

Tracing the evolution of the inflated calyx syndrome in the Physaloids (Solanaceae)

Rocío Deanna^{1,2}, Gloria E. Barboza^{1,2}, and Stacey D. Smith³

¹Instituto Multidisciplinario de Biología Vegetal (IMBIV), CONICET and Universidad Nacional de Córdoba, CC 495, CP 5000, Córdoba, Argentina, ²Facultad de Ciencias Químicas, Universidad Nacional de Córdoba. Haya de la Torre y Medina Allende, Córdoba, Argentina, ³University of Colorado at Boulder, Ramaley, Colorado, United States.

Species radiations are often triggered by the evolution of key morphological innovations that can unlock ecological opportunities. The inflated calyx syndrome (ICS) has been proposed as one such key innovation, and consists in the accrescence of the calyx after anthesis to an extent that the fruit is completely enclosed. This feature is found in many flowering plant families, such as Sapindaceae and Malvaceae, but is best known from the tomato family, Solanaceae. Hypotheses about its function include acting as a tumbleweed for dispersal, floatation in flooded environments, and protection of the developing fruit. Here we aim to resolve the evolutionary history of ICS in the tribe Physalideae, which contains tomatillos and their allies. We sampled 231 species (77 % of the tribe), sequenced four markers (ITS, LEAFY, *trnL-F* and *waxy*), and performed maximum likelihood and Bayesian analyses in order to provide a phylogenetic framework for comparative analyses. Fruiting calyx variation was scored as non-acrescent, partially acrescent-appressed, or inflated, and shifts in character state were estimated with Bayesian stochastic mapping. Preliminary results show the ancestral state of the tribe as ambiguous, but with a higher probability of having an acrescent-appressed calyx. The calyx inflation follows a stepwise evolution from non-acrescent to acrescent-appressed to an inflated calyx. Across the clade, we estimated over 80 changes, with shifts between partially acrescent-appressed to inflated calyces roughly twice as common as non-acrescent to partially acrescent-appressed calyces. Loss of inflation to an acrescent-appressed calyx is slightly more frequent than gain, but the loss of the accrescence is about twice more common than its gain from an entirely nude berry. This frequent evolutionary shifts in calyx morphology and the repeated origins of inflated calyces in Physalideae provide a strong foundation for future studies testing the influence of this trait on diversification rates after including the most recent fossil calibrations.

Keywords: inflated calyx, Solanaceae, Physalideae, convergence, phylogeny