ejpmr, 2017,4(12), 305-310

SJIF Impact Factor 4.161

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Review Article

ISSN 2394-3211

EJPMR

CHILLI (*CAPSICUM ANNUUM* L.) AS FOOD, SPICE AND MEDICINE: AN OVERVIEW

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Article Received on 27/09/2017 **Article Revised on 17/10/2017** **Article Accepted on 06/11/2017**

ABSTRACT

Chilli (*Capsicum annuum* L.) is an important commercial and export oriented crop in India. It is the life and soul of all delicious Indian dishes. It has been cultivated for thousands of years. It is famous for its intense pungent taste which is provided by its active constituent capsaicin. It is a good source of vitamins, minerals, dietary fibers and macronutrients. From ancient time it has been used as food, spice and household medicine for several common problems such as carminative, appetizer, stomachic, beverages, relief of pain in neuropathy and counter irritant in treatment of rheumatism, lumbago. It is generally recognized as a powerful local stimulant with no necrotic effect. Chilli plays an important role as an immunity booster, anti-microbial, anti-cancer, anti-ulcer, analgesic, anti-inflammatory, anti-septic and anti-hemorrhoidal agent. It is also helpful for the management of burns, psoriasis and chronic migraine. It is also beneficial in heart disorders and diabetes. The purpose of this review work is to outline the nutritional importance, beneficial and injurious effects of chilli on human health.

KEYWORDS: *Capsicum annuum* L., capsaicin, wonder spice, pharmacology.

1. INTRODUCTION

One of the most important spicy crops in India is chilli which grown almost throughout the country. More than 400 different varieties of chillies are found all over the world. It is also known as hot pepper, cayenne pepper, sweet pepper, bell pepper etc. In Indian diet chilli occupies an important place.[1] Chillies are not only rich in vitamins (especially in vitamin A and C), but also packed with potassium, magnesium and iron.[2] Due to its action to inhibit pain messengers, chillies have been used as pain reliefer. Extracts of chilli peppers are used for alleviating the pain of arthritis, headaches, burns and neuralgia. It is also claimed that chilli has the power to boost immune system and lower the cholesterol level. Chillies are also helpful in getting rid of parasites of gut.[3]

2. Origin of Chillies

Chillies are known from pre-historic times in Peru. They are believed to have originated in the tropical America. It is also said that chillies have originated in the Latin American regions of the New Mexico and Guatemala as a wild crop around 7500 BC, as per the remains of the pre-historic Peru. The people native to these places domesticated this crop in and around 5000 BC.[4,5,6] Christopher Columbus was one of the first Europeans to encounter them (in the Caribbean), and called them 'peppers' because they, like black and white pepper of the Piper genus known in Europe, have a spicy hot taste unlike other foodstuffs.[7] Upon their introduction into Europe chilis were grown as botanical curiosities in the gardens of Spanish and Portuguese monasteries.[8] The Portuguese brought capsicum from Brazil to India during the year 1584. Chillies became popular in the whole of Asia rapidly. The south Asian climate suited this crop, and since its introduction in the 16 century has been increasingly cultivated in south Asia. Chillies are the cheapest spices available in India and are eaten across all groups of people. The most important chilli growing states in India is Andhra Pradesh.[2,3]

3. Botanical Classification of Chillies

Chillies consist of dried ripe fruits of Capsicum *annum* linn., belonging to family Solanaceae (Table 1). It contains not less than 12% of non volatile ether soluble extractives.[9] It is an important crop in preparation of soups, chilli sauce, spicy water etc in country.[10] The term 'Capsicum' is derived from the Greek word "Kapsimo" is meaning "to bite." Genus Capsicum is divided into three sections i.e., Monotypic Tubocapsicum, Pseudoacnistus and Capsicum. Genus Capsicum includes 22 wild species and three varieties as well as five domesticated species and their wild relatives.[11]

Table 1: Botanical Classification of Chilli (*Capsicum annuum* L.)[12]	
Kingdom	Plantae
Subkingdom	Viridiplantae
Infrakingdom	Streptophyta
Superdivision	Embryophyta
Division	Tracheophyta
Subdivision	Spermatophytina
Class	Magnoliopsida
Superorder	Asteranae
Order	Solanales
Family	Solanaceae
Genus	*Capsicum* L.
Species	*Capsicum annuum* L.

4. Pharmacognosy of Chillies

Chili peppers journeyed from India, through Central Asia and Turkey, to Hungary, where it became the national spice in the form of paprika. The vernacular names of chillies are given in table below (Table 2).

Table 2: Vernacular names of Chilli (*Capsicum annuum* L.)[13]	
English	Chillies, Long Chillies, Red Chillies
Hindi	Lalmirca
Marathi	Mirchi
Kannada	Kempumenasu
Malayalam	Mulaku, Kappalmulaku, Paccamulaku, Cuvannamulaku
Sanskrit	Katuvirah, Raktamaricah
Tamil	Milagai
Telugu	Mirapakaya
Ayurvedic	Kantkari kul

5. Identity, Purity and Strength of Chillies

Chillies come in different colors, varieties, fragrances, sizes etc but are similar in structure i.e., hollow, seed containing and tube like structure. The identity, purity and strength of chillies are given in table below (Table 3).

Table 3: Identity, Purity and Strength of Chilli (*Capsicum annuum* L.)[14]	
Foreign matter	Broken chillies 7 % max.
Total ash	< 8 %.
Acid-insoluble ash	< 1.25 %.
Moisture	9 % max.
Non volatile Oil	9 % min.
Color value	2000 c.u. to 7000 c.u.

6. Description of Chillies

Macroscopic character: Depending upon the commercial variety of the drug, chillies fruits are of various shapes and size. Generally it is oblong, conical, 10-20 mm long and 4-7 mm wide. In the glabrous pericarp is attched to cup-shped five toothed calyx and straight pedicel. Pericarp is orange-red to dark reddish, shrunken and thin. Internally the pericarp is divided into two cells by the membranous dissepiment. Each cell consist of about 5-10 small, flattened, disc shaped whitish yellow seeds. Chillies powder is sternutatory with characteristic odour and extremely fiery, pungent taste. The official limit of pedicel and calices in the drug is about 3%.[15, 16]

Microscopic character: The transverse section of the pericarp of capsicum fruit shows the presence about 5-7 rows of outer epidermis made up of the subrectangular cells. Mesocarp consist of cellulosic polygonal parenchyma. With small vascular bundles and sandy crystal of calcium oxalate. It contains yellowish droplets of the oil which are known as chromatophores. The mesocarp is followed by single layer of larger cellulosic cells. Endocarp is made up of wavy cells, lignified tissues and the patches of sclerenchyma. The dissepiment consists of thin walled parenchyma.[15, 16]

7. Chemical Constituents of Chillies

Chillies gives pungent test due to presence of a substance known as *'Capsaicin'*. The membrane and seeds of chilli generate the pungent flavor. Capsicum contains pigments like *'Capsanthin'* and '*Carotene'* which gives red colour. Capsicum also contains fixed oils, proteins, ascorbic acid and thiamine. The pungency of capsicum can be destroyed by oxidising agents like potassium permanganate. IUPAC NAME of chilli is 8-Methyl-*N*-vanillyl-*trans*-6-nonenamide (Fig. 1).[16, 17, 18]

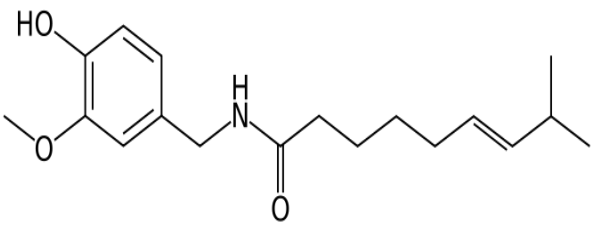

Figure 1: Chemical structure of Capsaicin.

8. Production of Chillies

The largest producer, consumer and exporter of chilli in the world is India, accounting for 11 lakh tons of production annually followed by China with a production of around 4 lakh tons, Mexico with the production of around 3 lakh tons and Pakistan also producing 3 lakh tons of chilli every year (Fig. 2).[19, 20]

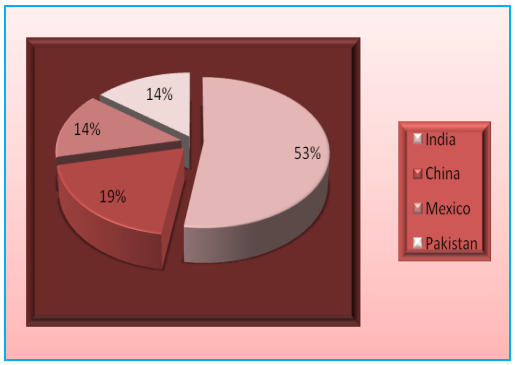

Figure 2: Scenareo of major chilli producing countries in World.

Chillies are cultivated in all the States and Union Territories of the country (Fig. 3).[21] Chillies are the most common universal spice cultivated all over the India. India contributes about 36% to the total world production of chillies. The production of Chilli in India is dominated by Andhra Pradesh which contributes nearly 57% to the total production. Karnataka is the second largest producer contributing 12% to the total production followed by Orissa (5%), West Bengal (5%), Maharashtra (4%), Madhya Pradesh (3%) and others about 14% (Fig. 4).[1]

Figure 3: Scenareo of chilli growing states in India.

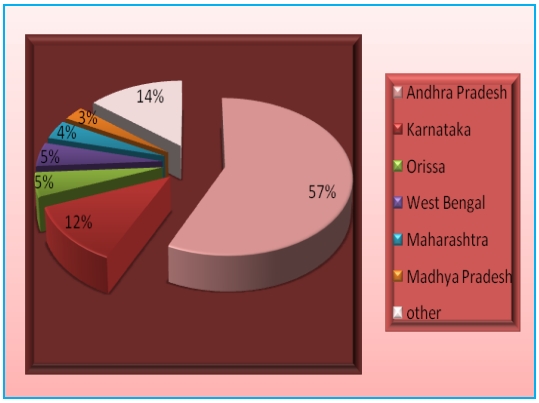

Figure 4: Scenareo of chilli producing states in India.

9 Uses of Chillies

a) Capsaicin cream is available for the relief of pain in osteoarthritis, post-herpetic neuralgia, and painful diabetic neuropathy.[16]

b) Immediate application of red chilli powdered to the part affected by a dog bite, minimizes the affect of the poison. It also acts as an antiseptic by preventing the formation of pus in the wound.[22]

c) Mixture of one spoonful of powdered chilli, one spoonful of salt and boil water prevents cholera.[16]

d) Sprinkling of mixture of red chilli powdered with boil water on those areas where bed bugs are present eliminates bed bugs.[16]

e) Swallowing of chilli seeds with hot water eliminates stomachache due to cold, gets vanished.[16]

f) Green chillies are rich sources of antioxidants and this makes them act like janitors of the body. Green chillies can protect the body against free radical damage and provides natural immunity to cancer and also slowing down the ageing process.[23]

g) Green chili is known to remove the harmful toxins from the human body and thus helps in preventing constipation.[23]

h) Consuming green chilies in the recipes and salads help in the digestion of the food since it is a very high source of vitamin C.[23]

i) Capsaicin is considered as a safe and effective topical analgesic agent in the management of arthritis pain, herpes zoster related pain, diabetic neuropathy, mastectomy pain and headaches.[23]

10. Nutritional Importance of Chillies on health

Chili peppers are available throughout the year in the markets either in the fresh dried or powdered form.[1] Chillies holds all the best properties for which it is consider as food. It has been used as a food for many years. Chillies are high in vitamin C.[16]

Green chili is the rich source of vitamin-A, C and E, vitamin B2 (Riboflavin) and B6 (Pyridoxine), niacin, folate, iron, copper, manganese, potassium, magnesium with small amount of protein and carbohydrates. Vitamin-C content of a green chilli is six times more than that of an orange fruit. A ½ cup of raw green chilli peppers provides 1.5 gm of protein, 0.15 gm of fat, 7.1

gm of carbohydrates and 1.1 gm of fiber. Recently, Russian scientists have identified vitamin-P in green chilli.[24] Green chilli is rich in carotenoids. Some of the phytonutrients in green chilli are α-Carotene, ß-Carotene, lutein and zeaxanthin. Green chilli has lanosterol and lanostenol as steroids. Capsicosides A, D and proto-degalactotigonin are steroidal glycosides present in green chilli. Tryptophan, lysine and phenylalanine are also found in green chilli. Green chilies also contain water and have no cholesterol.[25] Polyphenols obtained from green chilli showed anti-oxidant and vasodilator effects.[26]

On the other hand Red chilies contain large amounts of vitamin C and small amounts of carotene (pro-vitamin A). Yellow and especially green chilies contain a considerably lower amount of both substances. In addition, the peppers are the good source of most classes of vitamin B, especially rich in vitamin B6 and B12. They are very high source of minerals like potassium, magnesium and iron (Table 4).[16] Chillies have antibacterial and anti-oxidants qualities, and contain bioflavonoids.[24, 27, 28]

Table 4: The nutritional value of Chillies [per 100gm][16,29]

Parameters	Chillies Dry	Chillies Green
Moisture	10.000 gm	85.700 gm
Protein	15.000 gm	2.900 gm
Fat	6.200 gm	0.600 gm
Minerals	6.100 gm	1.000 gm
Fibre	30.200 gm	6.800 gm
Carbohydrates	31.600 gm	3.000 gm
Energy	246.000 K cal	29.000 K.gm
Calcium	160.00 mg	30.000 mg
Phosphorus	370.000 mg	80.000 mg
Iron	2.300 mg	4.400 mg
Carotene	345.000 µg	175.00 µg
Thiamine	0.930 mg	0.190 mg
Riboflavin	0.430 mg	0.300 mg
Niacin	9.500 mg	0.900 mg
Vitamin C	50.000 mg	111.000 mg
Sodium	14.000 mg	---
Potassium	530.000 mg	---
Phytin Phosphorus	71.000 mg	7.000 mg
Magnesium	---	272.000 mg
Copper	---	1.400 mg
Manganese	---	1.380 mg
Molybdenum	---	0.070 mg
Zinc	---	1.780 mg

11. Pharmacolgy of Chillies

The precise mechanism of action of capsaicin is not fully understood. Current evidence suggests that capsaicin relieves neuralgia pain by depleting and preventing re-accumulation of substance P in peripheral sensory neurons. Substance P is thought to be the principal chemo-mediator of pain impulses from the periphery to the central nervous system. Initial release of substance P from sensory neurons is believed to be responsible for burning or stinging sensations experienced by some individuals. Such unpleasant sensations may be reduced or prevented by capsaicin's patented Lidocare™ vehicle system which contains lidocaine.[16]

Capsaicin induced analgesia and desensitization has been explained on the basis of neuropeptide release and depletion, selective targeting of C fibers in the pain pathway, and activation of the vanilloid receptor type 1. Extracts of five species of hot peppers showed in vitro antimicrobial activity. Lipid peroxidation and bacterial counts were inhibited by the addition of hot or sweet peppers to beef patties. Antioxidant activity of capsicum is attributed to capsaicin. In vitro inhibition of bacteria and platelet aggregation by capsaicin has been associated with in vitro fluidization of lipid membranes. Capsicum reduced the serum levels of cholesterol and triglycerides and lowered serum glucose levels.[16] Capsaicin inhibited the formation of hydrochloric acid-induced ulcers, damage to the gastric mucosa, myeloperoxidase activity, lipid peroxidation, and hemorrhagic erosion. Capsaicin also inhibits constitutive activation of NF-κB in malignant melanoma cells.[30]

12. Beneficial Effects of Chillies on Health

12.1 Chillies as counter-irritant in rheumatism

The extract of these indigenous herbs are highly effective in rheumatism, stiff joints, bronchitis and chest colds with cough and headache.[16] It may be used as a cream for the temporary relief of minor aches and pains of muscles and joints associated with arthritis, simple backache, strains and sprains.[31]

12.2 Chillies as Stomachic

Chilli is a potent stimulating agent of stomach, improves circulation, aids digestion by stimulating gastric juices, stimulates the appetite, reduces inflammation, improves metabolism, relieves gas, colds, and stops bleeding from ulcers. Taking capsicum may significantly reduce the risk of ever developing a peptic ulcer. It is also beneficial for the kidneys, lungs, spleen, pancreas, heart, and stomach.[32]

12.3 Chillies as Food flavourant

Dry chilli is extensively used as a spice in all types of curried species in India and abroad. Grinding roasted dry chilli with other condiments such as coriander, cumin, turmeric and farinaceous matter makes curry powder. It is also used for seasoning of egg, fish and meat preparations, sauces, chutneys, pickles, frank furters, sausages etc. Bird chilli is used in making hot sauces as pepper sauce and tobacco sauce. Mandrani is a West Indies stomachache preparations made by adding cucumber, shallot, lime juice and Madeira wine to washed fruits of bird chilli.[16, 33]

12.4 Chillies as Heart Arrhythmias

Capsaicin reduced ventricular tachycardia and ventricular fibrillations. Capsaicin also dramatically

improved blood flow to the heart. Capsaicin seems to function as a natural calcium blocker, analogous to the effect of some prescription heart drugs.[16, 34]

12.5 Chillies as Elevated Cholesterol

Various biochemists studied that Chillies have the cholesterol-reducing properties and it is reported in the scientific literature. Capsaicin has been shown to help in prevention of different cholesterol associated heart diseases such as arteriosclerosis.[16, 35]

12.6 Chillies as Cancer

Chillies can protect the body against some known food and beverage chemicals that can cause cancer and induce cell mutations. When capsaicin is taken with plant chlorophyll, its mutagenic properties are suppressed.[16, 34]

12.7 Chillies as Diabetic Neuropathy

The topical application of capsaicin cream is quite safe and very effective in the treatment of pain ordinarily observed in patients experiencing diabetic neuropathy and diabetic polyneuropathy.[35]

12.8 Chillies as Beverages

Recently beverage products are emerging with capsaicin as an active ingredient.[36, 37] The first two capsaicin beverages to hit the market are Prometheus Springs Elixirs[38] launched in 2007 and Sweet16 launched in 2011.[39] It is common for people to experience pleasurable and even euphoriant effects from ingesting capsaicin. Folklore among self-described "chiliheads" attributes this to pain-stimulated release of endorphins, a different mechanism from the local receptor overload that makes capsaicin effective as a topical analgesic.[16]

13. Injurious Effects of Chillies on Health

13.1 Burning or pain sensation

The capsaicinoids in chilli bind to a receptor in the lining of the mouth. This is the same receptor that registers pain from heat, thus the effect is a burning feeling. This is a result of the flow of calcium ions from one cell to the next. The pungent molecule has an electron poor area, which is attracted to the electron rich area on the receptor protein. Repeated exposure to capsaicinoids depletes these receptors, enabling to eat hotter chillies and feel the same effect. The pain caused by this leads to the release of endorphins, the body's natural painkillers. These give a feeling of happiness and well being.[40]

13.2 Digestion Problems

The heat of the capsaicin can cause reflux and heartburn when the pepper reaches the stomach and interacts with the acid there. This also can result in nausea. Capsaicin once had an undeserved reputation for causing ulcers, but research has shown that while it can aggravate ulcer pain, it does not cause ulcers to develop. As hot pepper passes through and out of the system, it can prompt painful, burning diarrhea.[41]

13.3 Asthma

In high enough quantities, hot pepper can trigger an attack in asthma sufferers by causing air passages to spasm. This can be potentially dangerous if an inhaler or nearby medication is not taken urgently. One should stay away from hot pepper if he/she prone to bronchial problems.[41]

13.4 Accidents

Not all problems with hot pepper stem from eating it. If anyone uses it in cooking and gets any in eyes, the result can be extremely painful and eyes might tear profusely. Avoid rubbing them when working with capsaicin products. Using gloves can be useful because if hot pepper remains on skin, an uncomfortable stinging sunburn-like reaction can occur.[41]

14. Contraindication

Capsaicin topical cream is used externally to help relieve pain and discomfort caused by arthritis, fibromyalgia, bursitis, and other painful joint or muscle disorders or injuries. It can also be used to relieve itching from dermatitis or exzema.[42] Seek medical attention right away if any of these severe side effects occur when using Capsaicin Cream: Severe allergic reactions (rash; hives; itching; difficulty breathing; tightness in the chest; swelling of the mouth, face, lips, or tongue); difficulty breathing or swallowing; irritation, redness, blistering, or severe or persistent burning at the application site. It is contraindicated to pregnant women and lactating mother. Cayenne is contraindicated for individuals on ACE inhibitors, agents that reduce stomach acid, aspirin, blood-thinning medications and herbs, and theophylline.[16]

15. CONCLUSION

Chilli is a universal spice of India named as Wonder Spice which are available throughout the year. India is the World's largest producer, consumer and exporter of chilli. There are many claims to the benefits of chillies and its uses; it is belonging to the family solanaceae. Chillies provide widest range of physiological effects however results of some studies conducted to explore the beneficial effects of chillies were positive and some were negative. Though there are several common use and benefits, the most popular frequent use is as a spice. Chillies extract contain capsaicin as main constituents that uses in diabetic neuropathy, reduced cholesterol level and heart arrhythmia. Chillies also used in treatment of cancer.

ACKNOWLEDGEMENT

The author expresses gratefulness to Ramananda College, Bishnupur for providing the facilities to execute this review work. The author of this research paper is highly obliged to the Principal, Ramananda College, Bishnupur, Bankura for constant help and encouragement.

Declaration of interest

The author reports no conflicts of interest. The author alone is responsible for the content and writing of the paper.

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