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Review Article

MEDICINES FROM INDIAN CHILLIES: A MINI REVIEW

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ABSTRACT

India is a country with vast biodiversity. The country is rich in its natural resources. Varieties of spices, herbs, plants, and trees are grown in various parts of the country, which have more than one use. Most of them are rich source of nutrition, some are popular spices, and some have exclusive medicinal uses also. The objective of this article is to give a brief and compact review of the various types of chillies available in India, to discuss their versatile potential medicinal values, and to consider those for developing some potent and effective drugs with minimum or no side effects for wide range of pathological conditions. Indian traditional medicine is famous all around the world and for ages and now a days, Indian biodiversity has immense contribution in the development and advancement of alternative and complementary medicine. Chillies are one of the popular spices in India. They add the burning hot taste and wonderful color to Indian dishes. Not only in India, chillies are used all over the world in various dishes. We have primarily studies various investigatory reports available from all around the world to develop our insight into the medicinal potency of varieties of chillies grown in various parts of India. Several investigations have revealed the presence of various compounds in the chillies. Those compounds have been found to be of medicinal importance. Some of them have multiple medicinal applications. More of those are yet to be characterized. More and more structured and collaborative detailed investigations are required to recognize, characterize, and modify the various potent medicinal compounds from different types of chillies. *In silico*, experimental, and clinical studies are also essential. We may get some revolutionary compounds with potent medicinal properties for enriching our pharmaceutical ammunitions against fatal and deadly diseases from those hot green and red chillies. It can really be a beneficial milestone on the pharmaceutical world and a boon for mankind.

Keywords: Biodiversity, Chillies, Nutrition, Alternative medicine, Complementary medicine.

INTRODUCTION

More than four hundred varieties of chillies are grown all over the world. Out of those many are grown in countries of Asian continent including India. In fact, India is the largest producer of chillies. China is the second on the list [1]. There are several varieties of chillies. Each of them is unique in their appearance, shape, color, and flavor. According to the spices board of India, eighteen varieties of chillies have been recognized from various parts of India [2]. Capsaicinoids are the group of compounds found in chillies and capsicum group of vegetables, and they are the one actually who are responsible for imparting typical the hot burning taste to chillies. About 80-90% of the total capsaicinoid concentration in chillies is primarily the compound capsaicin. This capsaicin is chemically N-Vanillyl-8-methyl-6-(E)-noneamide. Capsaicin is a vanilloid, and it has various medicinal properties [3]. Various other compounds have also been isolated from chillies, and they have different types of medicinal potencies [3]. Capsaicin has been reported to possess anticancer activities. It can bind to cancer cells and destroy them [4,5].

Different types of chillies are grown in different states of India. They all are unique in their properties and flavors. Their constituents are also diverse. Geographical variation of soil contributed to this varied phytocomposition of chillies grown in different parts of the country. The composition and concentration of various compounds also depend on the stages of maturation of chillies [6].

TYPES OF CHILLIES IN INDIA

India produces 18 different types of chillies cultivated in different geographical regions having different common names. The varieties of chillies grown in India include Bird's eye chilli (dhani), tomato chilli, Byadagi (kaddi and daggi), Nalchetti, Ramnad Mundu, Tadappally, Ellachipur sannam, Guntur sannam, Hindpur, Sangli sannam, Jwala, Kanthari White, Kashmiri Chilli, Nagpur, Madhya Pradesh Sannam, Sattur, Mundu, Madras Puri, etc. [2].

NUTRITIONAL VALUES OF CHILLIES

Chillies have been found to contain a blend of different Vitamins and phytochemicals, i.e., carotenoids, Vitamin C, phenols, foliates, etc. [7]. Those are the kinds of common components of chillies of different species from parts of India. Studies conducted on six different varieties of chillies from India revealed that fat content ranges from 0.82 to 1.99 g%, protein 0.91-1.59 g%, dietary fiber 4.65-6.15 g%, and ash 0.67-0.82 g%. Naga king chilli contains 0.55 g% of capsaicinoids and are the richest source of capsaicinoids, whereas only 0.05 g% of capsaicinoids have been found to be present in hatei chilli. Nutrients content and concentration and type of bioactive contents vary among different types of chilli. It depends not only on the type of chilli but also on the soil chemistry of the place where it is cultivated. The prime bioactive compound recognized to be present in chillies is capsaicin (8-methyl-*N*-vanillyl-6-nonenamide) [7].

BIOACTIVE COMPOUNDS FROM CHILLIES

Different bioactive compounds have been found to be the components of chillies of different species [Table 1]. Analytical techniques such as the high-performance liquid chromatography and gas chromatography have been uses for analyzing the components of chillies. Compounds such as homocapsaicin, nordihydrocapsaicin, and homodihydrocapsaicin have been found to be present in chillies [6-8]. Among all these capsaicinoid compounds in chillies, almost 80-90% is composed of capsaicin (8-methyl-*N*-vanillyl-6-nonenamide). This compound has lots of biological potency and has been found to be of profound pharmaceutical importance [6]. Certain compounds such as 2-isobutyl-3-methoxypyrazine, 2,3-butanedione, trans-2-hexenal, linalool, 3-carene, and hexanal are some of the principal compounds recognized to be components of fresh commercial chilli (*Capsicum annuum* var annuum) at different stages of ripening. All those six compounds are volatile aromatic compounds. Presence of those compounds in chilli was made and confirmed using analytical techniques such as high-performance liquid chromatography, gas chromatography retention time, and mass spectrophotometry [9].

Table 1: Types of chillies from India, compounds present in them and their medicinal uses [1,2]

S. No	Region found	Common name	Scientific name	Heat	Medicinal use
1.	Himachal Pradesh and Jammu and Kashmir	Kashmiri chilli	*Capsicum annuum*	Mild	A good source of vitamin C, and vitamin A, having free radical scavenging and immune boosting effects
2.	Andhra Pradesh	Guntur sannam	*Capsicum annuum* var. Longhum *Capsicum frutescens* L.	High	A rich source of vitamin C and proteins
3.	North East	Bird's eye or dhani	*Capsicum frutescens*	High	Controlling flatulence. It is high in capsaicin. It is very effective in controlling cholesterol levels this chili to treat bruises and swelling and arthritic pain
4.	North East (Assam)	Bhut jolokia, u-morok, ghost pepper, red naga, naga jolokia	*Capsicum frutescens* X *Capsicum chinense* hybrid	Extreme	Analgesic
5.	Tamil Nadu and Andhra Pradesh	Mundu chilli or tomato chilli	*Warangal chappatta*	Mild	Rheumatic disorders
6.	Gujarat	Jwala chilli	*Capsicum annuum*. Longum group	Moderate	Used in arthritis, etc., pain disorders
7.	Kerala	Kanthari chilli	*Capsicum frutescens*	Moderate	Lumbago, neuralgia, and rheumatic disorders
8.	Karnataka and Goa	Byadagi chilli	*Capsicum annuum*. Longum group	Moderate	Uses in regional traditional medicine
9.	Andhra Pradesh	Madras puri	*Capsicum annuum*. Longum group	Moderate	Uses in regional traditional medicine
10.	Andhra Pradesh	Guntur sannam	*Capsicum annuum* var. Longhum	High	Rheumatic disorders
11.	Maharashtra	Ellachipur sannam	*Capsicum annuum* var. Longhum	Moderate	Has free radical scavenging and immune boosting effects
12.	Maharashtra	Nalchetti	*Capsicum annuum* var. Longhum	Moderate	
13.	Maharashtra	Sangli sannam	*Capsicum annuum* var. Longhum	Moderate	
14.	Sikkim	Dalley chilli or dalle khursani	*Capsicum frutescens*	Extreme	Has effects on level of lipidperoxidation and diverse medicinal values

Studies on chillies also tell us about "chilli oleoresin." It is an oil soluble extract of chilli, specifically red chillies. Again capsaicin is a prime component of this chilli oleoresin and imparts the typical flavor to it. Other components being capsorubin, capsanthin, etc., the latter two are carotenoids in nature and are the ones who impart the color to red chillies [10].

ABOUT CAPCAICIN AND ITS MEDICINAL PROPERTIES

Constituents from Chillies have been found to be successfully applied for treating various pathological conditions such as pain, obesity, cancer, and inflammation [11].

The capsaicinoid group of compounds present in chillies binds to a receptor in the mucous membrane of the mouth which produced the typical burning sensation on ingestion of chillies. However, the compound does not cause any deleterious change to tissues. Continuous ingestion of chilli builds a tolerance to the burning sensation and the threshold for the same rises. This happens due to growing tolerance of the receptors to capsaicinoids. These groups of compounds stimulate release of small neuropeptides called endorphins. Endorphins are known as happy hormones. They are kind of natural pain killers and are known to promote good mood and the feeling of wellbeing. Capsaicin content in chillies imparts the burning sensation and at the same time promotes good mood. Studies have revealed that this capsaicin has many medicinal properties (Fig. 1). And one nice thing is that none of species of chillies from India do possess too much capsaicin to cause any harm. Experimental overdosing of capsaicin has shown it to be harmful at a very high dose. Capsaicin has been found to have LD_{50} in mice, which is around 47.2 mg/kg [12].

Vanilloid receptor subtype 1 has been recognized as a receptor that binds to capsaicin. It forms a nonselective cation channel in the plasma membrane that brings about most of the pleiotropic effects exerted by capsaicin and its analogs (collectively termed as vanilloids) [13].

Studies reveal that capsaicin has the potency to destroy prostate cancer cells in experimental mice. At the same time, normal cells remained unharmed by capsaicin in the same mice. This finding ignited the hope of developing a potent anticancer therapeutic formulation using capsaicin [13]. The exact mechanism involved in such selective destruction of cancer cells by capsaicin is still unknown. The concentration of capsaicin, which has been found to be effective against the neoplastic cells, is considerably high and is not possible to be derived *in vivo* in humans from consumed chillies in his food. Here comes the necessity of developing a drug from containing capsaicin in fairly concentrated form chillies so as to meet the required amount for destroying cancer cells [13].

Studies reveal that capsaicin interacts with cancer cells and brings about the changes within the cell thereafter. The study has been conducted by measuring the natural fluorescence of the compound after it binds to cell membrane. The compound attaches to cell membrane and then triggers a series of chemical changes in the membrane, which ultimately leads to gradual destruction of the membrane integrity. The molecular pathway underlying the event is still not understood properly. Thus, we are on stepping forward on the way to utilize capsaicin as a therapeutic agent in cancer therapy and the best thing about the compound is that it does not harm normal, healthy cells. And also that all studies till date showing capsaicin to possess potential to destroy cancer cells do only reveal that the compound can reduce the rate of progression of the disease. It can reduce the size of tumor. But it has not yet been found to cure cancer completely or to destroy the tumor entirely. Thus, it seems that more research is needed to establish the exact molecular molecules involved in the mechanism of capsaicin-induced destruction of cancer cells and the molecular pathway it follows in the process [14]. Substance P is a neuropeptide associated with inflammation, and capsaicin has been found to be an effective inhibitor of substance P; Thus capsaicin has anti-inflammatory potency. Experimental studies in animal models reveal that capsaicin has the capacity to reduce the inflammation and

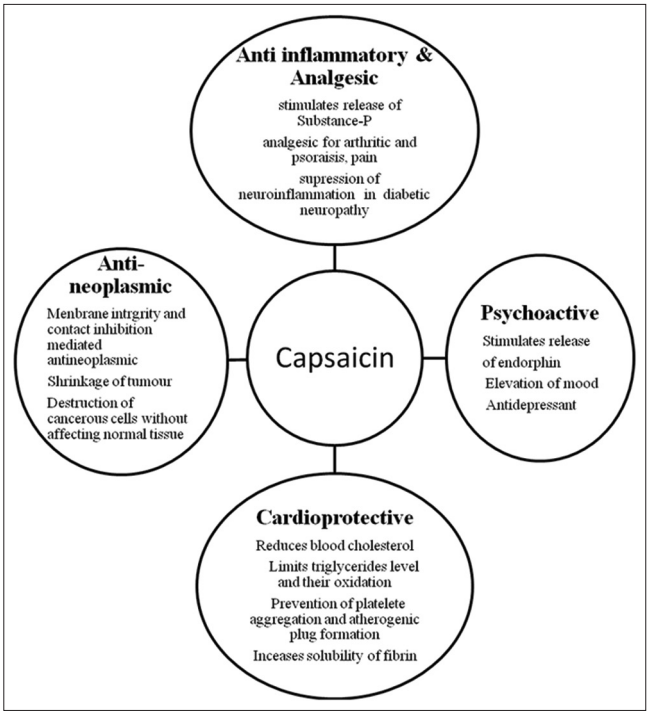

Fig. 1: Medicinal uses of capsaicin from chillies

it also delays the onset of arthritis. Capsaicin has neuroprotective capacity. It has been found to be effective against neuroinflammation associated with diabetic neuropathy, pain associated with psoriasis and arthritis [15]. Capsaicin is thus recognized as a natural analgesic. Studies conducted in 200 human subjects also establish the pain relief potency of capsaicin (Fig. 1) [16].

Substances from nature have been found to have cardio protective activity, and the best part is that if used in a proper dose, they have no cytotoxic effect. Natural cardioprotective agents do not cause any toxic side effects as well [17]. Capsaicin has been found to have cardio protective activity. It has been found to reduce blood cholesterol, platelet aggregation, levels of triglycerides, and also enhances the solubility of fibrin. Capsaicin from chilli has also been found to reduce the rate of oxidation of triglycerides in human male and female subjects [18]. Chilli has been found to reduce resting heart rate and increase perfusion of heart [17].

CONCLUSION

Chillies, being the rich source of Vitamin A and C, have been found to boost the immune system. Vitamin A and C from chilli helps to maintain the integrity of mucous membranes. Chillies being hot and burning in taste are believed to trigger the formation of gastric ulceration, but surprisingly, they are actually potent in preventing ulcer. Chillies are known to inhibit the growth of bacteria in stomach and thus are helpful in maintaining a healthy gastric environment. Compounds in chillies stimulate the secretion of protective buffering gastric juices [19]. Chillies have been found to be effective in reducing weight. It has high thermogenic value, stimulates the release of lipolytic peptides, increases metabolic rate, and thus are helpful in reducing weight [20]. One of the most complicated physiological situations in Type 2 diabetes is that the level of insulin in blood rises above normal but they cannot act due to the defects in their receptors on the cells. This raised level of insulin, termed as hyperinsulinemia, is responsible for the diabetic shock in which a diabetic patient's blood sugar suddenly decreases beyond marginal level and it adversely affects the brain and other important tissues of the body. Chilli administration has been found to be effective in enhancing the clearance of insulin by liver also. In simple words, chillies in diet can cause us to make less insulin (enough to meet our normal physiological requirement) and to use it more effectively. Thus, we may look forward for wonderful potent drug formulations from Indian chillies to enrich, upgrade, and strengthen our pharmaceutical reserves for more than one pathological conditions.

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