Pungent

What could cause that strange sensation of warmth you feel in the pit of your stomach after eating food made with hot peppers? It is usually followed by an immediate perception of sheer pleasure that spreads throughout the entire body and that some psychologists attribute to the release of endorphins in the brain. Is it caused by the same thing that creates a burning sensation in the mouth and irritation in the throat, brings tears to the eyes, gives you a runny nose and makes beads of perspiration break out on your forehead and back of the neck when you eat peppers that are too hot?

These contradictory sensations are caused by capsaicinoids that determine the spiciness in peppers and are unique to the chili species. Peppers contain seven different capsaicinoids, usually referred to as "capsaicin" after the most prevalent of them. Capsaicin, the source of 60 percent of the heat in peppers, is a colorless, odorless, flavorless compound and found principally in the placenta and cross-section of the pepper. The glands that produce this substance are found in the upper part of the pepper, where the placenta connects to the walls of the fruit. Despite the popular belief that the seeds are the hottest part of a pepper, they do

* Researcher at the UNAM Institute for Historical Research.

Unless otherwise specified all photos by Dave Dewitt and Paul Bosland.

Peppers[1]

*Janet Long**

Jorge Pablo de Aguinaco

not contain capsaicin. When they are perceived as hot, it is because they have come into contact with the placenta during harvest, transportation or in the general handling, when capsaicin can be distributed throughout the fruit. Capsaicin is a very stable alkaloid unaffected by heat or cold; it retains its original pungency over time and during the cooking or freezing process as well.

The heat in peppers causes a sensation classifiable somewhere between pleasure and pain. Anna Krajewska and John Powers, research associates from the University of Georgia, carried out a study that analyzes how the human body perceives the effects of chili peppers in the mouth and throat. The experiment demonstrated that the body registers the intensity of the pungency and experiences the effect of different capsaicinoids in different ways. In spite of the observation by several researchers that capsaicinoids have no flavor, Krajewska and Powers detected slight flavors associated with some of them.

Of the seven capsaicinoids, the least irritating is nordihydrocapsaicin. This substance registers pungency in the front of the mouth and palate, causing a mellow warming effect. Its effects are immediate, but the warm feeling recedes rapidly. Krajewska and Powers describe the flavor as slightly sweet with a fruity, spicy taste. Two capsaicinoids, capsaicin and dihydrocapsaicin, are responsible for 89 percent of the heat in peppers. They are

irritants that cause a sharp, stinging bite. The sensation is registered in the mid-mouth and mid-palate, as well as the throat and back of the tongue. The sensation develops rapidly and lasts longer than that of other capsaicinoids. A fourth capsaicinoid, homodihydrocapsaicin, turned out to be the most irritating of the seven and mainly affects the throat, the back of the tongue and the palate. Krajewska and Powers describe the sensation as a numbing burn which does not develop immediately after swallowing but is longer-lasting than other capsaicinoids and difficult to rinse out. The other three capsaicinoids are present in minimal quantities and do not significantly affect the pungency of peppers.

The research team points out that the differences in character, duration and location of pungency can only be observed when solutions of low concentrations are examined. At higher concentrations, the pungency of all capsaicinoids develops rapidly all over the mouth and throat and is too strong to detect any differences in perception. The investigation concludes that it is a combination of the seven capsaicinoids that produces the heat that characterizes each type of chili pepper.

Repeated consumption of hot peppers can desensitize the receptors, which explains how some chili pepper lovers create a tolerance for spicy food and can eat increasingly hot foods.

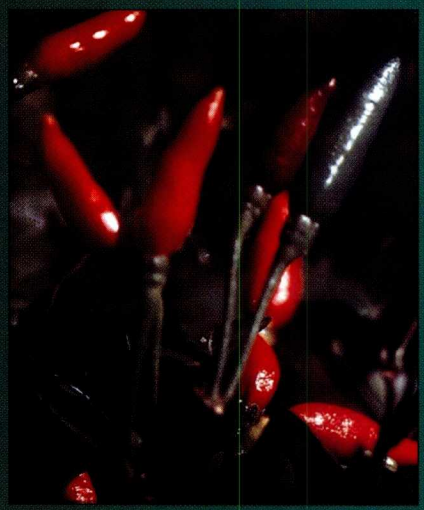
The sensation of warmth caused by capsaicin is registered on the pain receptors in the mouth and nose; the taste buds do not register it. Cells in the mouth and nose receive an impression of heat and pain and begin to release substance P, a chemical messenger that signals pain to the brain. The body's nervous system responds to the call, sending a message to the brain to release endorphins towards the affected nerve endings. The release of endorphins suppresses the pain and provokes a sensation of pleasure throughout the body. Paul Bosland, a pepper specialist from the University of New Mexico, believes that the endorphins act like a natural, safe morphine, without causing permanent damage to the body, much like the "jogger's-high" runners get from participating in a marathon. Repeated consumption of hot peppers can desensitize the receptors, which explains how some chili pepper lovers create a tolerance for spicy food and can eat increasingly hot foods.

Various factors determine the heat of a pepper. Certain types of chili peppers are known to be hotter than others. As a general rule, small chilies are more pungent than larger ones. This is caused by the relation of the placenta, where the heat is located, to the walls of the pepper. Small peppers have more placenta in relation to the walls of the fruit than large ones. The placenta of a *serrano* chili pepper, for example, makes up a very high percentage of the fruit, causing it to be very pungent. Dry chilies, with thin, transparent walls, like the *costeño* pepper, tend to be hotter than the thick-walled varieties.

The environment plays an important part in determining the pungency of pep-

Piquín chili pepper.

Serrano chili pepper.



Tabasco chili pepper.

pers. Minerals and salts found in the water and soil are components that influence a pepper's heat. An extreme climate, with periods of intense heat or drought, affects the amount of capsaicin produced in peppers. It has been noted that, under harsh atmospheric conditions, peppers become hotter than those grown under ideal conditions. Chili producers have observed that high nocturnal temperatures produce hotter peppers. Tales of hot pepper seeds transported and planted in another country that suddenly turned into mild peppers are common. The environment may be one factor that plays a role in this. In addition, peppers of the same species can be crossed easily with the help of bees and other insects, which may explain the change in pungency. Bell peppers and hot peppers belong to the same botanical species.

A chili pepper can contain different levels of capsaicin, depending upon its stage of ripening. Capsaicin begins to develop in the fruit during the fourth week after the flowering of the plant and reaches its maximum level just before maturity.

The same pepper plant can produce fruit of different pungency levels. The location of a pepper on the plant can also affect its heat; the fruit that forms on the lower level of the plant tends to be hotter than those that form at a higher level of the same plant.

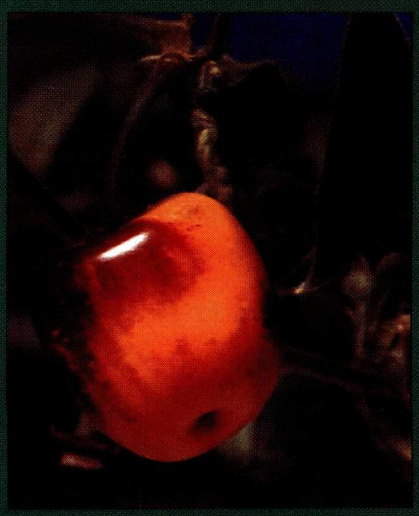
The environment plays an important part in determining the pungency of peppers. Minerals and salts found in the water and soil are components that influence a pepper's heat.

Chili peppers dried in the open air are not as hot as those dried in industrial ovens, where they are exposed to a stream of hot air with a minimum of light.

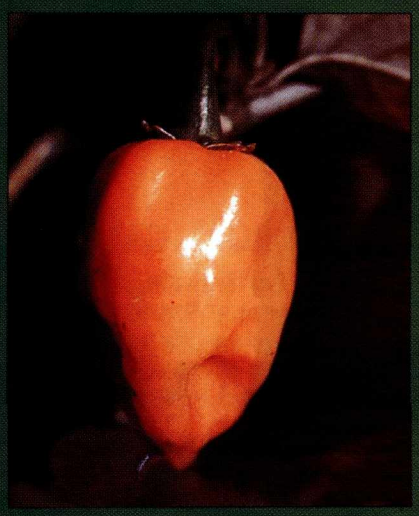
Canned chilies are hotter than fresh ones due to the volatilization of the capsaicin during the heating process, when this substance is distributed throughout the entire fruit and in the pickling solution in the can.

It is not easy to measure the heat in a pepper since capsaicin is generally described as being flavorless, colorless and with no distinguishing aroma. Nonetheless, it is such a potent substance that one drop of capsaicin can be detected in a solution of water at a proportion of one to fifteen million.

The original method for measuring the heat of peppers in a laboratory was based on the Scoville Heat Method, developed by a pharmacist of that name in 1912. The Scoville Method is based upon human taste and employs a panel of professional tasters who are not habitual consumers of peppers. Three of the five tasters must agree on an evaluation before assigning a number of Scoville units to the pepper. Using this method, bell peppers receive a value of "0" Scoville units, while *habanero* chilies register between 100,000 and 300,000 Scoville units, making them the hottest chili peppers in the world. The Scoville Method is now being replaced by a more sophisticated laboratory technique called High Pressure Liquid Chromatography which measures the amount of capsaicin in a specific pepper and converts the results into Scoville units. VM



Manzano chili pepper.



Habanero chili pepper.

Notes

[1]A longer version of this article was published in the March 1988 issue of *Nexos* magazine.

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