Where the wild veggies are

EurekAlert

Sites of origin and regions of domestication of many of our most important cultivated plants are still unknown. The botanical genus *Cucumis*, to which both the cucumber (*Cucumis sativus*) and the honeydew melon (*C. melo*) belong, was long thought to have originated and diversified in Africa, because many wild species of *Cucumis* are found there. "A molecular genetic analysis has now shown that the wild populations that gave rise to melons and cucumbers originated in Asia", says LMU botanist Professor Susanne Renner. "In addition, we have found that 25 related species which have never been formally described are found in Asia, Australia and regions around the Indian Ocean." Future genetic studies on <*C. sativus* and its wild relatives should therefore focus on Asia and Australia. The new results are important because the garden cucumber is one of the most widely cultivated vegetable crops, and the species is among the few flowering plants whose genomes have been fully sequenced. According to Renner, "Our study would not have been possible without the resources of the Munich herbarium and Botanical Garden. A large fraction of the plants we have been able to sequence was collected in India, Vietnam and Australia during the 19th century, and most were then forgotten in herbaria, that is, collections of dried plant specimens. Many of these come from locations that no longer have natural vegetation, for example, because they were collected at sites that now lie in built-up areas of cities like Hanoi." (PNAS online, July 2010)

The family *Cucurbitaceae* includes crop plants, such cucumbers, melons, loofah, and pumpkins. In terms of its economic importance, the cucumber is among the top ten crop plants cultivated worldwide, and the related honeydew melon is also of considerable agronomic significance. Species that belong to the genus *Cucumis* are also popular with botanical researchers. Indeed, the domestic cucumber was the seventh species of flowering plant to have its genome sequenced completely, being preceded by such agricultural heavyweights as rice and grapevine. Over the past 10 years, thousands of scientific papers on the biology of cucumbers and melons have appeared. Many of these studies have used these species as model systems to investigate the mechanism of sex determination during floral development. The question of the genetic origins of the genus *Cucumis*, on the other hand, has received comparatively little attention (the business about the Romans cultivating cucumber is wrong; I can send you a paper on this topic if you are interested). The general consensus among botanists has been that the melon originated in Africa, because putative wild ancestors of the cultivated variety had been identified there. It now turns out that none of these forms is ancestral to the melons we find in our markets and shops.

"We analyzed specific segments of the genetic material from herbarium specimens of more than 100 *Cucumis* species. The samples we used had been collected at various locations in Africa, Australia and Asia", reports Patrizia Sebastian, who is the first author on the new study. "It turned out that the closest living wild relative of

the cultivated melon is a native of Australia. The two lines diverged about 3 million years ago, and they last shared a common ancestor with their more distant relatives in Asia and Australia about 10 million years ago." The total number of *Cucumis* species found in Asia and Australia is now around 25, and they branched off from their African relatives some 12 million years ago.

Nine of the 25 species were identified for the first time in the new study. Renner and her colleagues are preparing formal systematic descriptions of the new species for a specialized journal. Taken together, the results argue that the common ancestor of cucumber and melon originated on the continent of Asia. Possible ancestral populations from which the domesticated forms derive have been localized in the Himalayas. The genetic diversity of the varieties of *C. melo* that occur in India and China is particularly striking. "Our data also prove that the closest living relative of our garden cucumber is the species C. hystrix, which is found in the Eastern Himalayas", says Renner. "Future investigations of the phylogeny of *Cucumis* should therefore focus on Asia and Australia."

The new findings once again emphasize the great significance for modern botanical research of the herbarium materials that have been assembled over centuries and are now held in institutions like herbarium of the Bavarian Natural History Collections and the LMU's own herbarium. "Many of the plants we examined in this study were collected in the course of the 19th century, and most were then ignored and forgotten", says Renner, who is Director of these herbaria and the Munich Botanic Garden. "In many ways, this material represents an irreplaceable treasure, because the habitats in which much of it was collected no longer exist. *Cucumis debilis*, for instance, no longer grows at the location from which it was last collected in 1931. The site is now a suburb of Hanoi."

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