

Botanical Briefs: Handling the Heat From *Capsicum* Peppers

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PRACTICE POINTS

- *Capsicum* peppers—used worldwide in food preparation, pepper spray, and cosmetic products—can cause irritant dermatitis from the active ingredient capsaicin.
- Capsaicin, which is isolated as a medication to treat musculoskeletal pain, postherpetic neuralgia, and more, can cause a mild local skin reaction.

Capsicum peppers—including chili peppers, paprika, and red peppers—are native to the Americas but used worldwide in spicy dishes. Capsaicin, the active ingredient of *Capsicum* peppers, is used topically to treat musculoskeletal pain, neuropathy, and other conditions. Capsaicin binds the transient receptor potential vanilloid 1 (TRPV1), releasing substance P and desensitizing nerves with long-term use. *Capsicum* peppers and capsaicin products (eg, medications, cosmetics, pepper sprays) can provoke an irritant contact dermatitis, causing erythema and cutaneous burning. Capsaicin-induced dermatitis can be relieved by washing the area with soap, detergents, or oily compounds. Ice water or high-potency topical steroids also can help. Capsaicin is available in creams, lotions, and patches. Synthetic TRPV1-agonist injectables based on capsaicin are in clinical trials for use in localized pain. Capsaicin is a neuropeptide-active compound found in *Capsicum* peppers with many promising applications; however, dermatologists should be aware of possible skin reactions to these plants and medications derived from them.

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Cutaneous Manifestations

Capsicum peppers are used worldwide in preparing spicy dishes. Their active ingredient—capsaicin—is used as a topical medicine to treat localized pain. *Capsicum* peppers can cause irritant contact dermatitis with symptoms of erythema, cutaneous burning, and itch.¹

Irritant contact dermatitis is a common occupational skin disorder. Many cooks have experienced the sting of a chili pepper after contact with the hands or eyes. Cases of chronic exposure to *Capsicum* peppers with persistent burning and pain have been called Hunan hand syndrome.² *Capsicum* peppers also have induced allergic contact dermatitis in a food production worker.³

Capsicum peppers also are used in pepper spray, tear gas, and animal repellents because of their stinging properties. These agents usually cause cutaneous tingling and burning that soon resolves; however, a review of 31 studies showed that crowd-control methods with *Capsicum*-containing tear gas and pepper spray can cause moderate to severe skin damage such as a persistent skin rash or erythema, or even first-, second-, or third-degree burns.⁴

Topical application of capsaicin isolate is meant to cause burning and deplete local neuropeptides, with a cutaneous reaction that ranges from mild to intolerable.^{5,6} Capsaicin also is found in other products. In one published case report, a 3-year-old boy broke out in facial urticaria when his mother kissed him on the cheek after she applied lip plumper containing capsaicin to her lips.⁷ Dermatologists should consider capsaicin an active ingredient that can irritate the skin in the garden, in the kitchen, and in topical products.

Obtaining Relief

Capsaicin-induced dermatitis can be relieved by washing the area with soap, detergent, baking soda, or oily compounds that act as solvents for the nonpolar capsaicin.⁸ Application of ice water or a high-potency topical steroid also may help. If the reaction is severe and persistent, a continuous stellate ganglion block may alleviate the pain of capsaicin-induced contact dermatitis.⁹

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Identifying Features and Plant Facts

The *Capsicum* genus includes chili peppers, paprika, and red peppers. *Capsicum* peppers are native to tropical regions of the Americas (Figure). The use of *Capsicum* peppers in food can be traced to Indigenous peoples of Mexico as early as 7000 BC.¹⁰ On the Scoville scale, which was developed to quantify the hotness of foods and spices, *Capsicum* peppers are rated at approximately 2 million units; by comparison, jalapeño peppers have a Scoville score of 4500¹¹ and capsaicin isolate has a score of 16 million units. *Capsicum* species rank among the hottest peppers in the world.

Capsicum belongs to the family Solanaceae, which includes tobacco, tomatoes, potatoes, and nightshade plants. There are many varieties of peppers in the *Capsicum* genus, with 5 domesticated species: *Capsicum annuum*, *Capsicum baccatum*, *Capsicum chinense*, *Capsicum frutescens*, and *Capsicum pubescens*. These include bell, poblano, cayenne, tabasco, habanero, and ají peppers, among others. *Capsicum* species grow as a shrub with flowers that rotate to stellate corollas and rounded berries of different sizes and colors.¹² Capsaicin and other alkaloids are concentrated in the fruit; therefore, *Capsicum* dermatitis is most commonly induced by contact with the flesh of peppers.

Irritant Chemicals

Capsaicin (8-methyl-6-nonanoyl vanillylamide) is a non-polar phenol, which is why washing skin that has come in contact with capsaicin with water or vinegar alone is insufficient to solubilize it.¹³ Capsaicin binds to the transient receptor potential vanilloid 1 (TRPV1), a calcium channel on neurons that opens in response to heat. When bound, the channel opens at a lower temperature threshold and depolarizes nerve endings, leading to vasodilation and activation of sensory nerves.¹⁴ Substance P is released and the individual experiences a painful burning sensation. When purified capsaicin is frequently applied at an appropriate dose, synthesis of substance P is diminished, resulting in reduced local pain overall.¹⁵



Capsicum peppers, which may cause irritant contact dermatitis.

Capsaicin does not affect neurons without TRPV1, and administration of capsaicin is not painful if given with anesthesia. An inappropriately high dose of capsaicin destroys cells in the epidermal barrier, resulting in water loss and inducing release of vasoactive peptides and inflammatory cytokines.¹ Careful handling of *Capsicum* peppers and capsaicin products can reduce the risk for irritation.

Medicinal Use

On-/Off-Label and Potential Uses—Capsaicin is US Food and Drug Administration approved for use in arthritis and musculoskeletal pain. It also is used to treat diabetic neuropathy,⁵ postherpetic neuralgia,⁶ psoriasis,¹⁶ and other conditions. Studies have shown that capsaicin might be useful in treating trigeminal neuralgia,¹⁷ fibromyalgia,¹⁸ migraines,¹⁴ cluster headaches,⁹ and HIV-associated distal sensory neuropathy.⁵

Delivery of Capsaicin—Capsaicin preferentially acts on C-fibers, which transmit dull, aching, chronic pain.¹⁹ The compound is available as a cream, lotion, and large bandage (for the lower back), as well as low- and high-dose patches. Capsaicin creams, lotions, and the low-dose patch are uncomfortable and must be applied for 4 to 6 weeks to take effect, which may impact patient adherence. The high-dose patch, which requires administration under local anesthesia by a health care worker, brings pain relief with a single use and improves adherence.¹¹ Synthetic TRPV1-agonist injectables based on capsaicin have undergone clinical trials for localized pain (eg, postoperative musculoskeletal pain); many patients experience pain relief, though benefit fades over weeks to months.^{20,21}

Use in Traditional Medicine—*Capsicum* peppers have been used to aid digestion and promote healing in gastrointestinal conditions, such as dyspepsia.²² The peppers are a source of important vitamins and minerals, including vitamins A, C, and E; many of the B complex vitamins; and magnesium, calcium, and iron.²³

Use as Cancer Therapy—Studies of the use of capsaicin in treating cancer have produced controversial results. In cell and animal models, capsaicin induces apoptosis through downregulation of the Bcl-2 protein; upregulation of oxidative stress, tribbles-related protein 3 (TRIB3), and caspase-3; and other pathways.^{19,24-26} On the other hand, consumption of *Capsicum* peppers has been associated with cancer of the stomach and gallbladder.²⁷ Capsaicin might have anticarcinogenic properties, but its mechanism of action varies, depending on variables not fully understood.

Final Thoughts

Capsaicin is a neuropeptide-active compound found in *Capsicum* peppers that has many promising applications for use. However, dermatologists should be aware of the possibility of a skin reaction to this compound from handling peppers and using topical medicines. Exposure to capsaicin can cause irritant contact dermatitis that may require clinical care.

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