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FRONT MATTER: REPLY

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Pungency: A reason for the sluggish expansion of hot spicy foods from the tropics

Reply to: Abdel-Salam OME. Preference for hot pepper: A complex interplay of personal, cultural, and pharmacological effects. Temperature 2016; 3:38-9; http://dx.doi.org/10.1080/23328940.2015.1111289;
Bosland PW. Hot stuff – do people living in hot climates like their food spicy hot or not? Temperature 2016; 3:40-1; http://dx.doi.org/10.1080/23328940.2015.1130521;
Caterina MJ. Seeking the tropical heat – a matter of microbes? Temperature 2016; 3:42-4; http://dx.doi.org/10.1080/23328940.2016.1139963;
Chahl LA. Hot genes and hot tropics. Temperature 2016; 3:45-6; http://dx.doi.org/10.1080/23328940.2015.1133878;
Gutierrez R and Simon SA. Why do people living in hot climates like their food spicy? Temperature 2016; 3:47-8; http://dx.doi.org/10.1080/23328940.2015.1119616;
Mozsik G. It remains a mystery why people living in hot climates consume spicier food. Temperature 2016; 3:49-50; http://dx.doi.org/10.1080/23328940.2015.1131033;
Thornton JS. Spicy heat love: less taste than protection from food poisoning? Temperature 2016; 3:51-2; http://dx.doi.org/10.1080/23328940.2015.1130522

Dear Editorial Board,

Temperature has received several letters[1-7] in reply to the "puzzle" that questioned why people living in the tropics consume more hot pepper than those living in temperate climates, which was published in my recent editorial.[8] The author of the puzzle, Arpad Szallasi, thinks that the puzzle has no answer.[9]

It has been assumed that hot pepper consumption has a strong biological (e.g., physiological or psychological) basis providing some "reward" to compensate the eater for the burning sensation caused by hot pepper or accepting this burning sensation itself as a reward.[1-7] Because chili peppers are popular in several tropical regions and unpopular in most or all subpolar regions, it has been further assumed that this biological basis has a latitude-dependent component. In other words, some climatic factors in the tropics and subtropics (e.g., temperature) or some cultural traits of societies living in these regions (e.g., the ways they have to preserve their food) have been thought to promote the consumption of high amounts of chili peppers. Such a latitude-dependent component has not been identified convincingly though, which explains Szallasi's position: there is no answer to the puzzle.[9]

However, instead of questioning why hot pepper is popular in the tropics, I suggest to take a closer look at why its popularity has not spread to other regions of Earth. It is likely that human consumption of any edible plants – whether bananas or chili peppers – was originally limited to the areas where these plants grew. With time, as a result of trade development, travel, and migration, many locally popular foods, including bananas and chili, became available globally. And yet, while bananas are arguably consumed today with comparable enthusiasm pretty much anywhere on the planet, the consumption of extra hot spicy dishes is not distributed homogeneously. Even though chili peppers, in one preparation or another, are occasionally used in minute amounts by many outside the tropics, authentic extra hot spicy dishes are still viewed at higher latitudes as rare, exotic, and typically unwelcome guests. What is preventing these dishes from rapidly spreading from places of their origin (which happened to be in the low latitudes) to higher latitudes?

I think the answer is as obvious as it can be: the pungency. The following two sideline observations from my lab's research provide an illustration to this line of thinking. The first was made in the 90s, when Vladimir Kulchitsky and others scientists in my lab studied rats subjected to surgical transection of both trunks of the vagus nerve below the diaphragm. To prevent complications of this surgery, we fed vagotomized rats postoperatively with milk, moisturized chaw, and fruits, mostly bananas and apples.[10] (Later we started using commercially available liquid diets for this purpose.) Even though our rats had never seen bananas in their prior life, they were eager to munch on the sweet tropical delicacy at first offering. The second observation comes from a later study, in which Andras Garami and other lab members offered habanero chili (*Capsicym chinense*, one of the hottest chili peppers known) to food-deprived mice, either of the "wild type" or those deficient in the transient receptor potential vanilloid-1 (TRPV1) channel, also known as the capsaicin receptor.[11] (Capsaicin, a TRPV1 agonist, is the principal substance responsible for the pungency of chili peppers.) The wild-type mice briefly tasted the peppers – only to never touch them again! In contrast, the TRPV1-deficient mice eagerly consumed the chili, even the hottest parts of the fruit, such as the septa and seeds. Clearly, the pungency, which is an attribute of hot peppers (but not of bananas), is a strong barrier to hot pepper consumption. When the pungency cannot be perceived (as in the absence of TRPV1), there is no barrier.

Repeated administration of capsaicin or other TRPV1 agonists results in the development of desensitization, or tolerance – the state in which many responses to TRPV1 agonists, including pain, are reduced (reviewed in ref. 12). This phenomenon can be utilized to decrease the sensitivity of the oral mucosa receptors to capsaicin. In fact, I would speculate that humans tolerate very spicy foods only when their oral mucosa receptors are relatively insensitive. When we conducted the abovementioned experiments with habanero chili,[11] one lab member was determined to taste the chili himself. He experienced severe burning pain and developed blisters on his lips. People who habitually consume (and enjoy) extra spicy foods neither experience pain at dinner nor develop blisters – their oral receptors are desensitized. But in order to become desensitized to capsaicin, one has to eat chili peppers repeatedly, which – and here is the catch-22 – is difficult to achieve in a society where hot spicy dishes are unpopular.

The present reply does not touch on why and how people living in the tropics started consuming a lot of hot pepper in the first place; the authors of other letters published in this issue reviewed several hypotheses.[1-7,9] In any case, the custom of consuming the enormous, from the physiology point of view, amounts of spices on a regular basis probably took a very long time to develop. After it has developed, the persisting exposure to high amounts of spices has been making people tolerant to them, thus allowing them to maintain the custom. So my answer to the puzzle is that the pungency is a natural barrier against appetite for hot chili, and that this barrier can be overcome only by repeated exposure to hot spicy dishes, which is not typically achieved in a society that dislikes hot spicy foods. This barrier prevents the extra hot spicy dishes, which happened to originate in the tropics, from spreading toward the poles.

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