al.,* 2007; Samy and Gopalakrishnakone, 2008; Ngoci *et al.,* 2011). Petalostemumal has exhibit activity against *S. aureus, B. subtilis,* and *C. albicans* and to a lesser extent to Gram-negative bacteria (Cowan, 1999; Ngoci *et al.,* 2011). This may be due to a disruption of the lipid fraction of the bacterial plasma membranes, resulting in changes in membrane permeability and leakage of intracellular substances. This is associated to the physicochemical properties of the dynamic principle (such as lipophilicity and water solubility), lipid composition, and net surface charge of bacterial membranes. These phytochemicals can penetrate cell membranes, penetrate the cell's interior, and interact with important inward targets for antibacterial activity (Trombetta *et al.,* 2005). They are used to relieve epilepsy and to treat colds, coughs and acute bronchitis (Ngoci *et al.,* 2011). From laboratory studies of terbenes from ginseng, it is suggested that the potential target of these compounds includes the hypothalamus-pituitaryadrenal axis owing to the observed effects on adrenocorticotropic hormone and corticosterone (Briskin, 2000; Ngoci *et al.,* 2011).

4. Conclusion

Herbal plant products are still an important plan in supporting primary health care systems. Some of these phytochemicals accidentally protect humans against pathogens, which is why they are a key target for drug anticipation programs. Their biological activity is mostly related to secondary metabolism, which is often described in detail for plant protection. The primary phytochemicals are known to have many properties that are important to cells, therapeutic, Prophylactic, nutritious and immune-modulating properties.

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