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FRONT MATTER: LETTER

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Hot genes and hot tropics

Letter on: Romanovsky AA. Protecting western red cedar from deer browsing—with a passing reference to TRP channels. Temperature, 2015; 2:142–9; http://dx.doi.org/10.1080/23328940.2015.1047078

Dear Editor-in-Chief,

This letter is in response to the puzzle posed in your editorial "Why do people living in hot climates like their food "hot" (spicy) whereas most cuisines under more temperate climates are relatively bland?"[1] Many speculative explanations for this seeming paradox have evolved. A favored physiological proposal is that the gustatory sweating induced by consumption of hot spicy food induces cooling of the body which is beneficial in a hot climate. Various explanations related to health and food safety have also been proposed including the proposal that the antibacterial effect of chilli protects the consumer from the ill effects of poorly stored food and disguises the taste of bad meat. These explanations lack substantiation.

In contemplating this puzzle it is worthwhile to consider briefly the history of the culinary use of chilli and other hot spices. Following the 1492 voyage of Christopher Columbus a widespread exchange of plants, animals and culture between the old and new worlds known as the Columbian Exchange occurred. Among the plants transferred from the new to the old world were plants of the genus *Capsicum*, members of the Solanaceae family, the fruit of which became known as chilli peppers. The culinary use of chilli peppers spread rapidly and chilli is now one of the world's most widely used spices.

All species of chilli peppers are native to the Americas. Recent studies by Kraft et al[2] using a multidisciplinary approach involving species distribution modeling, genetics, archaeobotanical data and paleobiolinguistics, have shown that the likely origin of the domesticated chilli pepper, *Capsicum annuum*, was central-east Mexico over 6,500 y ago. Further insights into the domestication and specialization of *Capsicum* have been provided by the recent whole-genome sequencing of cultivated and wild peppers by Qin et al[3].

The pungent 'hot' taste of chilli is conferred by the presence of capsaicinoids, mainly capsaicin and dihydrocapsaicin, which are exclusive to chilli. Capsaicin activates TRPV1 receptors on sensory nerves to produce a burning pain sensation. The capsaicinoid biosynthetic pathway has been extensively studied and several candidate genes have been implicated in capsaicinoid biosynthesis. The biosynthesis of capsaicin involves the condensation of vanillylamine with a medium chain branched fatty acid[4]. The acyl group determines pungency. Pungency in *Capsicum* is inherited by the *Pun (Pungent) 1* gene. A putative acyl transferase, capsaicin synthase, encoded by the *Pun 1* locus regulates pungency[3]. Loss of function alleles have been identified in non-pungent species of *Capsicum*. A recent study by Ogawa et al[5] demonstrated that the Pun1 protein has capsaicin synthase activity and is the primary determinant of capsaicin synthesis.

Pungency in peppers is affected by environmental factors such as temperature[6]. Pepper plants originated in hot tropical regions and require warm temperatures for their development. Therefore their domestication occurred in environmentally favorable locations. Prior to the Columbian Exchange chillies were unknown in the old world. The spread of chilli peppers to Asia was most likely promoted by Portuguese traders who, with Arab traders, dominated the spice trade. The cultivation and culinary use of chillies spread rapidly within those regions of the old world with warmer climates. They would not have been available in areas of northern Europe with colder climates which were also not on the traditional spice trade routes. Thus availability would have been the major factor determining the early culinary use of chilli in the old world.

Tradition and cultural practice play a major role in cuisines throughout the world. Cuisines have evolved using readily available ingredients since availability determines cost, as attested by the high price of black pepper in the middle ages. Nevertheless four hundred years elapsed before the culinary use of chilli appeared to a significant extent in Britain and northern Europe. It might be argued that the slow uptake of the use of chilli by peoples in cold climates resulted from an aversion of these peoples to spicing their food. This seems unlikely since other spices such as black pepper and mustard seed as well as many other milder herbs and spices were used to flavor food in these countries. Indeed, studies on phytoliths in pottery have revealed the use of spice in European prehistoric cuisine[7].

The first impetus to the culinary use of chilli in Britain was the return of colonialists following service in India. This was reinforced during the latter half of the 20th century by migration of people from the Indian subcontinent to Britain which resulted in a widespread acceptance of Indian food, including the use of chilli The latter half of the 20th century also saw increased communications and increased possibilities for ordinary citizens to travel and become exposed to Asian, Indian and Mexican cuisines. Foods containing chilli are now commonplace in supermarkets and kitchens in most parts of the world.

In conclusion, it is proposed that the answer to the puzzle lies primarily in the requirement of the *Capsicum* species for a tropical climate which restricted its availability in temperate climates until recent times and thus its use in traditional cuisines in these regions. The increasing adoption of chilli into the cuisines of temperate climate countries with strongly entrenched culinary traditions is a tribute to the appeal of the pungent sensory quality of chilli.

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Loris A. Chahl

School of Biomedical Sciences and Pharmacy
University of Newcastle, Newcastle, NSW 2308, Australia
loris.chahl@newcastle.edu.au